TOWN OF WELLESLEY, MA HAZARD MITIGATION PLAN

JULY 2023

Town of Wellesley

525 Washington Street

Wellesley, MA 02482

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https://www.wellesleyma.gov

Prepared by:

JAMIE CAPLAN CONSULTING LLC
Emergency Management Services

351 Pleasant Street, Suite B # 208 · Northampton, MA 01060
Phone: 413-586-0867 · Fax: 413-727-8282 · www.jamiecaplan.com

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Acknowledgements

The Town of Wellesley would like to thank the following people for supporting the development of this plan. This group was considered the Hazard Mitigation Planning Committee (HMPC) throughout the planning process.

- Eric Arbeene, Planning Director, Town of Wellesley
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- Mike Thompson, GIS Manager, Town of Wellesley
- Lisa Wolf, Sustainability Coordinator, Wellesley Municipal Light Plant
- Jeffrey Zukowski, Hazard Mitigation Planner, MA Emergency Management Agency

F1. For single-jurisdictional plans, has the governing body of the jurisdiction formally adopted the plan to be eligible for certain FEMA assistance? (Requirement §201.6(c)(5))

Local Adoption Resolution

TOWN OF WELLESLEY, MASSACHUSETTS
SELECT BOARD
A RESOLUTION ADOPTING THE
TOWN OF WELLESLEY, MA HAZARD MITIGATION PLAN

WHEREAS the Town of Wellesley recognizes the threat that natural hazards pose to people, property , and natural environment within the Town of Wellesley; and

WHEREAS the Town of Wellesley has prepared a multi-hazard mitigation plan, hereby known as TOWN OF WELLESLEY, MA HAZARD MITIGATION PLAN 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 TOWN OF WELLESLEY, MA HAZARD MITIGATION PLAN identifies mitigation goals and actions to reduce or eliminate long-term risk to people and property in the Town of Wellesley from the impacts of future hazards and disasters; and

WHEREAS adoption by the Town of Wellesley Select Board demonstrates its commitment to hazard mitigation and achieving the goals outlined in the TOWN OF WELLESLEY, MA HAZARD MITIGATION PLAN.

NOW THEREFORE, BE IT RESOLVED BY THE TOWN OF WELLESLEY, MA, THAT:

Section 1. In accordance with M.G.L. c. 40, the Town of Wellesley Select Board adopts the TOWN OF WELLESLEY, MA HAZARD MITIGATION PLAN. While content related to the Town of Wellesley may require revisions to meet the plan approval requirements, changes occurring after adoption will not require Town of Wellesley to re-adopt any further iterations of the plan. Subsequent plan updates following the approval period for this plan will require separate adoption resolutions.

ADOPTED by a vote of 5 in favor and 0 against, and 0 abstaining, this 9th day of January 2024.

By: Thomas H Ulfelder Thomas H. Ulfelder, Chair

ATTEST: By: Colette E. Aufranc Colette E. Aufranc, Vice Chair

APPROVED AS TO FORM: By: Cathryn Jane Kato K.C. Kato, Town Clerk

Record of Changes

This Town of Wellesley, MA Hazard Mitigation Plan Update will be reviewed and approved on a biannual basis by the HMPC and following any major disasters. All updates and revisions to the plan will be tracked and recorded in the following table. This process will ensure the most recent version of the plan is disseminated and implemented by the Town.

Table 1. Summary of Changes.

Date of Change	Entered By	Summary of Changes

Chapter 1. Introduction

The Federal Emergency Management Agency (FEMA) defines hazard mitigation per the Code of Federal Regulations (CFR) 44 Section 201.2 as "any **sustained** action taken to reduce **or eliminate** the **long-term risk** to human life and property from hazards."

"Disaster Mitigation Act (DMA) 2000 (Public Law 106-390)[1] provides the legal basis for FEMA mitigation planning requirements for State, local and Indian Tribal governments as a condition of mitigation grant assistance. DMA 2000 amended the Robert T. Stafford Disaster Relief and Emergency Assistance Act by repealing the previous mitigation planning provisions and replacing them with a new set of requirements that emphasize the need for State, local, and Indian Tribal entities to closely coordinate mitigation planning and implementation efforts."[2]

The Town of Wellesley, Massachusetts created this plan as part of an ongoing effort to reduce the negative impacts and costs from damages associated with natural hazards, such as nor'easters, floods, and hurricanes. This plan meets the requirements of the Disaster Mitigation Act 2000. More importantly, the plan was created to reduce loss of life, land, and property due to natural hazards that affect the Town of Wellesley. It is difficult to predict when natural hazards will impact the planning area, but it is accurate to say that they will. By implementing the mitigation actions listed in this plan, the impact of natural hazards will be lessened.

Local Mitigation Plans must be updated at least once every five years to remain eligible for FEMA hazard mitigation project grants. A local jurisdiction must review and revise its plan to reflect changes in development, progress in local mitigation efforts, and changes in priorities, and resubmit it for approval within five (5) years to continue to be eligible for mitigation project grants.

Purpose of the Plan

The purpose of the Local Hazard Mitigation Plan is to provide the Town of Wellesley with a comprehensive examination of all natural hazards affecting the area, as well as a framework for informed decision-making regarding the selection of cost-effective mitigation actions. When implemented, these mitigation actions will reduce the Town's risk and vulnerability to natural hazards.

This is the Town of Wellesley's **first** Hazard Mitigation Plan. They did develop a draft plan in 2010 which was not adopted by the Town. This 2023 plan is a result of a collaborative effort between the Town and the surrounding communities. Throughout the development of the plan, the Hazard Mitigation Planning Committee (HMPC) consulted the public and key stakeholders for input regarding identified goals, mitigation actions, risk assessment, and mitigation implementation strategy. A sample of key

[1] Disaster Mitigation Act of 2000, Pub. L. 106-390, as amended

[2] Disaster Mitigation Act of 2000. https://www.congress.gov/106/plaws/publ390/PLAW-106publ390.pdf

stakeholders who participated, included the Massachusetts Emergency Management Agency (MEMA), the Charles River Watershed Association, Wellesley College, and Babson College.

Guiding principles for plan development

The HMPC adhered to the following guiding principles in the plan's development.[3]

- Plan and invest for the future.
- Collaborate and engage early.
- Integrate community planning.

This plan meets the requirements outlined 44 CFR § 201.6(d)(3). These requirements are included in the plan in the green call-out boxes, like the one below.

> A local jurisdiction must review and revise its plan to reflect changes in development, progress in local mitigation efforts, and changes in priorities, and resubmit it for approval within 5 years in order to continue to be eligible for mitigation project grant funding.

Yellow call-out boxes like the one to the right, are definitions taken from the Federal Emergency Management Agency Local Policy Guide, April 2023. These are included throughout the plan for reference and explanation.

The HMPC prioritized mitigating impacts of climate change, mitigating risk to vulnerable communities, and protecting the built environment both today and in the future.

> ***COMMUNITY RESILIENCE** is 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 weaken a community) are key steps to resilience.*[1]

The HMPC identified the following list of hazards to profile. They are shown in order of climate change interaction for consistency with the 2018 State Hazard Mitigation and Climate Adaptation Plan (SHMCAP).

Table 2. Hazards Identified.

Primary Climate Change Interactions	Hazards
Changes in Precipitation	Flooding *(including riverine, dam failures, ice jams, etc.)* Drought Landslide
Rising Temperatures	Extreme Temperatures

[3] Federal Emergency Management Agency. (April 19, 2022). Local Mitigation Planning Policy Guide, p.13.

Primary Climate Change Interactions	Hazards
	Wildfires *(including brush fires)* Infectious Disease Invasive Species
Extreme Weather	Hurricanes/Tropical Storms Severe Winter Storm/Nor'easter *(including blizzard, ice storm, etc.)* Tornadoes Other Severe Weather *(including thunderstorms, etc.)*
Non-Climate Influenced Hazards	Earthquake

Mitigation Strategy

C3. Does the Plan include goals to reduce/avoid long-term vulnerabilities to the identified hazards? (Requirement §201.6(c)(3)(i))

The hazard mitigation strategy is the culmination of work presented in the Planning Area Profile (Chapter 2), Risk Assessment (Chapter 4), and Capability Assessment (Chapter 5). It is also the result of multiple meetings and sustained public outreach. The HMPC developed the goals shown below. The goals from the draft Town of Wellesley Hazard Mitigation Plan, 2010 and the Town's Community Resilience Building Workshop Summary of Findings Report, 2020 were revised to develop this current list. Information about the goal development process is in Chapter 6: Mitigation Strategy. These goals are considered "broad policy-type statements"[4] that represent the long-term vision for mitigating risk to natural hazards in the Town of Wellesley.

[4] Federal Emergency Management Agency. (2013). *Local Mitigation Planning Handbook,* p. 6.

Save Lives	• Reduce risk to people, property, infrastructure, and natural resources from natural hazards and climate change.
Infrastructure	• Mitigate risk to critical facilities and infrastructure from natural hazards and climate change.
Capacity	• Expand the Town's capacity to mitigate risk by adopting a culture of hazard mitigation through regulations, planning, and regional collaboration.
Natural Resources	• Implement actions that minimize risk from climate change and natural hazards to preserve or restore the functions of natural systems.
Education	• Educate all stakeholders about the value of hazard mitigation and how to implement it in their work, businesses, and homes.

Land Use and Development

E1. Was the plan revised to reflect changes in development? (Requirement §201.6(d)(3))

This is Wellesley's first Hazard Mitigation Plan and the HMPC felt it necessary to discuss land use and development to add perspective to the Town's current and future levels of risk. Wellesley has not seen any major changes in development since the 2010 Draft Hazard Mitigation Plan, mainly because the community is generally built-out and has a significant amount of protected land. Today, any changes in development within the planning area are largely infill development and redevelopment (i.e., demo and rebuild), with minimal to no impacts on the overall vulnerability of the community to natural hazards. This is because any of the planned infill development or redevelopment projects in Wellesley are not occurring in hazard-prone areas or increasing existing hazard vulnerabilities. This is primarily due to very limited developable areas of high hazard risk (i.e., special flood hazard areas, wildland/urban interface zones, steep slopes, etc.) in combination with the Town's strong regulations for new or improved development that require specific design and construction standards for hazard risk reduction. This includes updated stormwater management rules

> ***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.*

and regulations to better address urban flooding concerns associated with areas of high impervious surface coverage. More detailed information on the administration and effectiveness of the Town's development regulations is provided in Chapter 5.

Some of the most notable recent changes in Wellesley development includes the Town's substantial investments in public buildings and facilities (Town Hall, schools, etc.), which if anything, has decreased existing hazard vulnerabilities through structural improvements and upgrades. However, one of the more notable changes in recent planned developments in an area with known flood risks (current and future) is briefly described below, followed by a bulleted list of other anticipated developments the Town is currently tracking.

One recent change in development that has occurred in a hazard-prone area is the newly constructed 40R project at 40 William Street, which is in a special flood hazard area. This project is within the Wellesley Park 40R District, a proposed redevelopment project of Wellesley Office Park (20-100 Williams Street). As part of this project, numerous strategies are being considered to improve sustainability and to enhance protection of the adjacent natural resources, including the management and mitigation of the flooding impacts on the site and adjacent properties, as well as the implementation of best management practices for stormwater management. For example, these strategies include the following:

- Flood Prevention – Finished Floor Elevations (FFE) of structure more than 1' above flood elevation (exceeding current code requirements).
- Protection of Floodplain - Provide compensatory storage as required, and additional storage if possible.
- Stormwater Management reduction and quality improvements – Introduce new Stormwater Management System on Phase I site to reduce peak rates of runoff and improve water quality.
- Reduce urban heat island effects – use of light colored hardscape materials, light colored roofs, and installation of shade trees in development area. Minimize the removal of existing trees.

Other Anticipated or Planned Changes in Development

Other anticipated/proposed developments for the Town of Wellesley are listed below, which include all Chapter 40B Development Projects that have been approved or are currently seeking permit approval. Chapter 40B is a state statute, which enables local Zoning Boards of Appeals to approve affordable housing developments under flexible rules (Comprehensive Permit) if at least 20-25% of the units have long-term affordability restrictions. These potential future changes in development are not located in hazard-prone areas and are not expected to affect the overall risks and vulnerabilities of the community in any significant ways.

Projects Approved for a Comprehensive Permit:

- Fieldstone Way Application (135 Great Plain Avenue)

Projects Currently Seeking a Comprehensive Permit:

- Wellesley Crossing (Delanson Circle)
- Wellesley Park (148 Weston Road)
- 680 Worcester Street
- 16 Stearns Road
- 3 Burke Lane
- 136-140 Worcester Street

Progress in Mitigation Efforts

E2. Was the plan revised to reflect changes in priorities and progress in local mitigation efforts? (Requirement §201.6(d)(3))

Priorities in the Town of Wellesley have shifted since their draft plan was developed in 2010. This plan was never approved by FEMA or adopted by the Town. However, since 2010, the Town of Wellesley has prioritized climate adaptation, hazard mitigation, and equity and inclusion. The Town's Climate Action Plan was developed in 2022 and the Climate Action Committee is actively engaged in projects throughout Town. The Town also has a Sustainable Mobility Plan to meet net zero emissions by the year 2050. Wellesley joined the State's Municipal Vulnerability Preparedness (MVP) Program in 2019. Participation in this program included development of a Summary of Findings in 2020. Table 63 in the Mitigation Strategy Chapter details the status of each recommendation from the MVP Summary of Findings. This plan prioritized sustainable landscapes, stormwater management, and communication.

Authority and Assurances

The Town of Wellesley will continue to comply with all applicable Federal laws and regulations during the periods for which it receives grant funding, in compliance with 44 CFR 201.6. It will amend its plan whenever necessary to reflect changes in Local, State or Federal laws and regulations, as required in 44 CFR 201.6. The list of laws and regulations the Town with adhere to is below.

- Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act), as amended.
- National Flood Insurance Act of 1968, as amended.
- National Dam Safety Program Act (Pub. L. 92-367), as amended.
- 44 CFR Part 201 Mitigation Planning.
- 44 CFR, Part 60, Subpart A, including § 60.3 Flood plain management criteria for flood-prone areas.
- 44 CFR Part 77 Flood Mitigation Grants.

- 44 CFR Part 206 Subpart N. Hazard Mitigation Grant Program.

Plan Adoption

The Town of Wellesley will adopt the Plan when it has received "approved-pending adoption" status from the Federal Emergency Management Agency (FEMA). The Certificate of Adoption is included on page 7.

Document Overview

Below is a summary of the Town of Wellesley MA Hazard Mitigation Plan Update chapters, including appendices. The planning process closely adhered to FEMA guidelines and to the intent of those guidelines.

Chapter 2: Planning Area Profile
The Planning Area Profile chapter describes the Town of Wellesley, including history, population, government, and infrastructure. Included in this chapter is a list of critical facilities identified by the HMPC.

Chapter 3: Planning Process
The Planning Process chapter documents the methodology and approach of the hazard mitigation planning process. The chapter summarizes the HMPC meetings and the public outreach process (including public meetings). This chapter guides the reader through the process of generating this plan and reflects its open and inclusive public involvement process.

Chapter 4: Risk Assessment
The Risk Assessment identifies the natural hazard risks to the Town of Wellesley and its residents. The risk assessment looks at current and future vulnerabilities based on land use development including structures and infrastructure.

Chapter 5: Capability Assessment
The Capability Assessment looks at the Town's ability to mitigate risk prior to and following disaster. This chapter is structured around the following four categories: planning and regulatory, administrative, and technical, financial, as well as education and outreach. The chapter concludes with information regarding the National Flood Insurance Program (NFIP).

Chapter 6: Mitigation Strategy
This chapter provides a blueprint for reducing losses identified in the Risk Assessment. The chapter presents the hazard mitigation goals and identifies mitigation actions in priority groupings. Each mitigation action includes essential details, such as Town lead, potential funding sources, and implementation timeframe.

Chapter 7: Plan Implementation and Maintenance

The Plan Implementation and Maintenance establishes a system and mechanism for periodically monitoring, evaluating, and updating the Town of Wellesley Hazard Mitigation Plan Update. It also includes a plan for continuing public outreach and monitoring the implementation of the identified mitigation actions.

Appendices

The Appendices include documentation regarding the planning process, the list of mitigation actions and the *Hazus* Reports.

Chapter 2: Planning Area Profile

Wellesley's history dates back centuries, with the presence of local indigenous groups first, followed by the arrival of English settlers to the area in 1635. Algonquin Indians had already occupied the area, but their population severely declined due to illness and the King Philip's War. The English settlers gradually began to change the landscape through building houses, developing the trail systems, and clearing fields.[5]

By the early 1800s, West Needham (now called Wellesley) became a more "distinct town" with a small village center. Later, Wellesley became a group of villages which still exists as the Fells, the Hills, the Farms, the Falls, and the Square.[6] New transportation networks created during the early 19th Century also linked Wellesley with the surrounding region, particularly to Boston and New York. Though the Town was still small, mostly undeveloped, and dependent on agriculture, many new residents started to move in and work in nearby Boston.[7] As the Town became better known, more wealthy residents began to acquire large land holdings and started building mansions in these beautifully landscaped settings. Horatio Hollis Hunnewell, an investment banker and railroad financier, built the Town's first estate. Over time other estates were built, especially near Lake Waban, and included the William Emerson Baker estate which is now a conservation sanctuary and reservation.[8]

Residents of Wellesley continue to place high value on the scenic character and abundance of natural resources which was supported with one of its earliest civic improvements, the planting of American elms along major streets in the 1860s. As the agricultural industry began to shift, a new type of land use took advantage of the setting and in 1875 Wellesley College opened. Several other schools and colleges were soon established.[9]

The Town has had little population growth. Like many other towns and cities in the region, Wellesley grew rapidly after World War II, but it has since stabilized and slightly declined from 1970-1990 as household sizes fell. However, as of 1990, Wellesley has been gaining residents at a slightly faster rate than those in Norfolk County. According to the Massachusetts Department of Housing and Community Development (DHCD) Community Profile for Wellesley, the total area is 10.49 square miles and of that 10.18 square miles is land.

With a population of 29,550[10], Wellesley is a "mature suburban community situated on low rolling hills, with a landscape typical of glaciated southern New England."[11] The many parts of the community that

[5] "Open Space and Recreation Plan 2022-2029 Working Draft." (2022). Town of Wellesley, Massachusetts.
[6] "Open Space and Recreation Plan 2022-2029 Working Draft." (2022). Town of Wellesley, Massachusetts.
[7] "Open Space and Recreation Plan 2022-2029 Working Draft." (2022). Town of Wellesley, Massachusetts.
[8] "Open Space and Recreation Plan 2022-2029 Working Draft." (2022). Town of Wellesley, Massachusetts.
[9] "Open Space and Recreation Plan 2022-2029 Working Draft." (2022). Town of Wellesley, Massachusetts.
[10] QuickFacts Wellesley town, Norfolk County, Massachusetts. (2022). United States Census Bureau.
[11] "Open Space and Recreation Plan 2022-2029 Working Draft." (2022). Town of Wellesley, Massachusetts.

remain undeveloped help define the Town's character. Open space, includes the campuses of three colleges (Wellesley College, MassBay Community College, and Babson College), two private schools, and two golf courses.[12]

When looking at the Town's demographic makeup since 2020, 78.1% of residents identify as White, 2.9% as Black or African American, 13.6% as Asian, 0.1% as Native Hawaiian and Other Pacific Islander, and 5.2% Hispanic or Latino (of all races).[13] These demographic statistics were considered when developing a comprehensive public outreach strategy and mitigation actions to address a diverse population.

Climate Action

The Town of Wellesley completed a Climate Action Plan in 2022 and identified some critical areas of concern related to the region's changing climate and major weather events. They are listed below and briefly discussed.

- **Intense Storms:** The number and intensity of storms is rising with precipitation being concentrated in fewer, but heavier events. Nor'easters, ice storms, hurricanes, and heavy rain may lead to power outages and compromised communications systems.[14]
- **Flooding:** A single intense storm can cause flooding in Town which in turn disrupts and damages critical facilities and infrastructure, while also contaminating surface water. Flooding is concentrated near bodies of water like Morses Pond and the Charles River as well as in areas with extensive impervious surfaces.[15]
- **Drought:** Though precipitation is likely to be part of heavier, more intense weather events, this increases the potential for drought and therefore can cause water supply shortages, crop damage, and stress to natural habitats. An example of such impacts was found during the 2016 Massachusetts drought.[16]
- **Heat Waves:** As the earth warms, extreme heat, and heat waves (of 3 or more days over 90°F) will increase in Wellesley. This will risk heat-related illness, a higher demand for energy in the summer months, and worsened air quality.[17]

With these events being considered in-depth throughout Wellesley's Climate Action Plan, it is important to note that the Town's goals are to ensure that the Town government remains accountable for implementation of the Climate Action Plan, that climate action outside of Wellesley supports further

[12] "Open Space and Recreation Plan 2022-2029 Working Draft." (2022). Town of Wellesley, Massachusetts.
[13] QuickFacts Wellesley town, Norfolk County, Massachusetts. (2022). United States Census Bureau.
[14] "Town of Wellesley Climate Action Plan." (2022). Town of Wellesley, Massachusetts.
[15] "Town of Wellesley Climate Action Plan." (2022). Town of Wellesley, Massachusetts.
[16] "Town of Wellesley Climate Action Plan." (2022). Town of Wellesley, Massachusetts.
[17] "Town of Wellesley Climate Action Plan." (2022). Town of Wellesley, Massachusetts.

progress in the Town, that greenhouse (GHG) gas emissions are reduced, and that municipal systems and infrastructure become more resilient in the face of climate change impacts.[18]

Climate achievements to date include a 35.6% reduction in town-wide GHGs below a 2007 baseline, two "Net-Zero" ready buildings in design, the "Clean Comfort Program" to support installation of residential air source heat pumps, a Building Energy Tracking and Reporting program to assist commercial building owners with climate action, a Gas Leaks Working Group to address methane emissions, the Wellesley Drives Electric program and an Electric Vehicle Working Group to support the transition to electric vehicles, and a Food Waste Drop-off program.[19]

People

As of 2020, the Town of Wellesley had two Environmental Justice (EJ) Block Groups that fit the "Minority" EJ Criteria. There is a population of 3,638 people in these two EJ Block Groups, accounting for 12.3% of the Town's total population. There are 4.2% of the Town's population living in poverty.[20] Within Wellesley, 17.5% of its population is made up of foreign-born persons and the median household income is $213.684. According to the 2015 Open Space and Recreation Plan (using 2010 data) there were three EJ Block Groups (the one in the center of Wellesley is no longer there as of 2020).[21] The figure below shows the two current EJ Block Groups. The map and its related data were most recently updated in November 2022.[22]

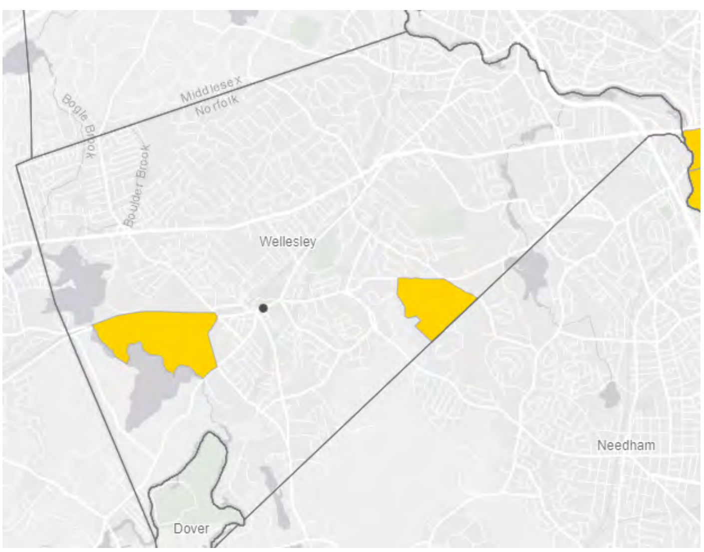

Figure 1. Wellesley Environmental Justice Communities.

The western-most EJ Block Group 4 (Census Tract 4044) fits the "Minority" criteria. It is located around Lake Waban. It is bordered in the north by Route 135, Route 16 to the east, Lake Waban to the south, and Pond Road in the west. Morses Pond is located slightly northeast of this Block Group. The total minority population in this block group is 41.4% and there are no households with language isolation.[23]

[18] "Town of Wellesley Climate Action Plan." (2022). Town of Wellesley, Massachusetts.

[19] "Town of Wellesley Climate Action Plan." (2022). Town of Wellesley, Massachusetts.

[20] Massachusetts 2020 Environmental Justice Communities. (2020). State of Massachusetts.

[21] "Open Space and Recreation Plan 2015-2022." (2015). Town of Wellesley, Massachusetts.

[22] Massachusetts 2020 Environmental Justice Communities Map Viewer. (2022). State of Massachusetts.

[23] Massachusetts 2020 Environmental Justice Communities Map Viewer. (2022). State of Massachusetts.

The eastern-most EJ Block Group 3 (Census Tract 4042.02) fits the "Minority" criteria. The total minority population in this block group is 49.0%.[24] The eastern EJ Block Group is bordered to the north by Wellesley Avenue, the Town's boundary to the south, Forest Street to the east, and Babson Way to the west. There is also a small park, called Sawyer Park, that sits just north this block group.[25]

Land Use and Development (Structures)

The Town of Wellesley has a deep-rooted history in open space and agricultural protection. Before World War II, Wellesley still had a large amount of undeveloped land, but after the war, there was a boom in residential building development. Commercial development was encouraged by the construction of Route 128 in 1956. Between 1951 and 1980, approximately 350 acres of farmland and 855 acres of woodland were converted to residential and commercial land use. This caused Wellesley to change from a primarily rural town to a suburban one. There is only one remaining working farm called the Hunnewell Family Farm located on Route 16 near the Natick Town line and much of it is protected under a conservation restriction.[26] As for future development, new single-family residences are limited to very rare and small subdivisions. Commercial development is also not as common, but there have been redevelopment opportunities in the Town's commercial districts.[27]

Over half of Wellesley's land is used for residential purposes. An additional 36% of the land is used for various "tax-exempt land use categories" like churches, cemeteries, non-profits, schools and colleges, and government-owned property. Commercial and industrial uses occupy less than five percent of the Town's land area. There are a few mixed-used properties, but they are distributed across the Town and within each of the previous categories.[28]

Wellesley's "somewhat complex zoning system" reflects the Town's built-out character. There are six single-family residential districts and five residential districts that allow for townhouses or multifamily houses. There are four zoning districts that cover commercial development and two zoning districts that allow for industrial uses. The Town re-zoned its parkland to make it the Parks, Recreation, and Conservation District in 2018. There is also a Transportation District that covers the commuter rail right-of-way and train platforms. These districts are supported by several overlay districts that protect "sensitive" resources in Wellesley which include:

- Floodplain and Watershed Protection District
- Conservation District
- Historic District

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[24] Massachusetts 2020 Environmental Justice Communities Map Viewer. (2022). State of Massachusetts.
[25] Massachusetts 2020 Environmental Justice Communities Map Viewer. (2022). State of Massachusetts.
[26] "Open Space and Recreation Plan 2022-2029 Working Draft." (2022). Town of Wellesley, Massachusetts.
[27] "Open Space and Recreation Plan 2022-2029 Working Draft." (2022). Town of Wellesley, Massachusetts.
[28] "Open Space and Recreation Plan 2022-2029 Working Draft." (2022). Town of Wellesley, Massachusetts.

- Water Supply Protection District
- Natural Resource Protection Development.[29]

Natural Resources

Rivers and Streams

The Charles River is located to the east of Wellesley. The Town's surface water consists of six stream systems that flow into the Charles River on the eastern and southwestern borders of the Town and into approximately thirteen ponds.[30]

The three eastern stream systems are:

1. **Cold Stream Brook Watershed** - includes most of the land east of Peirce Hill and north of Maugus Hill and contains Cold Stream Brook, Rockridge Pond, Indian Springs Brook, and The Water Way.
2. **Rosemary Brook Watershed** - runs from the east of the Wellesley Country Club northeast to the Charles River and includes Rosemary Brook and Academy Brook.
3. **Hurd Brook Watershed** - covers less than one square mile in the southeastern corner of Wellesley but includes significant wetlands around Dearborn Street and the Charles River.[31]

The three southwestern stream systems are:

1. **Fuller Brook Watershed** - begins west of Great Plain Avenue and continues north to Wellesley High School and southwest to Waban Brook and the Charles River. It covers most of the central part of Town and includes Fuller Brook, Waban Brook, Abbott Brook, Caroline Brook, and part of Cold Spring Brook.
2. **Waban Brook Watershed** - runs between Peirce Hill and Elm Bank and includes Morses Pond, Lake Waban, Boulder Brook, Jennings Brook, and Bogle Brook.
3. **Pollock Brook Watershed** - runs north of Washington Street and connects with the Charles River.[32]

Ponds and Lakes

The Town's ponds and lakes range from larger lakes such as the 103-acre Morses Pond and Lake Waban to smaller ponds that are scattered throughout Wellesley. Lake Waban and Morses Pond have been named "Great Ponds" because of their size and therefore are subject to state environmental

[29] "Open Space and Recreation Plan 2022-2029 Working Draft." (2022). Town of Wellesley, Massachusetts.
[30] "Open Space and Recreation Plan 2022-2029 Working Draft." (2022). Town of Wellesley, Massachusetts.
[31] "Open Space and Recreation Plan 2022-2029 Working Draft." (2022). Town of Wellesley, Massachusetts.
[32] "Open Space and Recreation Plan 2022-2029 Working Draft." (2022). Town of Wellesley, Massachusetts.

regulations. Longfellow Pond, Rockridge Pond, and Abbott Pond are considered “medium-sized” ponds.[33]

Many of the Town’s ponds have algal blooms that were caused by fertilizer pollutants and large amounts of sedimentation. After completing a Comprehensive Pond Management Plan, Wellesley began implementing the 2018 Pond Restoration Master Plan which aimed at improving and restoring the Town’s smaller ponds. Actions like dredging and watershed management activities are longer term, but sampling of Longfellow and Duck Ponds for contaminants could occur sooner.[34]

The Morses Pond Comprehensive Management Program will improve the Town’s largest pond and the adjacent areas that contain three wells used for drinking water. Morses Pond has experienced “a host of problems” which included eutrophication, excessive weed growth, and water pollution caused by runoff. With the new program, the Town will aim to reduce pollution in the pond by dredging, using herbicides and algaecides to kill invasive plants, limit development in the watershed, and encourage the construction of detention ponds. A citizen group, called the Friends of Morses Pond, advocates for the health of the pond.[35]

Critical Facilities and Infrastructure

Water & Sewer

The Town’s local water supply consists of nine wells. Three of the wells are located near Morses Pond and range in depth from 47 to 56 feet. The remaining four wells are located near Rosemary Brook and range in depth from 40 to 53 feet. The water from these wells is treated by Wellesley’s three corrosive control and iron/manganese removal treatment facilities. The main threat to water quality in the Town is called “non-point source pollution” or pollution that does not come from a single source but enters the water through stormwater runoff. This runoff can contain oil, grease, pesticides, per-and polyfluoroalkyl substances (PFAS), and other pollutants that need to be monitored.[36]

There are approximately 140 miles of street mains that distribute water throughout the Town. This also includes two large storage facilities that have a nearly six million gallon capacity. Due to the configuration of the mains and facilities, water from any given supply source can reach any point within town.[37]

The Wellesley Water and Sewer Division is responsible for the operation and maintenance of the Town’s water and sewer systems. It is organized into two programs, which are entirety funded by the taxpayers. The Town’s wastewater collection system consists of 132 miles of sewers, 22 pumping stations, five

[33] “Open Space and Recreation Plan 2022-2029 Working Draft.” (2022). Town of Wellesley, Massachusetts.
[34] “Open Space and Recreation Plan 2022-2029 Working Draft.” (2022). Town of Wellesley, Massachusetts.
[35] “Open Space and Recreation Plan 2022-2029 Working Draft.” (2022). Town of Wellesley, Massachusetts.
[36] “Open Space and Recreation Plan 2022-2029 Working Draft.” (2022). Town of Wellesley, Massachusetts.
[37] “Open Space and Recreation Plan 2022-2029 Working Draft.” (2022). Town of Wellesley, Massachusetts.

miles of force main, and 100 miles of house service connections. The collections systems for Wellesley College and Babson College are privately owned, but the wastewater is discharged into the Town's sewer system. The wastewater system is separate from the stormwater and other surface drainage systems to avoid the problems that may come from combined systems.[38]

Due to the Town's topography, wastewater drains in two different directions. The eastern portion has about 21% of Wellesley's wastewater collected through a network of gravity sewers and then transported to the Boulevard Road Pumping Station, pumped to Newton's Collection Systems, and is discharged to the Massachusetts Water Resources Authority's (MWRA) Nut Island Headworks Facility. The western portion has about 79% of the Town's wastewater that is discharged to the MWRA Wellesley extension sewer and then flows by gravity to the Nut Island Headworks Facility.[39]

Stormwater

To comply with the first phase of the Non-Point Discharge Elimination System (NPDES), Wellesley enacted a bylaw that aided in regulating stormwater. The bylaw states that, "any solid waste and non-stormwater flow, including construction debris, paint, automotive and petroleum products, cleaner and detergents, food and yard waste, and pet waste are specifically prohibited." Further regulations ensure that all connections to the Town's drainage network must be approved by Wellesley's Department of Public Works Engineering Division. The Town is considering a stormwater utility to help address stormwater management needs and to ensure that the Town complies with its MS4 permit.[40]

Transportation Infrastructure

Wellesley is located approximately 20 minutes from downtown Boston by Commuter Rail. The Town acts as an access point on a regional scale due to its major roadways and the Massachusetts Turnpike, alongside its proximity to the neighboring towns of Weston, Newton, Needham, Dover, and Natick.[41] The regional highways present in Town, Interstate 95, and Route 9, have had a "positive effect" on Wellesley's identity as a "commuter town" though the presence of these routes impacts its natural resources and environment through noise, heat, and polluted stormwater runoff. [42] Additionally, where built transportation infrastructure corridors intersect with natural corridors such as rivers and streams have the potential to cause conflicts. Road-stream crossings can impact fish and wildlife passage as well as natural movement of woody debris and sediments through stream corridors. Improvements and replacements to road/stream crossings including culverts and bridges have opportunities to restore aquatic connectivity, reduce flooding impacts and debris blockages to maintain critical public safety access corridors for first responders and residents. The Town of Wellesley is working with Charles River Watershed Association to assess stream-road crossings as part of their Charles River Flood Model for flooding as well as fish/wildlife impacts using the North Atlantic Aquatic Connectivity Collaborative road-

[38] "Water and Sewer Division FAQs." (n.d.). Town of Wellesley, Massachusetts.
[39] "Water and Sewer Division FAQs." (n.d.). Town of Wellesley, Massachusetts.
[40] "Open Space and Recreation Plan 2022-2029 Working Draft." (2022). Town of Wellesley, Massachusetts.
[41] "Open Space and Recreation Plan 2022-2029 Working Draft." (2022). Town of Wellesley, Massachusetts.
[42] "Open Space and Recreation Plan 2022-2029 Working Draft." (2022). Town of Wellesley, Massachusetts.

stream crossing assessment protocols. In addition to the limited access to the major highways, there is proximity to Routes 9, 16, and 135. The demand of these roads is considerable with over 100,000 vehicles entering Wellesley on all routes during peak hours, although at least half of these vehicles are traveling through Town to neighboring municipalities.[43]

Public transportation is accessible throughout Wellesley. It is bisected by Routes 9 and 16, as well as the Worcester Commuter Rail. Wellesley is served by the MWRTA bus network and MBTA Green line which can be accessed in Newton. Additional major routes include Route 128 and Route 95 which run on the Town's eastern border and provide access to the north and south shores of the State.[44] The Route 1 fixed bus route runs primarily between Framingham and the Woodland T station, but stops include the Natick mall, Mathworks, Oak Street, and MassBay Community College. The MWRTA uses the "flag down" system to wave down a bus in transit along its route so long as it is safe to do so. There is also a ride share service and "Catch Connect" which is available for residents who are unable to access the fixed bus route system.[45] The Town's Council on Aging has a bus service which holds 12-passengers and is equipped with a wheelchair lift. It runs Monday through Friday from 8:45am-3:30pm. They offer rides for medical appointments, shopping, and more.[46]

The Town's transportation network offers accessibility to cars, buses, and commuter rail as well as a network of trails that travel through on-street networks and into open space.[47] There are a total of 46 miles of trails, 27.5 miles of which are marked trails that offer woodland hiking routes in conservation and park areas. The Natural Resources Commission established a special committee in 1993 called the "Bikeways and Walkways Study Committee" that was devoted to planning trails into the future for the community. Their studies set the foundation for the development of the trail network, and it has grown to a combination of five interconnecting trails between open space areas and nine woodland trails. Wellesley was also "instrumental" in developing the six-town, 16-mile regional trail called the "Charles River Link" which connects trails in Medfield and Newton. The newest trail system addition is along the Charles River at 27 Washington Street which now crosses a bridge into Newton and provides access for both walkers and bicyclists.[48]

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43 "Open Space and Recreation Plan 2022-2029 Working Draft." (2022). Town of Wellesley, Massachusetts.

44 "Open Space and Recreation Plan 2022-2029 Working Draft." (2022). Town of Wellesley, Massachusetts.

45 "Micro Transit (Catch Connect) Service." (n.d.). Town of Wellesley, Massachusetts.

46 "Transportation." (n.d.). Wellesley Council on Aging.

47 "Open Space and Recreation Plan 2022-2029 Working Draft." (2022). Town of Wellesley, Massachusetts.

48 "Open Space and Recreation Plan 2022-2029 Working Draft." (2022). Town of Wellesley, Massachusetts.

Dams

Wellesley has twelve dams, four of which are significant hazard dams. The closest high hazard dam is the Charles River Dam (Natick Dam) located southwest of the Town and could impact the Town if breached. The Town of Natick is actively moving forward with the design of dam removal for their high hazard potential dam to eliminate the possibility of dam failure and reduce liability to the Town and downstream communities including Wellesley and restore the ecosystem of the Charles River. Two of the dams (Finlay Dam and Cordingly Dam) having functioning fish ladders. When maintained the Finlay and Cordingly ladders can play a significant role in helping to re-establish fish in the area, particularly the Blueback Herring and Alewives.[49]

Critical Facilities

The term "critical facilities" is often used to describe structures necessary for a community to respond and recover in emergency situations. These facilities often include emergency response facilities (fire stations, police stations, rescue squads, and emergency operation centers [EOCs]), custodial facilities (jails and other detention centers, long-term care facilities, hospitals, and other health care facilities), schools, emergency shelters, utilities (water supply, wastewater treatment facilities, and power), communications facilities, and any other assets determined by the community to be of critical importance for the protection of the health and safety of the population. The adverse effects of damaged critical facilities can extend far beyond direct physical damage. Disruption of health care, fire, and police services can impair search and rescue, emergency medical care, and even access to damaged areas.

The number and nature of critical facilities in a community can differ greatly from one jurisdiction to another, and usually includes both public and private facilities. Each community needs to determine the relative importance of the publicly and privately owned facilities that deliver vital services, provide important functions, and protect special populations.

A list of the critical facilities in Wellesley is provided in the table below. This list was obtained from the draft edition of the hazard mitigation plan and the MVP-funded Community Resilience Building (CRB) plan; and reviewed and modified by the HMPC during the planning process. In addition to this list the Wellesley Municipal Light Plant and the electric grid are considered critical t the Town.

> The Local Mitigation Planning Handbook (FEMA, 2013) explains that *"Critical facilities are structures and institutions necessary for a community's response to and recovery from emergencies. Critical facilities must continue to operate during and following a disaster to reduce the severity of impacts and accelerate recovery. When identifying vulnerabilities, it is important to consider both the structural integrity and content value of critical facilities and the effects of interrupting their services to the community."*

[49] "Open Space and Recreation Plan 2015-2022." (2015). Town of Wellesley, Massachusetts.

Table 3. Critical Facilities in Wellesley.

Facility	Address	Use or Comment
Weston Road Bridge	Weston Road (Over Train Tracks)	Bridge
Crest Road Bridge	Crest Road (Over Train Tracks)	Bridge
Route 9 Bridge	Route 9 (Over Cliff Road)	Bridge
Route 9 Bridge	Route 9 (Over Weston Road)	Bridge
Route 16 Bridge	Route 16 (Over Route 9)	Bridge
Cedar Street Bridge	Cedar Street (Over Route 9)	Bridge
Kingsbury Street Bridge	Kingsbury Street (Over Train Tracks)	Bridge
Rockland Street Bridge	Rockland Street (Over Train Tracks)	Bridge
Walnut Street Bridge	Walnut Street (Over River)	Bridge
Washington Street (Route 16) Bridge	Washington Street (Route 16) (Over Charles River)	Bridge
Glen Road Bridge	Glen Road (Over Train Tracks)	Bridge
Woodlawn Avenue Bridge	Woodlawn Avenue (Over Train Tracks)	Bridge
Train Track Bridge	Train Track Bridge Over Bacon Street	Bridge
Route 95 Bridge	Route 95 (Over Route 9)	Bridge
Route 9 Bridge	Route 9 (Over River to Newton)	Bridge
State Street Bridge	State Street (Over Creek)	Bridge
Cheney Drive Bridge	Cheney Drive	Bridge
Route 95 Bridge	Route 95 (Over Charles River)	Bridge
Route 9 Bridge	Route 9 (Over Railroad)	Bridge
Cliff Road Bridge	Cliff Road (Over Railroad)	Bridge
Washington Street Bridge	Washington Street (Over Waban Brook)	Bridge
Dover Road Bridge	Dover Road (Over Fuller Brook)	Bridge
Cottage Street Bridge	Cottage Street (Over Fuller Brook)	Bridge
Pickerel Road Bridge	Picerel Road (Over Morses Pond)	Bridge
West Riding Bridge	West Riding (Over Brook)	Bridge
Wellesley Housing Authority Community Building	109 Barton Road	Cooling Center
Cordingly Dam	Charles River at Washington Street Dam	Dam (Public, Significant Hazard)
Metropolitan Circular Dam	Charles River at Route 9 Dam	Dam (Public, Significant Hazard)
Morses Pond Dam	South side of Morses Pond on Central Street	Dam (Public, Significant Hazard)
Newton Lower Falls Dam (Finlay)	Charles River at Washington Street Dam	Dam (Public, Significant Hazard)

Facility	Address	Use or Comment
Wellesley Avenue Dam	North side of Wellesley Water Lands on Wellesley Avenue	Dam (Public, Low Hazard)
Kelly Park Dam	South side of Kelly Park at Elmwood Road	Dam (Public, N/A Hazard)
Rockridge Pond Dam	Northeast side of Rockridge Pond	Dam (Public, N/A Hazard)
Paintshop Dam	On Paintshop Pond south of athletic fields.	Dam (Private, Low Hazard)
Longfellow Pond Dam	North side of Longfellow Pond	Dam (Public, Low Hazard)
Reeds Pond Dam	South side of Reeds Pond	Dam (Public, N/A Hazard)
Natick Dam	Charles River near Fyffe Footbridge Dams (Southwest of Wellesley)	Dam (Public, High Hazard)
Lake Waban Dam	Lake Waban	Dam (Private, N/A Hazard)
Abbott's Pond Dam	Abbott's Pond Dam	Dam (Private, N/A)
Sabrina Lake Dam (Private)	Northwest part of Sabrina Lake	Dam (Private, N/A Hazard)
Newton Lower Falls Dam (Finlay)		
Wellesley Housing Authority	Morton Circle	Elderly/Disabled Public Housing
Wellesley Housing Authority	Washington Street	Elderly/Disabled Public Housing
Wellesley Housing Authority	Weston Road	Elderly/Disabled Public Housing
Wellesley Housing Authority	River Street	Elderly/Disabled Public Housing
EOC (Primary)		EOC
EOC (Alternate)		EOC
Fire Station HQ Station #2	457 Worcester Street	Fire
Fire Station #1	100 Central Street	Fire
Morses Pond Well #2		Groundwater Well
Morses Pond Well #3		Groundwater Well
Morses Pond Well #1		Groundwater Well
DPW Fuel Depot	20 Municipal Way	Hazardous Materials
Wellesley Recycling Center	169 Great Pain Avenue	Hazardous Materials
Verizon Battery Storage		Hazardous Materials
Wellesley College - Science Building	106 Central Street	Hazardous Materials

Facility	Address	Use or Comment
Babson College Facilities Building	231 Forest Street	Hazardous Materials
Maugus Hill Reservoir #1 (Abandoned)	Maugus Avenue	Holding Facility
Maugus Hill Reservoir #2	Maugus Avenue	Holding Facility
Maugus Hill Reservoir #3	Maugus Avenue	Holding Facility
Peirce Hill Reservoir #1	Monadnock Road	Holding Facility
Peirce Hill Reservoir #2	Monadnock Road	Holding Facility
Newton Wellesley Hospital	2014 Washington Street (Newton)	Hospital
Algoquin Gasline		Infrastructure
Wellesley Farms MBTA Train Station	90 Croton Street	Infrastructure
Wellesley Hills MBTA Train Station	341 Washington	Infrastructure
Wellesley Square MBTA Train Station	1 Grove Street	Infrastructure
Newton-Wellesley Alzheimers Center	694 Worcester Street	Medical Facility
Vanguard Medical Associates	230 Worcester Street	Medical Facility
Elizabeth Seton Residence	125 Oakland St.	Medical Facility
Waterstone at Wellesley	23 & 27 Washington St.	Medical Facility
Recycling and Disposal Facility	169 Great Plain Avenue	Municipal Office/Yard
Town Hall	525 Washington Street	Municipal Office
Municipal Light Plant	4 Municipal Way	Municipal Office
DPW HQ	20 Municipal Way	Municipal Office
Wellesley Baptist Church	2 Brook Street	Place of Worship
Wellesley Weston Chabad	793 Worcester Street	Place of Worship
Wellesley Meeting of Friends	26 Benvenue Street	Place of Worship
St. Andrews Episcopal Church	79 Denton Road	Place of Worship
Wellesley Congregational Church	207 Washington S	Place of Worship
United Methodist Church of Wellesley	2 Brook Street	Place of Worship
St. Paul's Church	502 Washington Street	Place of Worship
First Church of Christ Scientist	8 Rockland Street	Place of Worship
Unitarian Society of Wellesley Hills	309 Washington Street	Place of Worship
First Congregational Church	207 Washington Street	Place of Worship
St John's Catholic Church	49 Washington Street	Place of Worship
Temple Beth Elohim	47 Cedar Street	Place of Worship
Police Station HQ	485 Washington Street	Police Station
Hegarty Pumping Station MWRA	125 Barton Road	Pumping Station

Facility	Address	Use or Comment
Longfellow Pumping Station		Pumping Station (Well)
Rosemary Pumping Station		Pumping Station (Well)
Wellesley Ave. Pumping Station		Pumping Station (Well)
T.F. Coughlin Pumping Station		Pumping Station (Well)
Morses Pond Wells		Pumping Station (Well)
Tenacre Country Day	78 Benvenue Street	School
Dana Hall	45 Dana Road	School
Star Academy	502 Washington Street	School
John D. Hardy	293 Weston Road	School
Sprague Elementary	401 School Street	School
Ernest F. Upham (Currently Open - Will be Closed 2024)	35 Wynnewood Road	School
Hunnewell Elementary (New Building Under Construction)	28 Cameron Street	School
Joseph E Fiske	45 Hastings Street	School
Katharine Lee Bates	116 Elmwood	School
Schofield	27 Cedar Street	School
St. John the Evangelist	9 Glen Road	School
Wellesley Senior High	50 Rice Street	Shelter
Wellesley Middle	50 Kingsbury Street	Shelter
MLP Building	Municipal Way	Substation
Weston Road Substation	134 Weston Road	Substation
Worcester Street Substation	At Cedar Street	Substation
Longfellow Treatment Facility		Treatment/Pumping
Wellesley Ave. Treatment & Pumping Facility		Treatment/Pumping
Morses Pond Treatment & Pumping Facility		Treatment/Pumping
Dale St. Pump Station		Treatment/Pumping
Boulevard Rd. Pump Station		Treatment/Pumping
Bacon St. Ejector		Treatment/Pumping
Cartwright Rd. Ejector		Treatment/Pumping
Colburn Rd. Ejector		Treatment/Pumping
Colgate Rd. Ejector		Treatment/Pumping

Facility	Address	Use or Comment
College Rd. Ejector		Treatment/Pumping
DPW Yard Ejector Station		Treatment/Pumping
Eisenhower Cir. Ejector		Treatment/Pumping
Fisher Ave. Ejector		Treatment/Pumping
Greylock Rd. Ejector		Treatment/Pumping
Lake Rd. Ejector		Treatment/Pumping
Morses Pond Beach Ejector		Treatment/Pumping
Pickerel Rd. Ejector		Treatment/Pumping
RDF Ejector Station		Treatment/Pumping
Sabrina Farm Rd. Ejector		Treatment/Pumping
Shore Rd. Ejector		Treatment/Pumping
Stonecleve Rd. Ejector		Treatment/Pumping
William Street Ejector		Treatment/Pumping
T.F. Coughlin SW-1		Wells
T.F. Coughlin SW-3		Wells
Morses Pond Well #4		Wells
Woodridge Road Booster Station		Wells

Economy

Wellesley's top three industries by occupation according to the United States Census include:

1. Educational services, and health care and social assistance
2. Professional, scientific, and management, and administrative and waste management services
3. Finance and insurance, and real estate and rental and leasing.[50]

According to the Town's Unified Plan that was created in 2019, "For most people who live in Wellesley, 'economic development' means that the town's commercial villages have successful and useful retail and other small businesses."[51]

Wellesley is also home to three commercial villages which include:

1. Wellesley Square
2. Wellesley Hills
3. Lower Falls.[52]

[50] "Industry By Occupation for the Civilian Employed Population 2020 ACS 5-Year Estimates." (2022). United States Census Bureau.
[51] "The Wellesley Unified Plan." (2019). Town of Wellesley, Massachusetts.
[52] "The Wellesley Unified Plan." (2019). Town of Wellesley, Massachusetts.

The 2019 Wellesley Unified Plan stated that the Town usually has a “hands-off” approach to economic development unless problems are severe, with no designated staff or administrators solely for economic development purposes. Storefront rents in Wellesley are high which makes it difficult for new businesses and independent retailers to enter the market. One of the values of the Plan states that the Town desires to, “Support existing and new businesses in commercial areas that complement and enhance our community, while protecting quality of life and environmental resources.”[53]

Historic and Cultural Resources

Wellesley is known for its scenic resources and many of them have a historical significance, as well. The Town has worked to maintain a strong sense of place through the stewardship of publicly owned landscapes. The figure below highlights the abundance of recreational resources available to area residents.

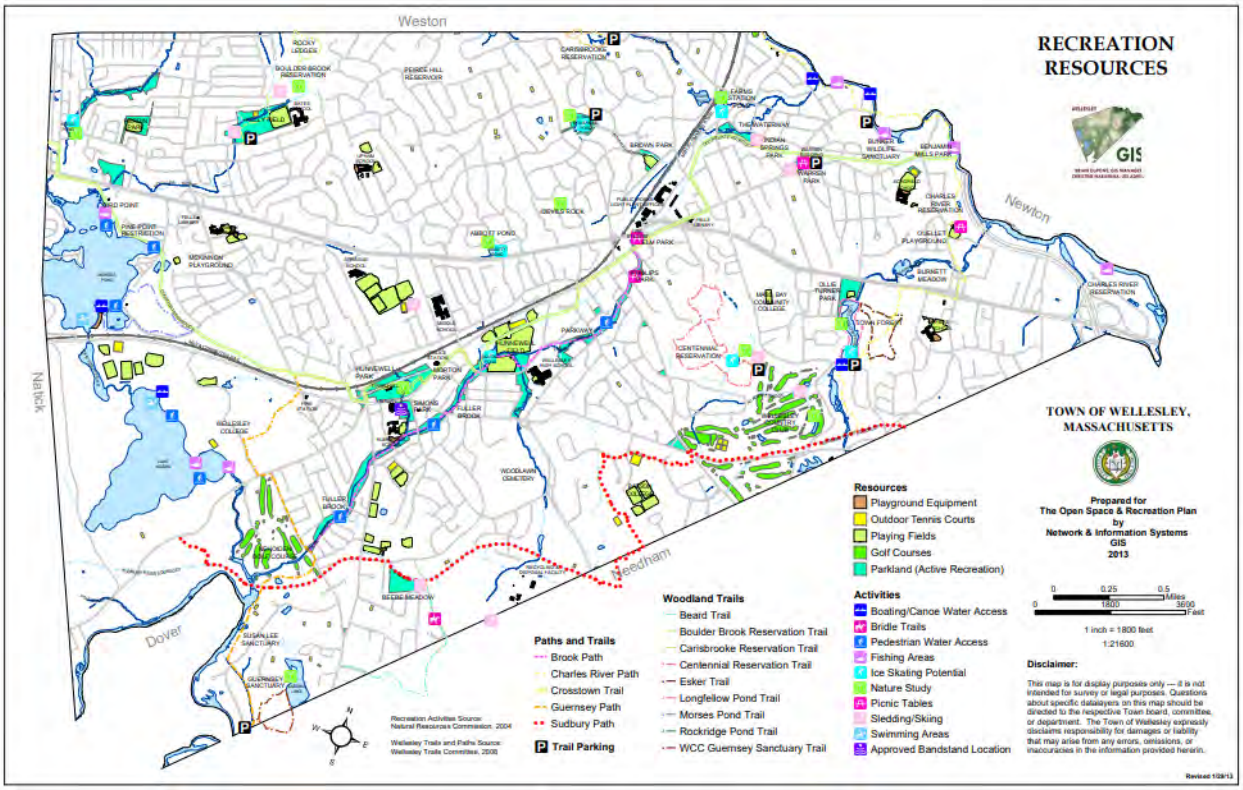

Figure 2. Map of Wellesley Recreational Resources.

According to the 2022 Open Space and Recreation Plan Working Draft, dozens of identified “cultural landscapes” remain critical to the Town’s identity and character.[54]

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[53] “The Wellesley Unified Plan.” (2019). Town of Wellesley, Massachusetts.

[54] “Open Space and Recreation Plan 2022-2029 Working Draft.” (2022). Town of Wellesley, Massachusetts.

The Hunnewell Park/Town Hall Park, for example, was established in 1887 and includes over 10 acres of land. It was Wellesley's first municipal park and is listed on the National Register of Historic Places. In 1985, there were over 550 trees of 80 different species in this area alone. The Hunnewell Playground was established in 1901 and is just over 49 acres which includes high school grounds, recreational facilities for all ages, and a World War I Memorial Grove. Wellesley Farms Railroad Station Landscape was established in the 1880s and the original landscape was designed by the famous landscape architect Frederick Law Olmsted Sr. The station itself is listed on the National Register of Historic Places.[55]

Additional regional parks and landscapes include the Charles River Reservation, established in the 1890s, that is 72-acres and offers a culturally significant landscape with the river and its surrounding open space. The Elm Bank, a 19th Century estate is now a state-owned parkland and watershed land with a portion of it being listed on the National Register. Part of the estate is also leased by the Massachusetts Horticultural Society. The Cochituate Aqueduct, constructed in 1846 is a 50-acre aqueduct meant to transport drinking water. It is also listed on the National Register as the Cochituate Aqueduct Linear District. The final landscape in this specific category is the Sudbury River Aqueduct which was constructed in 1876. It is 44 acres and includes Waban arches at the confluence of the Fuller and Waban Brooks. It is listed on the National Register as Sudbury Aqueduct Linear District.[56]

Wellesley has six historic institutional landscapes. The first is the Wellesley College that was established in 1875. It is a 397-acre main campus that overlooks Lake Waban. Though the campus has expanded, it still retains its "spacious landscaped character" and has been evaluated for the National Registry. Dana Hall School, established in 1881, is 50-acres and remains a preparatory school for Wellesley College. Tenacre Country Day School, which was established in 1910 with over 14-acres of land, is a private school that was initially a part of the Dana Hall School. Babson College was established in 1923 and sits on over 169-acres of land. Its campus includes the former Convalescent Home on Forest Street which began in 1879 as part of the Children's Hospital and provided care and fresh air for children suffering from TB and other diseases like polio. Babson's campus also included the former Channing Sanitarium which was a private hospital for patients with "mental and nervous ailments." The Massachusetts Bay Community College is also present in the Town and was established in 1961 on over 47-acres of land. The Wellesley Campus is a commuter school for more than 5,000 students. Finally, there is the Wellesley Country Club which was established in 1910 and has over 137-acres of land. The historic main building was demolished to build the new clubhouse and 66-acres of land became a golf course and the former Almshouse became the clubhouse.[57]

There are also several historic neighborhoods in Wellesley that highlight the Town's rich history. The Hunnewell Estates Historic District is home to late 19th Century estates along Washington Street and Pond Road. Famous homes like Wellesley and The Oaks of the Hunnewell family reside there, alongside the first documented golf course in New England and a 2.5-mile walking trail. The Cottage Street Local

[55] "Open Space and Recreation Plan 2022-2029 Working Draft." (2022). Town of Wellesley, Massachusetts.
[56] "Open Space and Recreation Plan 2022-2029 Working Draft." (2022). Town of Wellesley, Massachusetts.
[57] "Open Space and Recreation Plan 2022-2029 Working Draft." (2022). Town of Wellesley, Massachusetts.

Historic District is a late 19th Century residential district on Cottage Street, Weston Road, Waban Street, and Abbott Street and is recognized as a local historic district. The W. E. Baker Estate (Ridge Hill Farms) is a former 19th Century estate and amusement park between Grove Street and the Charles River. It once had elaborate gardens and the area west of Sabrina Lake is now the Guernsey Sanctuary and Susan Lee Memorial Sanctuary (both owned by the Wellesley Conservation Land Trust, Inc.).[58] All of these landscapes and sites help residents and visitors remember the Town's past and ensure that it is maintained going into its future.

[58] "Open Space and Recreation Plan 2022-2029 Working Draft." (2022). Town of Wellesley, Massachusetts.

Chapter 3. Planning Process

The planning process was developed in full compliance with the current planning requirements of the Federal Emergency Management Agency (FEMA), and the unique needs of the Town of Wellesley, per the following rules and regulations:

- Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act), as amended.
- National Flood Insurance Act of 1968, as amended.
- National Dam Safety Program Act (Pub. L. 92-367), as amended.
- 44 CFR Part 201 Mitigation Planning.
- 44 CFR, Part 60, Subpart A, including § 60.3 Flood plain management criteria for flood-prone areas.
- 44 CFR Part 77 Flood Mitigation Grants[10].
- 44 CFR Part 206 Subpart N. Hazard Mitigation Grant Program.

A1. Does the Plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction? (Requirement §201.6(c)(1))

A priority through the planning process was equity, which FEMA defines as the “consistent and systematic fair, just and impartial treatment for all individuals.” This was a central theme through the planning process and effort was made to develop an inclusive planning process. The whole community (individuals, communities, private and nonprofit sectors, faith-based organizations, and all levels of government) were given an opportunity to participate.

The planning process for this updated mitigation plan began in August 2022 and concluded in March 2023 (this does not include the months of plan review and adoption). The Town developed a Municipal Vulnerability Preparedness (MVP) Program summary of findings in 2020. This planning effort contributed to the development of the mitigation plan. Below is a graphical display of the original plan development timeline, it shifted slightly through the process. Meghan Jop, Executive Director of Government Services was the Chair of the Hazard Mitigation Planning Committee (HMPC) and the primary contact for the consulting team. Ms. Jop facilitated all activities related to the mitigation plan update, including meeting logistics, data gathering, and public outreach. The Consulting Team met with Ms. Jop on August 29, 2022, to review the planning process and timeline, and to discuss developing the HMPC, collecting GIS, and determining the status of previously identified mitigation actions.

Table 4. Planning Process Timeline.

	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Task 1. Convene Local HMPC	Kick-off Meeting	HMPC Meeting		HMPC Meeting & Public Meeting		HMPC Meeting		HMPC Meeting & Public Meeting	
Task 2. Update Hazard Profiles									
Task 3. Update Critical Facility Inventory									
Task 4. Update Mitigation Goals									
Task 5. Update Mitigation Actions									
Task 6. Plan Review, Evaluation, and Implementation									
Task 7. Public Review of Draft									
Task 8. Review and Approval									

Hazard Mitigation Planning Committee

The HMPC included representatives from each of these key sectors to create a shared understanding of risk and to build support for activities to mitigate natural hazard risk. The HMPC met four times, September 27, 2022, November 3, 2022, January 10, 2023, and February 23, 2023. All the meetings were conducted via Zoom due to the Covid-19 Pandemic, however sometimes Town employees gathered at their offices. A list of participants at each of these meetings is included in Appendix A. The complete HMPC list is included below.

Table 5. HMPC Members.

First Name	Last Name	Title	Affiliation	Phone	Email
Eric	Arbeene	Planning Director	Town of Wellesley	781-431-1019 x2237	earbeene@wellesleyma.gov
Jeffrey	Azano-Brown	Department of Public Works	Town of Wellesley	781-431-1019 x3360	jazanobrown@wellesleyma.gov
Nathaniel	Brady	Interim Fire Chief	Town of Wellesley	781-235-1300	nbrady@wellesleyma.gov
Kate	Deeb	Director of Campus and Community Partnerships	Babson College		kdeeb@babson.edu
Brian	Drainville	Maintenance Supervisor	Wellesley Housing Authority	781-235-0223	bdrainville@wellesleyhousing.org
Brian	Dupont	IT Director	Town of Wellesley	781-431-1019 x2280	bdupont@wellesleyma.gov
Amy	Frigulietti	Assistant Executive Director	Town of Wellesley	781-431-1019 x2205	afrigulietti@wellesleyma.gov
Stephanie	Hawkinson	Public Information Officer	Town of Wellesley	781-431-1019 x2207	shawkinson@wellesleyma.gov
David	Hickey	Town Engineer	Town of Wellesley	781-431-1019 x3310	dhickey@wellesleyma.gov
Suzanne	Howard	EHS Director	Wellesley College	781-283-3882	showard@wellesley.edu
Leonardo	Izzo	Director of Public Health	Town of Wellesley	781-431-1019 x4110	lizzo@wellesleyma.gov
Dira	Johanif	Urban Resilience Advocate	Charles River Watershed Association	617-540-5650	djohanif@crwa.org
Meghan	Jop	Executive Director	Town of Wellesley	781-431-1019 x2200	mjop@wellesleyma.gov
Marybeth	Martello	Sustainability Director	Town of Wellesley	781-431-1019	mmartello@wellesleyma.gov

First Name	Last Name	Title	Affiliation	Phone	Email
Joseph	Murray	Facilities Project Manager	Town of Wellesley	781-431-1019 x2402	jmurray@wellesleyma.gov
Jeff	Peterson	Assistant Fire Chief (retired)	Town of Wellesley	781-431-1019 x6213	jpeterson@wellesleyma.gov
Jack	Pilecki	Chief of Police	Town of Wellesley	781-431-1019 x7123	jpilecki@wellesleyma.gov
George	Sarceno	Assistant Town Engineer	Town of Wellesley	781-431-1019 x3319	gsaraceno@wellesleyma.gov
Brandon	Schmitt	Natural Resource Commission Director	Town of Wellesley	781-431-1019 x2298	bschmitt@wellesleyma.gov
Jackie	Sullivan	Executive Director	Wellesley Housing Authority	781-235-0223 x 12	jsullivan@wellesleyhousing.org
Mike	Thompson	GIS Manager	Town of Wellesley	781-431-1019 x2289	mthompson@wellesleyma.gov
Lisa	Wolf	Sustainability Coordinator	Wellesley Municipal Light Plant	781-431-1019 x3400	lwolf@wellesleyma.gov
Jeffrey	Zukowski	Hazard Mitigation Planner	MA Emergency Management Agency	508-820-1422	jeffrey.zukowski@state.mas.us

The Executive Director developed the HMPC to support the planning process and to include representatives from seven key sectors of the community as shown in the table below.

Table 6. Sectors of the Community represented on the HMPC.

Sectors of the Community	HMPC Members
1. Emergency Management	Fire Chief, Interim Fire Chief, Retired Assistant Chief Local Emergency Planning Committee members Chief of Police Wellesley College Babson College
2. Economic Development	Planning Director Assistant Planning Director who heads Economic Development
3. Land Use and Development	Planning Director Engineering staff Assistant Director of Department of Public Works Department of Public Works staff Facilities Coordinator
4. Housing	Housing Authority Representative Planning Department Representatives of Housing Task Force
5. Health and Social Services	Health Department
6. Infrastructure	Planning Director Engineering Staff Department of Public Works
7. Natural and Cultural Resources	Natural Resources Director Charles River Watershed Association

The first HMPC Meeting, was held on September 27, 2022, and included nineteen people! The meeting began with a discussion of environmental justice populations. The HMPC mentioned that the Town has a high population of people with Korean, Japanese, or Chinese heritage. They mentioned that there is a language barrier with this population, and they live primarily in an area off Cedar Street. The Town has started a Freedom Team to combat hate crimes by making connections with the foreign language school and network. They also discussed hazards and hazard impacts mentioning that stormwater management is an issue that is more prevalent that flooding in the floodplain. During a discussion of critical facilities, it was mentioned that a microgrid is planned for the library which is a heating and cooling center. Finally, the Committee mentioned the substantial amount of new growth, specifically multi-unit housing that has increased the population density and the amount of impervious surface which increases the risk of flooding.

The second HMPC Meeting, was held on November 3, 2022, and included several new HMPC members who represented the Wellesley Housing Authority, the Charles River Watershed Association, and the Natural Resource Commission. The meeting began with a discussion about plan integration. The previous plan was not officially adopted or completed. The concepts and goals were loosely integrated into the Local Emergency Operations Plan. It was however, referenced in many local plans. The Town has shifted since the 2010 draft plan was written and is now extremely proactive. They intend to fully integrate the Hazard Mitigation Plan (HMP) with the new Unified Plan, the Housing Production Plan, and the Climate Action Plan. They view the HMP as a document to fully unify all the on-going efforts underway. They then discussed outreach for the upcoming public meeting and agreed to get the word out through all Town boards and committees, through the news and social media. They may work with the Chinese language school to translate public meeting materials. The HMPC then discussed each hazard in detail to capture high hazard areas, past experiences, and current concerns. The environmental justice communities each touch the Charles River which presents a potential flooding concern.

The third HMPC meeting, was held on January 10, 2023, and included early results from the risk analysis, a review of the recently released Massachusetts Climate Change Assessment, and findings and recommendations from the Capability Assessment. During the meeting the HMPC reviewed problem statements stemming from the risk analysis. This discussion led to identifying some additional high hazard areas, such as Lyndon Street which can flood under the railroad tracks. They also mentioned the need for a Stormwater Utility to support additional flood mitigation projects. The HMPC mentioned that the Town is pushing for complete electrification and wants to make sure that goals and actions reflect this priority. The HMPC agreed to streamline the eight goal statements that were developed in the draft plan from 2010 and identified the goals in the figure below. Each goal has an identified theme that supports the priorities of the Town.

Save Lives	• Reduce risk to people, property, infrastructure, and natural resources from natural hazards and climate change.
Infrastructure	• Mitigate risk to critical facilities and infrastructure from natural hazards and climate change.
Capacity	• Expand the Town's capacity to mitigate risk by adopting a culture of hazard mitigation through regulations, planning, and regional collaboration.
Natural Resources	• Implement actions that minimize risk from climate change and natural hazards to preserve or restore the functions of natural systems.
Education	• Educate all stakeholders about the value of hazard mitigation and how to implement it in their work, businesses, and homes.

Figure 3. Goal Statements.

The fourth HMPC meeting, was held on February 23, 2023, and focused on mitigation action prioritization and plan review. The HMPC discussed ranking the mitigation actions in order of priority based on benefit vs. cost analysis. The proposed system was modified to meet the needs of the Town. The cost of mitigation actions were given high, medium, and low categories based on the following criteria:

- Low under $50,000
- Medium $50,000 - $250,000
- High over $250,000

A point system was developed in the Mitigation Action Tracker that prioritized actions that mitigate high risk hazards, benefit critical facilities, benefit EJ communities, and protect natural resources. The complete prioritization system is detailed in Chapter 6. Mitigation Strategy.

The HMPC agreed to target outreach for the plan review to the Environmental Justice community that primarily includes people of Chinese descent. For this reason, outreach materials will be translated to Chinese, and the community will be directly engaged through the Chinese Language School. They will also target outreach to the Sustainable Wellesley group through their news blast. In addition, announcements will be posted in the local online newspaper and on the Town's website.

The HMPC also participated in two public meetings, one on November 16, 2022, and one on February 16, 2023. These were also attended via Zoom. Finally, the HMPC reviewed the draft Town of Wellesley, MA Hazard Mitigation Plan Update prior to sending it to the Massachusetts Emergency Management Agency (MEMA) for their review in April 2023.

Public Engagement

A2. Does the Plan document an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, agencies that have the authority to regulate development as well as other interests to be involved in the planning process? (Requirement §201.6(b)(2))

A3. Does the Plan document how the public was involved in the planning process during the drafting stage? (Requirement §201.6(b)(1))

The Public Outreach Strategy was designed to involve the whole community in the mitigation planning process. The public was engaged in the planning process during the drafting of the plan and prior to plan approval through two public workshops (a flyer for the first workshop is shown below). They were also given a chance to review the plan prior to its review by MEMA or FEMA. The purpose of public engagement was to:

- Generate public interest in mitigation planning.
- Identify and accommodate special populations.
- Solicit public input.
- Engage local stakeholders.
- Create opportunities for public and local stakeholders to be actively involved in the mitigation planning process.

Both public workshops were hosted virtually due to the Covid-19 pandemic. Each meeting included a PowerPoint presentation and plenty of opportunity for questions and discussion. In addition, Mentimeter was used to facilitate input from meeting participants. This has proven to be an effective tool when engaging people who may not be comfortable speaking up in a virtual meeting. The HMPC participated in each meeting.

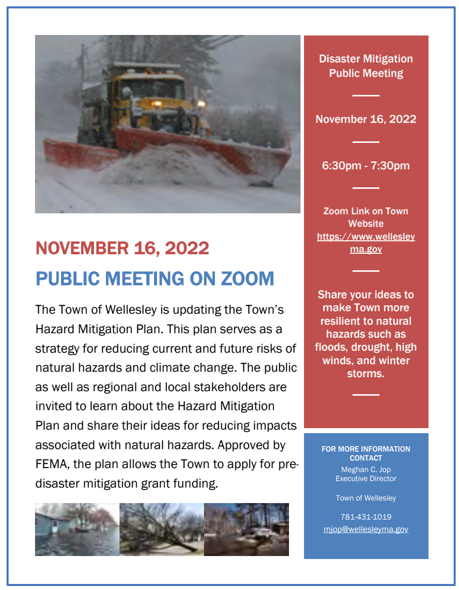


Figure 4. Public Workshop Flyer.

> ***COMMUNITY LIFELINES** are the most fundamental services in the community that, when stabilized, enable all other aspects of society.*

Representatives from all community lifelines (described below) were included in public engagement efforts. Community lifelines are a driving force behind FEMA's strategic goals for building a culture of preparedness and readying the nation for catastrophic disasters. The seven community lifelines can be a powerful tool for local governments when evaluating risk and developing mitigation actions. The HMPC considered the seven community lifelines when conducting outreach through this planning process. The seven community lifelines and their respective components are shown in the figure below.

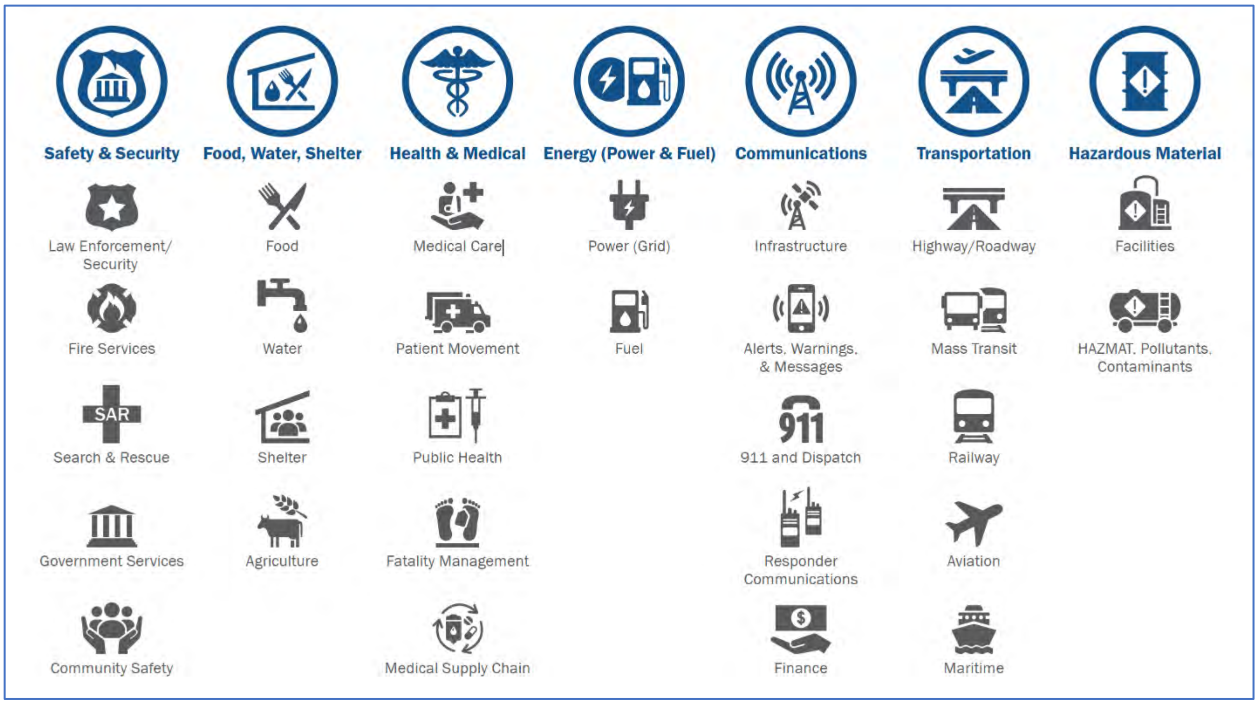


Figure 5. Community Lifelines.

Outreach for the public workshops and for plan review was sent via press release, email blasts, and news postings. It included sending press releases to the local online newspaper, The Swellesley Report (https://theswellesleyreport.com), news and announcement posts on the Wellesley, MA website homepage (https://wellesleyma.gov), the Town's Facebook page (shown in the figure below), direct invitations to the Chinese Language School, to the environmental justice population, and to the Sustainable Wellesley group. HMPC members sent email invitations to their counterparts in adjacent communities, to all Wellesley department staff and board members, and to several regional groups including the Charles River Watershed Association and the Metropolitan Area Planning Council. Public Workshops were recorded and posted to the Town's cable access channel.

Approximately 12% of the Town's population is made up of minorities. Wellesley has two designated Environmental Justice Communities. Outreach to these communities specifically included, direct connection with the Chinese Language School and translated announcements.

Figure 6. Facebook Public Meeting Announcement.

The first public meeting occurred on November 16, 2022, and 25 people participated. This meeting emphasized identification of hazards and critical facilities. Participants gave feedback regarding what they have noticed in terms of climate change and how the Town can address these changes. When asked, "what buildings, organizations, or infrastructure, do people rely on?" the follow responses were captured:

- Department of Public works
- Gas stations
- Hospital
- Library
- Local Businesses
- Mass Bay Community College
- Municipal Light Plant
- Police
- Roads
- Schools
- Supermarkets
- Tolles Parsons Center (Senior Center)
- Town Hall
- Transportation
- Warren Building
- Water/Sewer Department

This list of “critical facilities” was reviewed against the list developed by the HMPC to make sure key facilities were included. Supermarkets were not added to the list, but medical facilities and elderly housing were added.

When asked about areas of high hazards several people named portions of Route 9. They also mentioned houses on College Road, Geraldine Road, and the solar farm located in the Turner Road parking lot. The final question asked to the group was designed to inspire a list of mitigation ideas. A few ideas were captured on Mentimeter (shown in the figure below), and some inspired conversation.

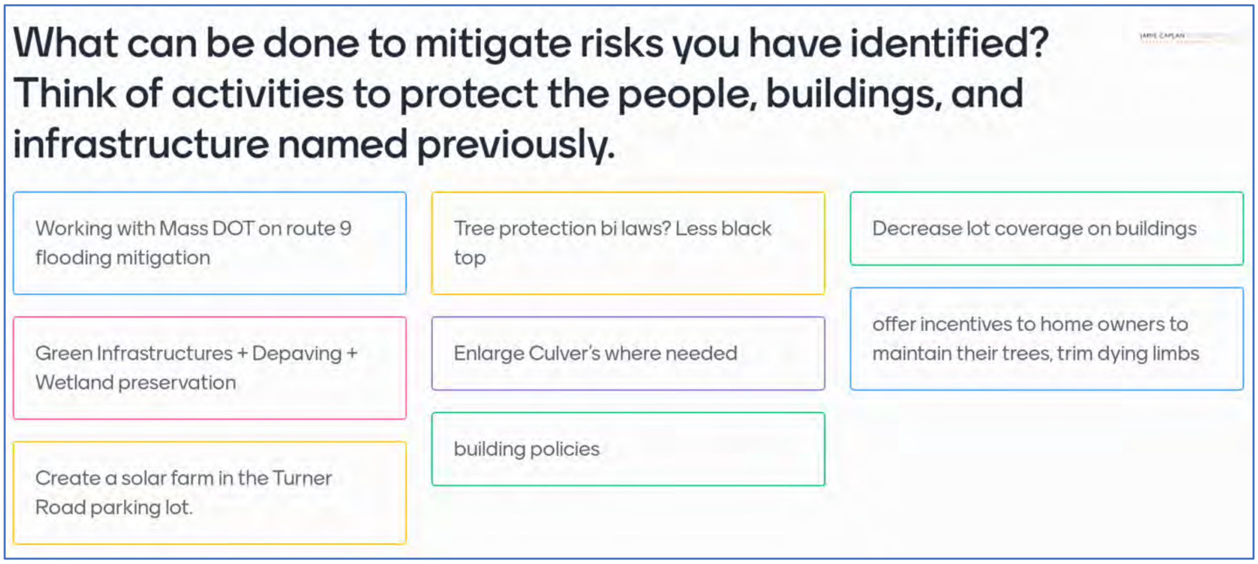


Figure 7. Mitigation Suggestions in Public Meeting.

Discussion and comments in the meeting included a request to add the Natick Dam to the list of critical facilities and to focus on power outages throughout the plan. The public requested to see actions recommending microgrids and energy storage as possible solutions for power outages. Meeting participants also discussed how to include guidance about mitigating the risk of heat caused by large asphalt areas such as parking lots. These recommendations were discussed by the HMPC and incorporated in the list of mitigation actions.

The second public meeting occurred on February 16, 2023, and 26 people participated. This meeting emphasized mitigation actions and the layout of the plan. Meeting participants included Town employees, residents, and people affiliated with the colleges. An initial question to the audience included naming three natural hazards they are most concerned with. The following word cloud shows these results. It also supports the HMPC emphasis on developing mitigation actions to mitigate the flood risk.

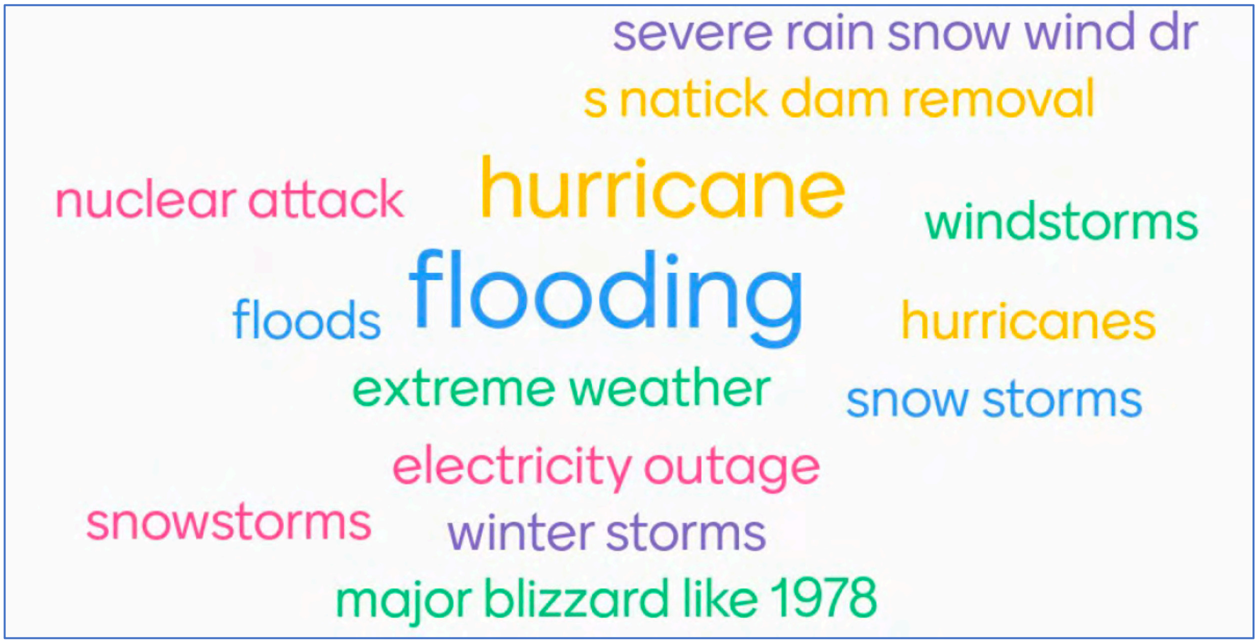


Figure 8. Three natural hazards of biggest concern.

A follow-up question asked the audience how they recommend the Town mitigate the flood risk and the following list shows some of those responses.

- Helping river neighbors lift up their homes...are their grant opportunities for residents?
- Permeable driveways and roads. Storm drain clearing.
- Address undersized poorly managed failing 1930's open drainage systems in neighborhoods.
- Don't build in floodplains. Protect wetlands. Smart regs on stormwater control.
- Partnering with upstream communities, stormwater management/utility carrot, drain cleaning and adoption especially before large storms.
- Install or move emergency generators away from flood risks, e.g., out of basements.
- By working closely with neighboring communities thar are removing dams and haven't really paid much attention to impact of downriver residents in Wellesley.
- Wetland preservation.
- Many commercial properties are sitting in flood zones near Charles River at Lower Falls; potentially for sale; can we put them aside?
- Reforest.
- Watch for sluice trails.
- Less mowing more foresting in town land.
- Widespread adoption of heat pumps for extreme heat and cold.

- Annual true pruning. Redundancy lines. Underground electric.
- With underground electric, avoid construction of transformers and electric vaults in at risk areas, such as basements.

The meeting proceeded to share with the audience some of the highest priority mitigation actions and then asked the group for additional ideas to mitigate risk. They responded with the following suggestions.

- Preserve wildlife that can deal with mosquitos, ticks, etc. born illnesses.
- Solar and battery storage.
- Distributed solar with battery storage.
- Plantings around flood areas to contain flooding/prevent erosion, when properties are redeveloped like near the floodplain, make sure they are complying with updated stormwater regulations.
- Underground electric.
- Backup power plans for critical facilities.
- Drought rules.
- Widespread pruning of tress for high wind mitigation.
- Bring in micro-nuclear reactors to supplement our supply of electricity.
- Watch out for sluice way formations.

Contributions from the HMPC and public engagement impacted the plan in multiple ways. The table below indicates some of the contributions, others are included above and throughout the plan.

Table 7. Where public engagement informed the plan.

Area of the Plan Impacted	**Contributions**
Planning Area Profile	• Added critical facilities based on public feedback, medical facilities, elderly housing, and the Natick Dam. • Description of the population and high hazard areas.
Planning Process	• Participated in every aspect of the planning process and determined how to engage the public and key stakeholders.
Risk Assessment	• Reviewed locations of critical facilities and discussed extent of hazard impacts based on previous events. • Added the qualitative review to the risk analysis for determination of the hazard risk ranking.

Area of the Plan Impacted	Contributions
Capability Assessment	• Contributed plans, bylaws, and reports for review. • Completed three Capability Assessment questionnaires including the National Flood Insurance survey and the Safe Growth survey.
Mitigation Strategy	• Identified and prioritized mitigation actions based on their concerns, specifically regarding power outages, and hazard impacts to critical facilities. Included microgrids and back-up battery storage as potential mitigation actions.
Implementation Plan	• The HMPC determined the implementation and update schedule. The public expressed an interest in remaining involved in the plan's implementation.

Review of Draft Plan

Figure 9. Public Review Flyer.

The Town made the plan available for public review the third week in May 2023. A press release announcing the availability to review the plan was sent and the announcement was posted to the Town website. The Swellesley Report was targeted, the Chinese Language School translated the announcement and shared it, the announcement ran on Wellesley's media channel and the Sustainable Wellesley group announced the plan's availability through their news blasts. The HMPC also sent emails to specific stakeholders in Town and in the adjacent communities. Announcements were also posted on social media and mentioned in meetings with stakeholders and the public. Hard copies of the plan were kept in the Town Hall, the Library, and in the Planning Office. Comments from the public were collected by the Executive Director of Government Services.

Several comments were received from the public. These included positive feedback about the plan overall. In addition, someone mentioned the need to put more attention on the electric grid and to specifically address the potential impacts from electric grid failure. Based on a comment about the electric grid and flooding, a bullet point was added to the problem statements in the risk assessment to address this. A comment was also made to rank the following action as high priority instead of medium priority. "**Accelerate and maximize Installation of solar and battery storage on municipal properties, where appropriate.**" In addition, it was recommended that this be a town-wide action and include the Municipal Light Plant leading a multi-department effort to develop a comprehensive plan to mitigate this risk that includes both pro-active steps such as renewable energy (solar and geothermal) with storage in microgrids and an action plan should the grid go down. These changes were not made however, the HMPC will consider this during their next meeting.

Chapter 4. Risk Assessment

Hazard Identification

> ***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, infrastructure, or natural and cultural resources.*

The first step in the risk assessment was to revisit and evaluate the hazards identified for study and inclusion in the Town's previous draft hazard mitigation plan. This was a key topic of discussion at the first Hazard Mitigation Planning Committee (HMPC) meeting, along with the consideration of any additional hazards to include in the updated risk assessment. While only natural hazards are required to be addressed by FEMA, other hazards such as technological and human-caused hazards may be included if they are of significant concern to the community and determined to be a mitigation priority.

In completing the updated hazard identification process, the HMPC considered the results of the Town's recent Municipal Vulnerability Preparedness (MVP) planning effort, as well as the 2018 State Hazard Mitigation and Adaptation Plan (SHMCAP).[59] As a result of this process all hazards from the 2010 draft plan remain included in this updated risk assessment. For this updated assessment, some hazards have been consolidated or renamed to be consistent with the SHMCAP, as further described below.

The top four natural hazards identified for the MVP effort are thoroughly covered in this assessment, which include flooding, intense storms, heat waves, and drought. In addition, two new hazards have been identified and incorporated into the assessment, infectious disease and invasive species. Infectious disease was added based on the impacts of the Covid-19 pandemic as well the Commonwealth's growing concern for the increased prevalence of vector-borne diseases. Invasive species was added to reflect the concern for this becoming a more prevalent hazard with projected climate changes; and to ensure that the risk assessment is aligned with the SHMCAP.

With the addition of invasive species, all relevant hazards as identified in the SHMCAP were considered and addressed in this risk assessment for Wellesley. Due to the community's inland location, coastal hazards identified in the SHMCAP are not included (such as sea level rise, coastal flooding, coastal erosion, and tsunami).

To better reflect the relationship between natural hazards and changing climate and weather patterns, each of the individual hazards identified for the updated risk assessment have been reorganized and categorized according to their primary interaction with climate change. These new categories are consistent with the SHMCAP and include the following:

[59] Massachusetts State Hazard Mitigation and Climate Adaptation Plan. 2018.

- Changes in Precipitation
- Rising Temperatures
- Extreme Weather
- Non-Climate Influenced Hazards

Individual hazards are also grouped within each category according to their primary hazard (for example, all flooding-related hazards are listed under “Flooding” in the Changes in Precipitation category). This new classification for identified hazards was utilized for the plan update to consolidate and be consistent with the state’s current hazard classification scheme per the SHMCAP.

Table 8 provides an abbreviated list of the 12 primary hazards included in the update risk assessment.

Table 8. Town of Wellesley Hazards.

Primary Climate Change Interactions	**Hazards**
Changes in Precipitation	1. Flooding *(including riverine, dam failures, ice jams, etc.)* 2. Drought 3. Landslide
Rising Temperatures	4. Extreme Temperatures 5. Wildfires *(including brush fires)* 6. Infectious Disease 7. Invasive Species
Extreme Weather	8. Hurricanes/Tropical Storms 9. Severe Winter Storm/Nor’easter *(including blizzard, ice storm, etc.)* 10. Tornadoes 11. Other Severe Weather *(including thunderstorms, etc.)*
Non-Climate Influenced Hazards	12. Earthquake

Link to Massachusetts Climate Change Assessment

The *2022 Massachusetts Climate Change Assessment* report was issued in December 2022 (https://www.mass.gov/info-details/massachusetts-climate-change-assessment#read-the-report-). This report provided statements about the impacts of climate change in five sectors within each of seven designated regions of Massachusetts. Wellesley is in the "Eastern Inland" region shown in purple in the figure below. The table below lists the top two or three impacts of climate change in each of the five sectors within this region.

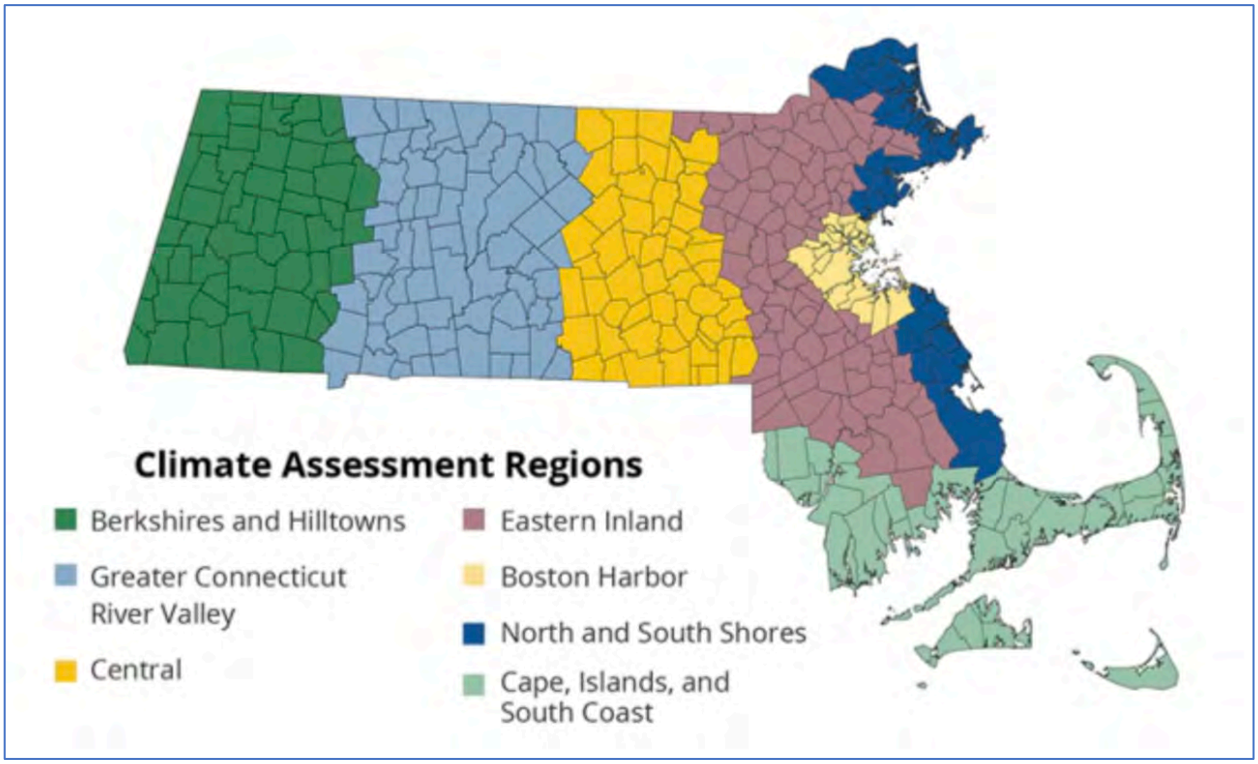


Figure 10. Climate Assessment Regions. Wellesley is in the Eastern Inland Area.

Table 9. Top Impacts of Climate Change per Sector in Eastern Inland Region.

Sector	Top Impacts per Sector	Comments
Human	Increase in vector-borne disease incidence and bacterial infections	Including West Nile Virus and Lyme due to favorable conditions for mosquitos and ticks
	Reduction in food safety and security	Causes are production and supply chain issues as well as spoilage during outages
Infrastructure	Damage to electric transmission and distribution	From extreme cold, heat stress, extreme storms, high winds, and flooding

Sector	Top Impacts per Sector	Comments
	Damage to buildings	Causes are heavy rainfall and overwhelmed drainage
	Damage to rails and loss of rail/transit service	Causes are flooding and track buckling from heat
Natural Environment	Freshwater ecosystem degradation	Causes are warming waters, drought, and runoff
	Forest health degradation	Causes are warming temperatures, changing precipitation, wildfire frequency, and increasing pests
Governance	Increase in costs of responding to climate migration	Includes planning for abrupt increases in local populations
	Increase in demand for State and municipal services	Includes emergency response, food assistance, and health care
Economy	Reduced ability to work	For outdoor workers during extreme heat events, as well as delays in commute times
	Reduction in availability of affordably priced housing	Causes are direct damage (floods) and scarcity caused by demand

Eventually, these impacts will be incorporated into the SHMCAP update scheduled for release in late 2023. The Town assumes that the SHMCAP will provide guidance about how to link the top climate impacts with the profiling of specific hazards. In the meantime, the Town proposes to incorporate these top climate change impacts in this edition of its plan as outlined below.

Table 10. How This Plan Addresses the Top Impacts of Climate Change per Sector.

Sector	Top Impacts per Sector	Approach to Incorporating Impacts
Human	Increase in vector-borne disease incidence and bacterial infections	Vector-borne and infectious diseases are a hazard profiled in this plan.
	Reduction in food safety and security	Some of the hazards that affect food security (i.e., droughts) are profiled in this plan. However, Wellesley depends on food from other regions, and

Sector	Top Impacts per Sector	Approach to Incorporating Impacts
		additional efforts beyond the scope of this plan will be needed to protect food safety and security.
Infrastructure	Damage to electric transmission and distribution	Severe weather events that damage transmission and distribution are hazards profiled in this plan.
	Damage to buildings	Severe weather events and floods that damage buildings are hazards profiled in this plan.
	Damage to rails and loss of rail/transit service	Severe weather events, floods, and extreme heat events that damage transit systems are hazards profiled in this plan.
Natural Environment	Freshwater ecosystem degradation	Invasive species are addressed as a hazard profiled in this plan. Additional efforts beyond the scope of this plan will be needed to protect freshwater ecosystems.
	Forest health degradation	Invasive species, droughts, wildfires, and severe weather events that damage forests are hazards profiled in this plan. Additional efforts beyond the scope of this plan will be needed to protect Forest health.
Governance	Increase in costs of responding to climate migration	The capability assessment and related mitigation actions will help address increased costs related to responding to climate migration.
	Increase in demand for State and municipal services	The capability assessment and related mitigation actions will help address increased demands for municipal services.
Economy	Reduced ability to work	The individual hazards addressed in this plan can reduce ability to work, and the specific actions for each hazard will help protect lifelines and systems needed for work.
	Reduction in availability of affordably priced housing	The individual hazards addressed in this plan can reduce the availability of affordably priced housing, and the specific actions for each hazard will help protect housing options and opportunities.

Hazard Profiles

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)(s)(i))

B2. Does the plan include a summary of the jurisdiction's vulnerability and the impacts on the community from the identified hazards? Does the summary also address NFIP-insured structures that have been repetitively damaged by floods? (Requirement 44 CFR §201.6(c)(s)(ii))

The risk assessment for the SHMCAP describes the natural hazards that have the potential to impact the Commonwealth and provides the underlying narrative for this hazard profile for the Town of Wellesley. This section is organized by climate change interaction category, consistent with the SHMCAP. Because this section repeats information from the SHMCAP, some citations have been removed for brevity. The original citations can be found in the SHMCAP.

Profiles have been developed for each identified hazard, organized by primary climate change interaction. Hazard profiles include the following sections: Hazard Description, Location, Previous Occurrences, Extent, Probability of Future Events, and Vulnerability Assessment; these are described in the table below.

Table 11. Hazard Characterization.

Category/Method	Definition
Description	Description of hazard, its characteristics, and potential effects.
Location	Describes geographic areas within the town that are affected by the hazard.
Previous Occurrences	Provides information on the history of previous hazard events for the region, including their impacts on people and property.
Extent	Describes potential strength or magnitude of a hazard. Where possible, extent is described using established scales.
Probability of Future Events	Describes likelihood of future hazard occurrences in the town based on best available and climate-informed science.
Vulnerability Assessment	Describes potential impact on the community, including estimated potential losses and the anticipated effects of climate change.

> ***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).*

To describe previous occurrences, this plan update highlights major events from history but *relies primarily on a ten-year lookback (2012 through 2021)* ending with any events from the date of plan development (2022). This helps maintain a concise narrative. Where applicable, narratives about warning times (i.e., floods, heat advisories, and wildfires) are incorporated into the *"Extent"* subsections.

> ***IMPACTS** are 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).*

The vulnerability assessment characterizes how hazards have impacted and may impact the different aspects of the community. In the vulnerability assessment sub-sections, the magnitude and likelihood of a hazard event are evaluated, and impacts are quantified using hazard models. Some hazards, like earthquakes and winter storms, will impact the entire community while other hazards, like floods and landslides, impact specific locations in the community. The areas that could be impacted are defined as the community's exposure. The results of the vulnerability assessment are used to help identify mitigation measures the community may take to lessen the impact and better understand their benefits.

Primary Climate Change Interaction: Changes in Precipitation

Flooding Including Dam Failures and Ice Jams

Nationally, flooding causes more damage annually than any other severe weather event. Flooding in Massachusetts is often the direct result of frequent weather events such as coastal storms, nor'easters, tropical storms, hurricanes, heavy rains, and snowmelt. In an inland community such as Wellesley, flooding is the result of moderate precipitation over several days, intense precipitation over a short period, or melting snowpack. Increases in precipitation and extreme storm events will result in increased inland flooding. Common types of flooding are described below.

> The Town of Wellesley Community Resilience Building Workshop Summary of Findings (2020) lists "Flooding" as one of the top four hazards of concern.

Description

Figure 11. Stormwater Flooding in Wellesley.

Riverine Flooding: Riverine flooding often occurs after heavy rain. Areas of the state with high slopes and minimal soil cover (such as found in western Massachusetts) are particularly susceptible to flash flooding caused by rapid runoff that occurs in heavy precipitation events and in combination with spring snowmelt, which can contribute to riverine flooding. Frozen ground conditions can also contribute to low rainfall infiltration and high runoff events that may result in riverine flooding. Some of the worst riverine flooding in Massachusetts' history occurred because of strong nor'easters and tropical storms in which snowmelt was not a factor. Tropical storms can produce very high rainfall rates and volumes of rain that can generate high runoff when soil infiltration rates are exceeded.

Floodplains are the low, flat, and periodically flooded lands adjacent to rivers, lakes, and oceans. These areas are subject to geomorphic and hydrologic processes. Floodplains may be broad, as when a river crosses an extensive flat landscape, or narrow, as when a river is confined. These areas form a complex physical and biological system that supports a variety of natural resources and flood storage.

Drainage-Related Flooding: Drainage systems are designed to remove surface water from developed areas as quickly as possible to prevent localized flooding on streets and adjacent properties. They make use of a conveyance system that channels water away from a developed area to surrounding streams, bypassing natural processes of water infiltration into the ground, groundwater storage, and evapotranspiration. Flooding from overwhelmed drainage entails floods caused by increased water runoff due to development and drainage systems that are not capable of conveying high flows. Since drainage systems reduce the amount of time the surface water takes to reach surrounding streams, flooding can occur more quickly and reach greater depths than if there were no urban development at all. In almost any community with some degree of development, basement, roadway, and infrastructure flooding can result in significant damage due to poor or insufficient stormwater drainage.

Ice Jam: An ice jam is an accumulation of ice that acts as a natural dam and restricts the flow of a body of water. A freeze-up jam usually occurs in early winter to midwinter during extremely cold weather when super-cooled water and ice formations extend to nearly the entire depth of the river channel. This type of jam can act as a dam and begin to back up the flowing water behind it. A breakup jam, forms as a result of the breakup of the ice cover at ice-out, causing large pieces of ice to move downstream, potentially piling up at culverts, around bridge abutments, and at curves in river channels. Breakup ice jams occur when warm temperatures and heavy rains cause rapid snowmelt. The melting snow, combined with the heavy rain, causes frozen rivers to swell. The rising water breaks the ice layers into large chunks, which float downstream and often pile up near narrow passages and obstructions (bridges and dams). Ice jams may build up to a thickness great enough to raise the water level and cause flooding upstream of the obstruction.

Dam Overtopping: Dam overtopping is caused by floods that exceed the capacity of the dam, and it can occur as a result of inadequate spillway design, settlement of the dam crest, blockage of spillways, and other factors. Overtopping accounts for one-third of all dam failures in the U.S. The two primary types of dam failure are catastrophic failure (characterized by the sudden, rapid, and uncontrolled release of impounded water) and design failure (which occurs as a result of minor overflow events).

There are a number of ways in which climate change could alter the flow behavior of a river, causing conditions to deviate from what the dam was designed to handle. For example, more extreme precipitation events could increase the frequency of intentional discharges. Many other climate impacts, including shifts in seasonal and geographic rainfall patterns, could also cause the flow behavior of rivers to deviate from previous hydrographs. When flows are greater than expected, spillway overflow events (often referred to as “design failures”) can occur. These overflows result in increased discharges downstream and increased flooding potential. Therefore, although climate change will not increase the probability of catastrophic dam failure, it may increase the probability of design failures.

Beaver Dams: Additional causes of flooding include beaver dams. Beaver dams obstruct the flow of water and cause water levels to rise. Significant downstream flooding can occur if beaver dams break.

Secondary Hazards: The most problematic secondary hazards for flooding are fluvial erosion, riverbank erosion, and landslides affecting infrastructure and other assets located within floodplains. Without the space required along river corridors for natural physical adjustment, such changes in rivers after flood events can be more harmful than the actual flooding. The impacts from these secondary hazards are especially prevalent in the upper courses of rivers with steep gradients, where floodwaters may pass quickly and without much damage, but scour the banks, edging buildings, and structures closer to the river channel or cause them to fall in. Landslides can occur following flood events when high flows oversaturate soils on steep slopes, causing them to fail. These secondary hazards also affect infrastructure.

Roadways and bridges are impacted when floods undermine or wash out supporting structures. Dams may fail or be damaged, compounding the flood hazard for downstream communities. Failure of wastewater treatment plants from overflow or overtopping of hazardous material tanks and the dislodging of hazardous waste containers can occur during floods as well, releasing untreated wastewater or hazardous materials directly into storm sewers, rivers, or the ocean. Flooding can also impact public water supplies and the power grid in similar ways, through inundation and/or erosion.

Location

Heavy rainfall events occur regularly in Massachusetts. As a result, riverine flooding and drainage-related flooding affect most of the communities in the Commonwealth, including Wellesley. Dam failure has the potential to impact areas downstream of dams, including river corridors in and adjacent to Wellesley. Ice jams, if they occurred, would be limited to segments of the rivers with more modest changes in grade.

Previous Occurrences

Flooding is a major concern in Wellesley. The Town's previous draft hazard mitigation plan notes that Wellesley has experienced many flooding events and provides a brief list ending with spring 2010. The Town's MVP-funded CRB Workshop Summary of Findings (2020) notes that *"Flooding in Wellesley is primarily concentrated around Morses Pond and along the banks of the Charles River. The first of these areas primarily impacts residential units and the latter primarily impacts commercial areas. Pockets of flooding are commonly reported throughout town, however, and Wellesley High School (the town's designated emergency shelter) also sits in the 100-year floodplain."* The Climate Action Plan (2022) similarly notes that *"Flooding is concentrated around Morses Pond, along the banks of the Charles River, and in areas with extensive impervious pavement, affecting both residential and commercial buildings."*

As noted earlier, this plan update relies primarily on a ten-year lookback (2012 through 2021) inclusive of the date of plan development (2022). From 2012 through 2021, none of the disaster declarations in Massachusetts that cover Norfolk County were related to *flood impacts* in Norfolk County. The NOAA Storm Events database (https://www.ncdc.noaa.gov/stormevents/) lists the following flood events affecting Wellesley in this timeframe.

- 9/1/2013 – Flash Flood: An upper-level disturbance moved over southern New England bringing showers and thunderstorms to the region. A complex of showers and thunderstorms developed over the Wellesley/Needham area. These storms moved very slowly, if at all, producing three to four inches of rain over the region in 1 to 2 hours' time. This resulted in widespread flash flooding across both. **Several streets, including a few major highways were closed due to flooding including Washington Street, Route 9, Route 16, Route 128 at exit 19, Great Plain Avenue, and Weston Road. Many cars were stuck in flood waters on these roads and across intersections.** Another round of heavy rain resulted in renewed flooding across Wellesley and Natick. In Wellesley, many **roads were flooded, including Wellesley Avenue, Brook, Washington, Cottage and Worcester Streets, and Ingraham, Dover, and Amherst Roads.** Numerous basements also were flooded in this region. Damage of $80,000 was reported for both communities combined.
- 10/29/2017 – Flood: The remnants of Tropical Storm Phillipe merged with a mid-latitude system approaching the U.S. East Coast. This created an area of low pressure that moved north from the Carolinas through New York State on the 29th. The low swung a cold front through Southern

New England during the early morning of the 30th. The combined system generated strong to damaging winds, especially in Eastern Massachusetts. **Albion Road at Cliff Road in Wellesley was flooded; State Route 9 near the Fire Department Headquarters was flooded.** Damage figures were not reported.

- 1/12/2018 – Flood: A slow-moving cold front crossed New England from the afternoon of January 12 to the morning of January 13. Strong southerly winds ahead of the front drew mild and humid air north over Southern New England. This helped generate heavy downpours before the front moved through. Rainfall amounts ranged from one to three inches. At 11:25 PM EST, **Cedar Street in Wellesley was reported flooded and impassable near the intersection with Barton Road.** Damage figures were not reported.
- 7/6/2019 – Flood: A cold front advanced into a very moist, almost tropical air mass in place across southern New England. This produced a line of thunderstorms, some with torrential downpours that caused flooding. **Flooding was reported on Route 135 in Wellesley, and two feet of water was reported in the three left lanes of I-95 S in Wellesley.** Damage figures were not reported.
- 6/21/2020 – Flood: Hot, humid conditions prevailed across the region. Without much atmospheric forcing, it took a sea breeze boundary to set off strong thunderstorms, which became severe in eastern Massachusetts during the afternoon hours. Localized flooding also occurred. **In Wellesley, there was significant flooding at Wellesley Fire Headquarters on Route 9. On Haskins Road, a car was stuck in flood waters. A car was stuck in flood waters on the Route 9 bridge.** Damage figures were not reported.

The Town's HMPC noted in September 2022 that challenges associated with flooding of Route 9 have been ongoing for "decades." Some of the reports listed above certainly confirm that flooding on Route 9 remains a major challenge.

The Town's Open Space and Recreation Plan (2015-2022) and its draft update (2022-2029) note that "five specific areas [are] subject to chronic flooding:

- Lexington Road, which crosses Boulder Brook just upstream of the Worcester Street crossing near the Natick town line.
- Cedar Brook Road, which crosses Boggle Brook at the outlet of Reed Pond near the Natick line.
- River Street, which runs along the Charles River between Washington Street and Walnut Street.
- #1 Washington Street, bordering the Charles River (opposite River Street).
- Windsor Road, which parallels Academy Brook just south of Centennial Reservation."

Four of the above five areas (all except Washington Street [Route 16]) are not the same as the roads called out in the Storm Events database for 2012-2022. This indicates that floods along Lexington Road, Cedar Brook Road, River Street, and Windsor Road may not be reported as often as floods along

Figure 12. Roadway Flooding in Wellesley.

Washington Street. The HMPC provided some clarification during its October 2022 meeting, relative to typical flooding that has been occurring in recent years. The committee members explained that several areas in the Town experience floods due to overwhelmed drainage systems. Damage typically occurs in basements and garages of private properties.

According to the previous edition of this plan, dam failures and ice jams have not occurred in Wellesley. Most streams within Wellesley likely do not have the characteristics necessary for ice jams, although the Charles River does have characteristics that could cause ice jams along the Town boundaries.

In summary, the most frequent flooding in Wellesley appears to be occurring most often on streets, which leads to road closures and some damage to vehicles; and to the basements and garages of private properties in neighborhoods where drainage systems are often overwhelmed. When these areas of non-riverine flooding are considered along with risks posed along Morses Pond and the Charles River, it is clear that flood risks in Wellesley are a significant challenge.

Extent

The frequency and severity of flooding are measured using a discharge probability, which is the probability that a certain river discharge (flow) will be equaled or exceeded in a given year. Flood studies use historical records to determine the probability of occurrence for the different discharge levels. The flood frequency equals 100 divided by the discharge probability. For example, the “100-year discharge” has a 1 percent chance of being equaled or exceeded in any given year. The “annual flood” is the greatest flood event expected to occur in a typical year. These measurements reflect statistical averages only; it is possible for two or more floods with a 100-year or higher recurrence interval to occur in a short time period. The same flood can have different recurrence intervals at different points on a river.

The 1% annual chance flood is the standard used by most federal and state agencies. It is used by the National Flood Insurance Program (NFIP) to guide floodplain management and determine the need for flood insurance. The extent of flooding associated with a 1% annual probability of occurrence (the base flood or 100-year flood) is called the 100-year floodplain, which is used as the regulatory boundary by many agencies. Also referred to as the Special Flood Hazard Area (SFHA), this boundary is a convenient tool for assessing vulnerability and risk in flood-prone communities. The term “500-year flood” is the flood that has a 0.2% chance of being equaled or exceeded each year. Base flood elevations and the boundaries of the 1% annual chance (100-year) and the 0.2% annual chance (500-year) floodplains are shown on Flood Insurance Rate Maps (FIRMs), which are the principal tools for identifying the extent and location of the flood hazard.

Both the 100-year and the 500-year floodplains are determined based on past events. As a result, the flood maps do not reflect projected changes in precipitation events.

Flooding in Massachusetts is forecast and classified by the National Weather Service (NWS) Northeast River Forecast Center as minor, moderate, or severe based upon the types of impacts that occur. Minor flooding is considered “disruptive” flooding that causes impacts such as road closures and flooding of recreational areas and farmland. Moderate flooding can involve land with structures becoming inundated. Major flooding is a widespread, life-threatening event. River forecasts are made at many locations in the state containing USGS river gauges with established flood elevations and levels that correspond to each of the degrees of flooding.

Due to the pattern of meteorological conditions needed to cause serious flooding, it is unusual for a flood to occur without warning. Flash flooding, which occurs when excessive water fills either normally dry creeks or riverbeds or dramatically increases the water surface elevation on currently flowing creeks and river, can be less predictable. However, potential hazard areas can be warned in advanced of potential flash-flooding danger. Flooding is more likely to occur due to a rainstorm when the soil is already wet and/or streams are already running high from recent previous rains. NOAA’s Northeast River Forecast Center provides flood warnings for Massachusetts, relying on monitoring data from the USGS stream gauge network. Notice of potential flood conditions is generally available several days in advance. State agency staff also monitor river, weather, and forecast conditions throughout the year. Notification of potential flooding is shared among state agency staff, including the Massachusetts Emergency Management Agency (MEMA) and the Office of Dam Safety. The NWS provides briefings to state and local emergency managers and provides notifications to the public via traditional media and social networking platforms.

Dams are a special consideration within the Extent characterization for floods. Many dams in Massachusetts were built in the 19th Century without the benefit of modern engineering design and construction oversight. Dams can fail because of structural problems due to age and/or lack of proper maintenance. Dam failure can also be the result of structural damage caused by an earthquake or flooding brought on by severe storm events. The Massachusetts Department of Conservation and Recreation (DCR) is the agency responsible for regulating dams in the state (M.G.L. Chapter 253, Section 44, and the implementing regulations 302 CMR 10.00). The DCR was also responsible for conducting dam inspections until 2002, when state law was changed to place the responsibility and cost of inspections on the owners of the dams. In accordance with the new regulations, which went into effect in 2005, dam owners must register, inspect, and maintain dams in good operating condition. Owners of High Hazard Potential dams and certain Significant Hazard Potential dams are also required to prepare, maintain, and update Emergency Action Plans. The state has three hazard classifications for dams:

1. High Hazard Potential: Dams located where failure or improper operation will likely cause loss of life and serious damage to homes, industrial or commercial facilities, important public utilities, main highways, or railroads.
2. Significant Hazard Potential: Dams located where failure or improper operation may cause loss of life and damage to homes, industrial or commercial facilities, secondary highways or railroads or cause interruption of use or service of relatively important facilities.
3. Low Hazard Potential: Dams located where failure or improper operation may cause minimal property damage to others. Loss of life is not expected.

Owners of dams are required to hire a qualified engineer to inspect and report results using the following inspection schedule:

- High Hazard Potential dams – 2 years
- Significant Hazard Potential dams – 5 years
- Low Hazard Potential dams – 10 years

The time intervals represent the maximum time between inspections. More frequent inspections may be performed at the discretion of the state. Owners of High Hazard Potential dams and certain Significant Hazard Potential dams are also required to prepare, maintain, and update Emergency Action Plans (EAPs). Dams and reservoirs licensed and subject to inspection by the Federal Energy Regulatory Commission (FERC) are excluded from the provisions of the state regulations provided that all FERC-approved periodic inspection reports are provided to the DCR. FERC inspections of high and significant hazard projects are conducted on a yearly basis. All other dams are subject to the regulations unless exempted in writing by DCR.

Probability of Future Events

The frequency of hazard events of disaster declaration proportions is defined by the number of federally declared disaster events for the Commonwealth over a specified period of time. The historical record indicates the Commonwealth has experienced 22 coastal and inland flood-related disaster declaration events from 1954 to 2017. In the northeast, precipitation has increased by 17% from the baseline level recorded in the period from 1901 to 1960 to present-day levels measured from 2011 to 2012. Therefore, based on these figures, the Commonwealth may experience a flood event of disaster declaration proportions approximately once every three years.

However, the frequency of flooding varies significantly based on watershed, riverine reach, and location along each reach. Additionally, it is important to note that floods of lesser magnitude occur at a much higher frequency. The SHMCAP notes that in the ten-year period 2007 to 2017, the NOAA Storm Events Database reports that there were 433 flood events in Massachusetts, which is an average of more than 43 floods per year. The Town of Wellesley should assume that the probability of future flood events is high, especially given the number of flood occurrences in the Town during the last ten to 20 years. Climate change will increase the probability of flooding caused by intense precipitation. The National Climate Assessment and NCEI both project more fall, winter, and spring precipitation as well as more intense precipitation. The Massachusetts Climate Change Assessment notes that the region could experience a doubling of the frequency of the current 1% annual chance flood by 2050; and a four-fold increase in the intensity of precipitation associated with a 10% chance storm by 2090.

Despite the potentially favorable characteristics and profile of the Charles River for allowing ice jams, the lack of any previous occurrences supports a statement that the probability of ice jams is low.

According to information from the MA DCR Office of Dam Safety, four classified dams in Wellesley and posing a significant hazard while one is located just outside the Town's boundary posing a high hazard. The remainder are low or non-jurisdictional (the storage capacity of the impoundment and height of dam are such that they need not be regulated). Upstream of the Town's boundaries, numerous dams pose risks along the Charles River and its tributaries. Failure of these highly regulated dams is believed to have a very low probability. Overall, dam failure has a low probability of occurring. Dams are described further in the vulnerability assessment below.

Vulnerability Assessment

To support the vulnerability assessment, the Town's parcel and building footprint data was merged into a single GIS layer which included building occupancy, structure value, content value, and number of stories. This dataset was used in GIS to determine exposure to hazards by overlaying it with the hazard information and it was used for loss estimation by integrating it into FEMA's Hazus software. Additionally, the 2020 U.S. Census data was used to determine exposure to hazards.

Exposure

In Wellesley, the 1% annual chance floodplain (100-year floodplain) covers about 636 acres, or approximately 9 percent of the Town. In addition to the 100-year floodplain, there is stormwater with the potential to cause localized flooding.

There are some critical utility facilities located in the 100-year floodplain. In the 100-year floodplain, there are four water facilities: Viradox building, Wellesley Ave. Storage facility, T.F. Coughlin Pumping Station, and Rosemary Pumping Station; and four ejectors: Lake Road, Pickerel Road, William Street Ejector #2, and William Street #3. There are no additional critical facilities in the 500-year floodplain. There are 41 buildings in the 100-year floodplain and 158 buildings in the 500-year floodplain. For the 100-year floodplain, there are 12 buildings that are part of an environmental justice community. Table 12 shows the types of buildings exposed to the flood and their value. The number in parenthesis shows the total number of buildings and building values for the Town.

Additionally, the structures found in the National Register of Historic Places were overlaid with the floodplain and nine bridges located in the Fuller Brook Park could be exposed to the base flood event.

Table 12. Buildings in 100-Year Floodplain.

Building Type	Number of Buildings (Total in Town)	Building Value (Total in Town)
Single Family	21 (8,535)	$7,561,000 ($5,274,535,000)
Multi-Family	2 (318)	$614,000 ($467,875,000)
Commercial	9 (232)	$154,284,000 ($2,756,199,000)
Educational	2 (214)	$21,794,000 ($18,861,800,000)
Government	5 (106)	$19,325,000 ($111,511,000)
Religious/Non-Profit	1 (51)	$966,000 ($139,701,000)
Agriculture	0 (3)	$0 ($709,000)
Group Quarters	0(8)	$0 ($49,407,000)
Garage/Outbuilding	1(19)	$1,000 ($1,953,000)
Vacant	0 (37)	$0 ($61,363,000)
Total	**41 (9,523)**	**$204,545,000 ($$27,725,053,000)**

The population exposed to the 100-year floodplain is shown in Table 13. The column in the middle shows the population in and around the floodplain (wherever the Census Block overlapped with the floodplain boundary) while the column on the right shows the total population numbers for the Town. The population in and adjacent to the floodplain contains a larger percent of older and lower income populations than the Town population with nearly fifteen percent part of the EJ community.

Table 13. Population Exposed to 100-Year Floodplain (2020 U.S. Census).

Demographics	Population in and Adjacent to Floodplain	Total Population
Population	5,963	29,550
Households	2,103	9,282
White	4,499 (75.4%)	22,079 (74.7%)
Black	127 (2.1%)	622 (2.1%)
American Indian	3 (0.1%)	21 (0.1%)
Asian	881 (14.8%)	4,393 (14.9%)
Pacific Islander	2 (0.0%)	9 (0.0%)
Other Race	77 (1.3%)	531 (1.8%)
Two or More Races	374 (6.3%)	1,895 (6.4%)
Hispanic or Latino:	266 (4.5%)	1,523 (5.2%)
Population under 18:	1,400 (23.5%)	7,635 (25.8%)
Population over 64:	1,004 (16.8%)	4,394 (14.9%)
Annual Income < $30K/year	193 (9.2%)	602 (6.5%)
Population in EJ Zone*:	871 (14.6%)	3,638 (12.3%)

**Massachusetts Office of Energy and Environmental Affairs, 2022*

Although dams and their associated impoundments provide many benefits to a community, such as water supply, recreation, hydroelectric power generation, and flood control, they also pose a potential risk to lives and property. Dam failure is not a common occurrence, but dams do represent a potentially disastrous hazard. When a dam fails, the potential energy of the stored water behind the dam is instantly released, oftentimes with catastrophic consequences as the water rushes in a torrent downstream flooding an area known as an "inundation area." The number of casualties and the amount of property damage will depend upon the timing of the warning provided to downstream residents, the number of people living or working in the inundation area, and the number of structures in the inundation area.

There are no high hazard dams in Wellesley although there is the Charles River Dam that is one third of a mile to the southwest in the Town of Natick which may cause casualties and damage if breached. Table 14 identifies the dams within the Town.

Table 14. Dams in Vicinity.

Name	Ownership	Hazard Type
Cordingly Dam	Public (State)	Significant
Metropolitan Circular Dam	Public (State)	Significant
Morses Pond Dam	Public (Town)	Significant
Newton Lower Falls Dam (Finlay)	Public (State)	Significant
Longfellow Pond Dam	Public (Town)	Low
Paintshop Pond Dam	Private	Low
Wellesley Avenue Dam	Public (Town)	Low
Kelly Park Dam	Public (Town)	N/A
Lake Waban Dam	Private	N/A
Reeds Pond Dam	Public (Town)	N/A
Rockridge Pond Dam	Public (Town)	N/A
Sabrina Lake Dam	Private	N/A

The 100-year Floodplain (FEMA) with the Town's critical facilities is shown in Figure 13. There are four water facilities: Viradox building, Wellesley Ave. Storage facility, T.F. Coughlin Pumping Station, and Rosemary Pumping Station; and four ejectors: Lake Road, Pickerel Road, William Street Ejector #2, and

William Street #3 in the 100- and 500-year floodplain.

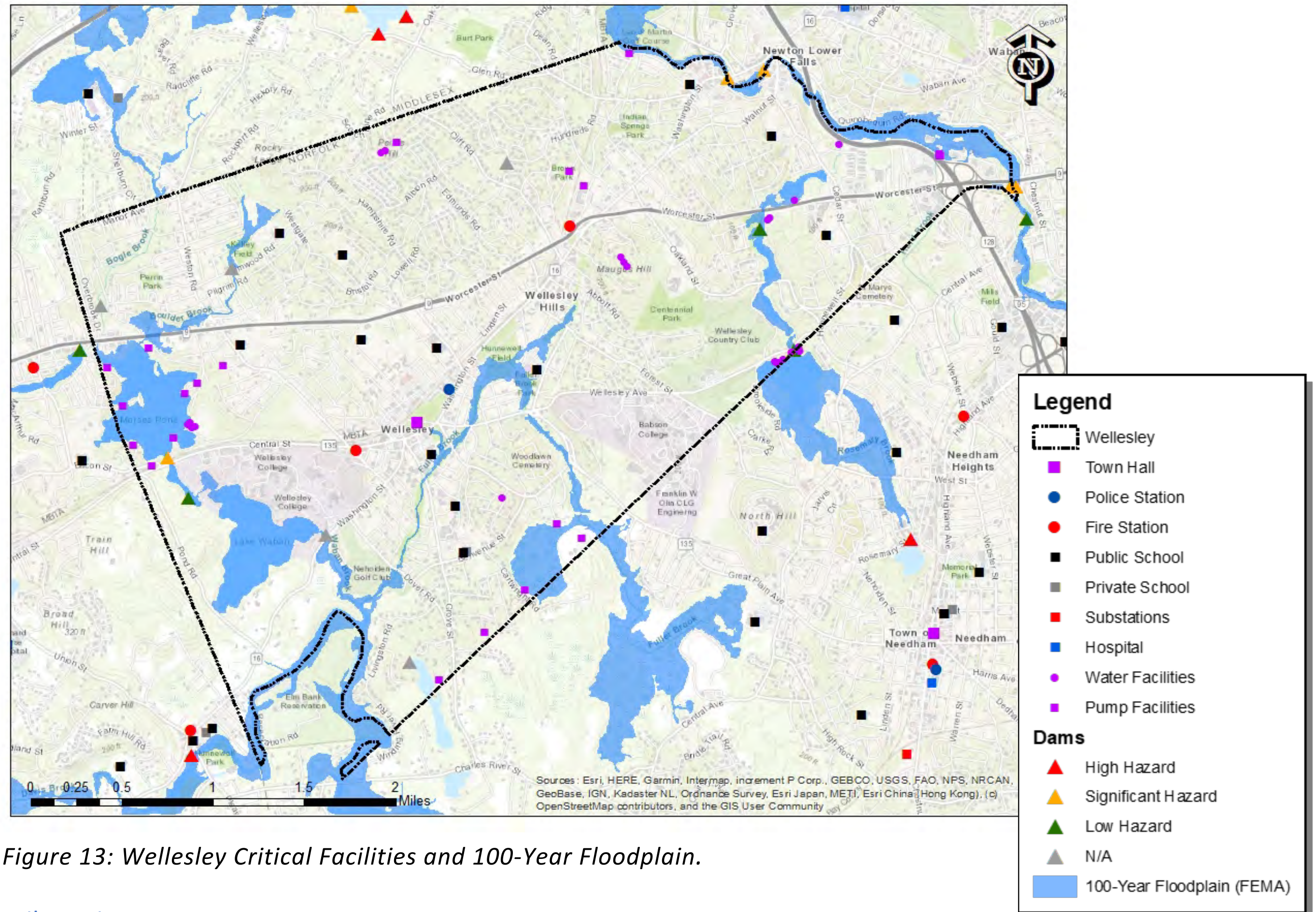


Figure 13: Wellesley Critical Facilities and 100-Year Floodplain.

Built Environment Impacts

To identify built environment impacts to the Town, FEMA's risk assessment software, Hazus, was implemented. Building footprint data and parcel data was used to update the model while the latest floodplain was also integrated into the software. The economic loss results of the 100-year event are shown in Table 15. The Town's Average Annual Loss (AAL) is calculated to be $2,274,600.

Climate change will increase the probability of additional flood impacts to the built environment. Future floodplains may be larger than the current FEMA modeled floodplain and new development should consider these projected conditions.

Table 15. Building Loss for the 100-Year Flood Scenario.

Loss Type	Residential ($Million)	Commercial ($Million)	Other Occupancy ($Million)	Total ($Million)
Building Loss	1.80	1.01	0.09	**2.90**
Content Loss	0.60	1.89	0.22	**2.71**
Business Inventory Loss	0.00	0.01	0.01	**0.02**
Business Income Loss	0.00	25.92	0.89	**26.81**
Business Relocation Loss	1.54	7.16	0.43	**9.13**
Rental Income Loss	0.48	5.22	0.02	**5.72**
Wage Loss	0.00	13.73	2.26	**15.99**
Total	**4.42**	**54.93**	**3.92**	**63.28**

Population Impacts

The Town should be aware that senior and low-income segments of Wellesley's population may be more vulnerable to hazard events due to a number of factors. Senior and low-income populations may be physically or financially unable to react and respond to a hazard event and require additional assistance. Access to information about the hazard event may be lacking, as well as access to transportation in the case of an evacuation. The location and construction quality of housing can also pose a significant risk. Table 13 shows the number of senior and low-income residents in Wellesley. The Town should be aware of the potential needs of residents within these population segments in the event of a hazard occurrence.

Using the Hazus software, the 100-year flood scenario results showed that there would be approximately 125 to 175 displaced households and 85 to 115 people seeking public shelter needs.

Climate change will increase the probability and magnitude of flood impacts to the population. Future floodplains may be larger than the current FEMA modeled floodplain and new development should consider these projected conditions. Vulnerable populations should be considered when development near the current floodplain is planned.

Environment Impacts

One of the major environmental impacts of a major flood would be the potential release of hazardous materials. There are three tier 2 facilities in the floodplain containing hazardous materials: 49 Walnut Park, 100 William Street, and 80 William Street. Hazardous materials are transported on Interstate 95 and Route 9 and pass over several floodplains.

Climate change will increase the probability and magnitude of flood impacts to the environment. Future floodplains may be larger than the current FEMA modeled floodplain and new development should consider these projected conditions including whether hazardous materials are stored there.

Problem Statements for Flood.

Problem statements summarize risk and vulnerability and are included following each hazard profile. The problem statements were developed to bridge the gap between identified hazard and development of the mitigation actions. Problem statements are included in each hazard profile section.

Table 16. Problem Statements Related to Flooding.

Assets	Problems Associated with Flood
People (including underserved communities and socially vulnerable populations)	• The high school is adjacent to the flood and may expose children to potential impacts. • If the electric grid goes down due to flooding the impact would reach throughout the Town and include coping with extreme temperatures, food spoiling, wildfires, etc.
Structures (including facilities, lifelines, and critical infrastructure)	• Consistent flood events have impacted Route 9, and increasing precipitation intensities will ensure that challenges continue to impact this critical roadway. The Town and State will need to work together to reduce flood impacts. • The Town has long recognized five specific areas of flood-related challenges. When possible, progress should be made reducing either the frequency of flooding or the impacts of flood events: 1. Lexington Road, which crosses Boulder Brook just upstream of the Worcester Street crossing near the Natick town line. 2. Cedar Brook Road, which crosses Boggle Brook at the outlet of Reed Pond near the Natick line. 3. River Street, which runs along the Charles River between Washington Street and Walnut Street. 4. #1 Washington Street, bordering the Charles River (opposite River Street). 5. Windsor Road, which parallels Academy Brook just south of Centennial Reservation.

Assets	Problems Associated with Flood
	• Other flooded roads based on recent NCEI data include Lexington Road, Cedar Brook Road, River Street, and Windsor Road. • Several critical facilities and pieces of infrastructure are in areas of flood risk: four water facilities (Viradox building, Wellesley Ave. Storage facility, T.F. Coughlin Pumping Station, and Rosemary Pumping Station) and four ejectors (Lake Road, Pickerel Road, William Street Ejector #2, and William Street #3). • The High School building is immediately adjacent to the 1% annual flood zone associated with Fuller Brook.
Systems (including networks and capabilities)	• Several utilities are located in the floodplain and system disruption is a possibility. • The Town is currently precluded from adopting higher regulatory standards to protect against flooding (must comply with State Building Code).
Natural, historic, and cultural resources	• There are several bridges listed on the National Register of Historic Places and located in Fuller Brook Park which may be exposed to the flood hazard. Simon Park also is exposed to the base flood.
Activities that have value to the community	• The Boston Marathon route goes through Wellesley on Central Street and Washington Street. Both streets may be subject to flooding.

Droughts

Droughts are typically defined as periods of deficient precipitation. How this deficiency is experienced can depend on factors such as land use change, the existence of dams, and water supply withdrawals or diversions. Droughts can vary widely in duration, severity, and local impact.

> The Town of Wellesley Community Resilience Building Workshop Summary of Findings (2020) lists “Drought” as one of the top four hazards of concern.

Description

The National Drought Mitigation Center references five common, conceptual definitions of drought:

1. Meteorological drought is a measure of departure of precipitation from normal.
2. Hydrological drought is related to the effects of precipitation shortfalls on stream flows and on reservoir and groundwater levels.
3. Agricultural drought links various characteristics of meteorological and hydrological drought to agricultural impacts and occurs when there is not enough water available for a particular crop to grow at a particular time.
4. Socioeconomic drought is associated with the supply and demand of economic goods with elements of meteorological, hydrological, and agricultural drought.
5. Ecological drought is an episodic deficit in water availability that drives ecosystems beyond thresholds of vulnerability and impacts ecosystem services.

Drought conditions can cause a shortage of water for human consumption and reduce local firefighting capabilities. Public water suppliers may struggle to meet system demands while maintaining adequate pressure for fire suppression and meeting water quality standards. The Massachusetts DEP requires all PWSs to maintain an emergency preparedness plan.

Private well owners can be vulnerable to droughts. With declining groundwater levels, well owners may experience dry wells or sediment in their water due to the more intense pumping required to pull water from the bedrock or overburden aquifer. Wells may also develop a concentration of pollutants, which may include nitrates and heavy metals depending on local geology.

The loss of clean water for consumption and for sanitation may be a significant impact depending on the affected population's ability to quickly drill a deeper or a new well or to relocate to unaffected areas. During a drought, dry soil and the increased prevalence of wildfires can increase the amount of irritants (such as pollen or smoke) in the air. Reduced air quality can have widespread deleterious health impacts but is particularly significant to the health of individuals with pre-existing respiratory health conditions like asthma (CDC).

Lowered water levels can result in direct environmental health impacts, as the concentration of contaminants in swimmable bodies of water will increase when less water is present. Harmful algal blooms may occur, closing recreational areas.

One primary hazard in this plan that is commonly associated with drought is wildfire. A prolonged lack of precipitation dries out soil and vegetation, which becomes increasingly susceptible to ignition as the duration of the drought extends. A drought may increase the probability of a wildfire occurring.

Location

Parts of Massachusetts can experience significantly different weather patterns due to topography, distance from coastal influence, as well as a combination of regional, national, and global weather patterns. As a result, the Massachusetts Drought Management Plan (DMP) assesses drought conditions in six regions: Western, Connecticut River Valley, Central, Northeast, Southeast, and Cape and Islands. A regional approach allows customization of drought actions and conservation measures to address situations in each region; and allows for the determination of a drought on a watershed basis. Droughts have the potential to impact the entirety of Wellesley.

Previous Occurrences

The Commonwealth of Massachusetts has never received a Presidential Disaster Declaration for a drought-related disaster. However, several substantial droughts have occurred over the past 100 years. Massachusetts experienced its most significant drought on record in the 1960s. The severity and duration of the drought caused significant impacts on both water supplies and agriculture.

Although short or relatively minor droughts occurred over the 50 years following the drought of the 1960s, the next long-term event began in March 2015 when Massachusetts began experiencing widespread abnormally dry conditions. In July 2016, based on a recommendation from the Drought Management Task Force (DMTF), the Secretary of the Executive Office of Energy and Environmental Affairs (EOEEA) declared a Drought Watch for Central and Northeast Massachusetts and a Drought Advisory for Southeast Massachusetts and the Connecticut River Valley. Drought warnings were issued in five out of six drought regions of the state. Many experts stated that this drought was the worst in more than 50 years. DMTF declared an end to the drought in May 2017 with a return to wetter-than-normal conditions.

The drought of 2015-2017 was likely a significant disruption to health of resources in the Town. During the execution of the Town’s MVP-funded planning, CRB Core Team members indicated that Wellesley's lakes and wetlands were highly impacted by the drought of 2015-2017. Similarly, the Climate Action Plan (2022) notes that *“during the 2016 drought in Massachusetts, Wellesley’s water bodies and wetlands were highly impacted.”*

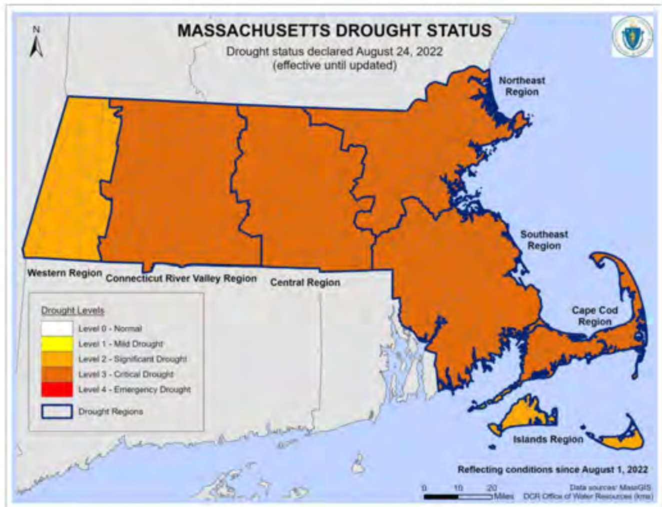
USDA declares agricultural disasters as needed for a variety of hazards. Information can be found at https://www.fsa.usda.gov/programs-and-services/disaster-assistance-program/disaster-designation-information/index. The single line item related to droughts in Norfolk County is listed below, corresponding to 2016.

Table 17. USDA Disasters Events That Refer to Drought.

Year	Event	Event “Begin Dates”
2016	Drought, high winds, wildfire, excessive heat, insects	8/24/2016, 9/21/2016

The drought of 2020, a so-called “flashy drought” that impacted southern New England, was evidently not impactful in Norfolk County. Flashy droughts are described below.

The drought of 2022 was ongoing when this plan development commenced, but its severity was alleviated by rainfall in September 2022. At the present time, the drought of 2022 appears to be typical of a flashy drought. Conditions in winter 2022-2023 will determine if drought impacts linger into 2023.



Applying the same ten-year lookback as the severe storms database review, USDA payments to Massachusetts agricultural sectors for drought impacts associated with events from 2012 through 2021 were reviewed. This timeframe includes the droughts of 2015-2017 and 2020. USDA payments in Wellesley were not related to droughts, although some payments were made for COVID-related interruptions.

The severity of a drought depends on the degree of moisture deficiency, duration, spatial extent, and location relative to resources or assets. The drought of the 1960s is the drought of record because duration, spatial extent, moisture deficiency, and impact all contributed to historic levels. In contrast, the severity of the 2016-2017 drought was due to impacts on natural resources (record low stream flows and groundwater levels), many water supplies, farms, and agriculture and to the swift onset of the drought.

Extent

Drought is defined by a combined look at several indices as detailed in the Massachusetts DMP (EOEEA and MEMA, 2013). The indices are:

- Standard Precipitation Index for 3-, 6-, and 12-month time periods
- Precipitation as a percent of normal (or historic average) for 2-, 3-, 6-, and 12-month time periods
- Crop Moisture Index
- Keetch-Byram Drought Index
- Groundwater levels
- Stream flow

- Reservoir levels

These indices are analyzed monthly to generate a hydrological conditions report and used to determine the onset, severity, and end of droughts. Five levels of increasing drought severity are defined in the DMP: *Normal, Advisory, Watch, Warning,* and *Emergency*. The drought levels are associated with actions outlined in the DMP. Recommendations of drought levels are made by the DMTF to the Secretary of the EOEEA, who then declares the drought level for each region of the state.

Other entities may measure drought conditions by these or other criteria more relevant to their operations. For example, water utilities may calculate the days of supply remaining. Farmers may assess soil moisture and calculate the water deficit for specific plants to determine irrigation needs or decide to change their crop based on the deficit or harvest early for non-irrigated crops.

The five drought levels in the 2013 DMP provide a basic framework for taking actions to assess, communicate, and respond to drought conditions. Under the "Normal" condition, data are routinely collected, assessed, and distributed. When drought conditions are identified, the four drought levels escalate moving to heightened action, which may include increased data collection and assessment, interagency communication, public education and messaging, recommendations for water conservation measures, and a state of emergency issued by the Governor. At the "Emergency" level, mandatory water conservation measures may be enacted. These regionally declared drought levels and associated state actions are intended to communicate and provide guidance to the public and stakeholders across industries to enable them to respond early and effectively and to reduce impacts. Individual public water suppliers may have their own drought management plan, drought levels, and associated actions, which they may follow at all levels except at the Emergency level when mandatory actions may be required.

Droughts develop over long periods of time relative to other hazards. However, flashy droughts are changing these norms (AMS, 2017). Flashy droughts may develop quickly or quickly intensify a developing or existing drought. The 2016-2017 drought is an example. Dry conditions from late 2015 lingered through the winter, with scattered groundwater levels reporting below normal and less than normal snowpack heading into spring 2016. Impacts were first seen in March 2016 in stream flows, groundwater levels, and reservoirs showing the long-term deficit. Then, as precipitation dramatically dropped below normal from June through September 2016, the entire state experienced record low stream flows and groundwater levels.

NOAA and others are advancing the science of early warning for droughts like the early warnings for floods and earthquakes to better project flashy droughts. Based on projected climate change, the distributions of precipitation events will continue to become more extreme, with periods of minimal rain alternating with extreme rain events. Therefore, developing ways to project and adapt to flash droughts may be critical for sectors such as agriculture and water supply.

The Massachusetts Water Resources Commission publishes the hydrologic condition report monthly, which includes the seven drought indices and the National Climate Prediction Center's U.S. Monthly and Seasonal Drought Outlooks. The National Drought Mitigation Center produces a weekly Drought Monitor map. In accordance with the DMP, drought declarations are made monthly.

Probability of Future Events

Using data collected since 1850, the probability of the precipitation index of the DMP exceeding the threshold at each drought level was calculated. On a monthly basis over the 162-year period of record from 1850 to 2012, there is a 2% chance of being in a drought warning level.

Table 18. Frequency of Drought Events Exceeding the Precipitation Index of the DMP.

Level	Frequency Since 1850	Probability in Any Given Month
Emergency	5 occurrences	1% chance
Warning	5 occurrences	2% chance
Watch	46 occurrences	8% chance
Source: EOEEA and MEMA		

The likely range of consecutive dry days per year is projected to increase by up to nearly 20 days per year in 2090, compared to the annual statewide baseline of approximately 16 days per year from 1971 to 2001. Table 4-16 indicates the projected number of consecutive dry days according to the "high" and "low" limits of the Northeast Climate Adaptation Science Center (NE CASC) data.

Table 19. Projected Continuous Dry Days by Planning Year.

Planning Year	2030	2050	2070	2100
Projected Range of Consecutive Dry Days	16.44-17.94	16.34-18.64	15.94-18.94	16.34-19.64
Source: resilient MA, 2018				

These projections suggest that the average time between rain events is likely to remain fairly constant; however, individual drought events could still increase in frequency and severity. The incidence of droughts in 2015-2016, 2020, and 2022 certainly underscores that the probably of future droughts is high.

Vulnerability Assessment

Exposure

Drought is a gradual phenomenon, and its condition occurs naturally in a broad geographic area. The entire Town would be exposed to drought conditions.

Built Environment Impacts

Major water users are more susceptible to drought, and these include water utilities, farmers using irrigated agriculture, mining operations, and some commercial users.

With an increased probability of drought and drought magnitude, water utilities should consider reviewing or developing extreme drought scenarios.

Population Impacts

Populations considered most vulnerable to drought impacts are identified based on a number of factors including their physical and financial ability to react or respond during a hazard. Homeowners with a shallow well could also be more vulnerable to a drought. Table 13 summarizes the senior and low-income populations in Wellesley. It should be noted that there may be overlap within the two categories, so that the total number of persons exposed may be lower than what is shown in the table. However, the Town should be aware of the potential needs of residents within these population segments in the event of a hazard occurrence.

Socioeconomic impacts of the drought may also include anxiety and depression about economic impact, health problems associated with poor water quality, fewer recreational activities, higher incidents of heat stroke, and even loss of human life.

With an increased probability of drought and increased drought magnitude, and the potential of increased water costs, vulnerable populations may be more severely impacted in the future.

Environment Impacts

Although agriculture is limited in the Town, there are some natural areas and an arboretum which may be adversely impacted by drought. Drought amplifies the risk of loss of biodiversity and affects animal and plant species. Economic impacts include higher food and lumber prices. Drought can shrink the food supplies of animals and plants dependent on water and damage their habitats. Sometimes the environmental damage caused by a drought is temporary, and other times it is irreversible.

Problem Statements for Drought

Table 20. Problem Statements for Drought.

Assets	Problems Associated with Drought
People (including underserved communities and socially vulnerable populations)	• Vulnerable communities may have difficulty accessing potable water during an emergency drought event. If wells begin drying up and rationing is required, having a plan to get vulnerable people water should be considered. If rates are increased to lower water

Assets	Problems Associated with Drought
	demand, this may also adversely impact underserved and vulnerable communities.
Structures (including facilities, lifelines, and critical infrastructure)	• Water supply infrastructure may need to be shut down and water quality may become substandard. Businesses requiring water for daily operations may have their operations limited due to water restrictions.
Systems (including networks and capabilities)	• Outdoor water use restrictions and other water conservation measures during periods of extreme drought can be challenging to enforce, even when mandated through local declaration.
Natural, historic, and cultural resources	• Lakes and wetlands in Wellesley were adversely impacted by the drought of 2015-2017. Younger trees and dwarf tree varieties may be adversely impacted since they have a smaller root system.
Activities that have value to the community	• Farmer's market may need to be shut down if nearby agricultural areas are not irrigated.

Landslides

The term "landslide" includes a wide range of ground movements such as rock falls, deep failure of slopes, and shallow debris flows. The most common types of landslides in Massachusetts include translational debris slides, rotational slides, and debris flows. Most of these events are caused by a combination of unfavorable geologic conditions (silty clay or clay layers contained in glaciomarine, glaciolacustrine, or thick till deposits), steep slopes, and/or excessive wetness leading to excess pore pressures in the subsurface.

Description

Historical landslide data for the Commonwealth suggests that most landslides are preceded by higher-than-normal precipitation, followed by a single, high-intensity rainfall of several inches or more (Mabee and Duncan, 2013). This precipitation can cause slopes to become saturated. Landslides associated with slope saturation occur predominantly in areas with steep slopes underlain by glacial till or bedrock. Bedrock is relatively impermeable relative to the unconsolidated material that overlies it. Similarly, glacial till is less permeable than the soil that forms above it. Thus, there is a permeability contrast between the overlying soil and the underlying, and less permeable, unweathered till and/or bedrock. Water accumulates on this less permeable layer, increasing the pore pressure at the interface, leading to a failure or slide.

Occasionally, landslides occur as a result of geologic conditions and/or slope saturation. Adverse geologic conditions exist wherever there are lacustrine or marine clays, as clays have relatively low strength. These clays often formed in the deepest parts of the glacial lakes that existed in Massachusetts following the last glaciation. These lakes include Bascom, Hitchcock, Nashua, Sudbury, Concord, and Merrimack, among many other unnamed glacial lakes. When oversteepened or exposed in excavations, these vulnerable areas often produce classic rotational landslides.

Landslides can also be caused by external forces, including both undercutting (due to flooding or wave action) and construction. Undercutting of slopes during flooding or coastal storm events is a major cause of property damage. Streams and waves erode the base of the slopes, causing them to oversteepen and eventually collapse.

Location

In 2013, the Massachusetts Geological Survey and University of Massachusetts Amherst published a Slope Stability Map of Massachusetts. This project, funded by the FEMA Hazard Mitigation Grant Program, was designed to provide statewide mapping and identification of landslide hazards that can be used for community level planning as well as prioritizing high-risk areas for mitigation. The maps produced from this project should be viewed as a first-order approximation of potential landslide hazards across the state.

The Slope Stability Map categorizes areas of Massachusetts into stability zones, and the categorization is correlated to the probability of instability in each zone. The probability of instability metric indicates how likely each area is to be unstable, based on the parameters used in the analysis. According to the map, these unstable areas are located throughout the Commonwealth. Landslide risk is therefore assumed present in Wellesley.

Previous Occurrences

Nationwide, landslides constitute a major geologic hazard because they are widespread, occur in all 50 states, and cause approximately $1 billion to $2 billion in damages and more than 25 fatalities on average each year. In Massachusetts, landslides tend to be more isolated in size and pose threats to highways and structures that support fisheries, tourism, and general transportation.

Landslides commonly occur shortly after other major natural disasters, such as earthquakes and floods, which can exacerbate relief and reconstruction efforts. Many landslide events may have occurred in remote areas, causing their existence or impact to go unnoticed. Expanded development and other land uses may contribute to the increased number of landslide incidences and/or the increased number of reported events in the recent record. Notwithstanding these risks, very few landslides have been reported in Wellesley. The previous edition of this plan notes that “no known landslides have been reported by Town officials.”

Extent

Variables that contribute to the extent of potential landslide activity in any area include soil properties, topographic position and slope, and historical incidence. Predicting a landslide is difficult, even under ideal conditions. As a result, estimations of the potential severity of landslides are informed by previous occurrences as well as an examination of landslide susceptibility. Information about previous landslides, such as the information and images from landslides after Tropical Storm Irene can provide insight as to both where landslides may occur and what types of damage may result. It is important to note, however, that landslide susceptibility identifies only areas potentially affected and does not imply a time frame when a landslide might occur. The distribution of susceptibility across the Commonwealth is depicted on the Slope Stability Map, with areas of higher slope instability considered to also be more susceptible to the landslide hazard.

Characterizing the warning time before landslides can be challenging. Mass movements can occur suddenly or slowly. The velocity of movement may range from a slow creep of inches per year to many feet per second, depending on slope angle, material, and water content. Some methods used to monitor mass movements can provide an idea of the type of movement and the amount of time prior to failure. It is also possible to determine the areas that are at risk during general time periods. Assessing the geology, vegetation, and amount of predicted precipitation for an area can help in these predictions. However, there is no practical warning system for individual landslides. The current standard operating procedure is to monitor situations on a case-by-case basis and respond after the event has occurred. Generally accepted warning signs for landslide activity include the following:

- Springs, seeps, or saturated ground in areas that have not typically been wet before
- New cracks or unusual bulges in the ground, street pavements, or sidewalks
- Soil moving away from foundations
- Ancillary structures, such as decks and patios, tilting and/or moving relative to the main house
- Tilting or cracking of concrete floors and foundations
- Broken waterlines and other underground utilities
- Leaning telephone poles, trees, retaining walls, or fences
- Offset fence lines
- Sunken or down-dropped road beds
- Rapid increase in creek water levels, possibly accompanied by increased turbidity (soil content)
- Sudden decrease in creek water levels even though rain is still falling or has just recently stopped
- Sticking doors and windows, and visible open spaces indicating jambs and frames out of plumb

- A faint rumbling sound that increases in volume as the landslide nears
- Unusual sounds, such as trees cracking or boulders knocking together

Probability of Future Events

The probability of future occurrences is defined by the number of events over a specified period of time. The SHMCAP notes that from 1996 to 2012, eight noteworthy events triggered one or more slides in the Commonwealth. However, because many landslides are minor and occur unobserved in remote areas, the true number of landslide events is probably higher. The SHMCAP estimated that about 30 or more landslide events occurred in the period between 1986 and 2006. This roughly equates to one to three landslide events each year in Massachusetts. Given this information, the probability of a landslide in Wellesley is considered low. Nevertheless, climate change will increase the occurrence of intense precipitation and flooding while also increasing the likelihood of flashy droughts; this variability may contribute to unstable conditions where landslides are possible.

Vulnerability Assessment

Exposure

While landslides are rare, their impacts can be devastating, including loss of property, disruption to infrastructure, and injury and death. Continued development, particularly on steep slopes or unstable soils, increases the chances that landslides will be a danger. Other associated concerns are debris management issues including debris removal and identification of disposal sites.

To help identify potential landslide areas for the Town, the slope stability index developed by the Massachusetts Geological Survey was used. The unstable and moderately unstable regions were queried out of the data and overlaid with the critical facilities and other buildings. There were no critical facilities found in the unstable or moderately unstable area.

The other building data was overlaid with the unstable and moderately unstable areas. Table 21 shows the result of this analysis. Twenty-five buildings were found in the unstable area and twenty-one buildings were found in the moderately unstable area including single-family and multi-family homes and government buildings.

Table 21. Buildings in Unstable and Moderately Unstable Area.

Building Type	Number of Buildings (Total in Town)	Building Value (Total in Town)
Single Family	41 (8,535)	$ 19,873,000 ($5,274,535,000)
Multi-Family	1 (318)	$83,000 ($467,875,000)
Government	4 (106)	$4,418,000 ($111,511,000)

None of the buildings in the unstable and moderately unstable areas also have environmental justice concerns.

Figure 14 shows the landslide susceptibility map for the Town. The red and pink areas are more susceptible to landslides.

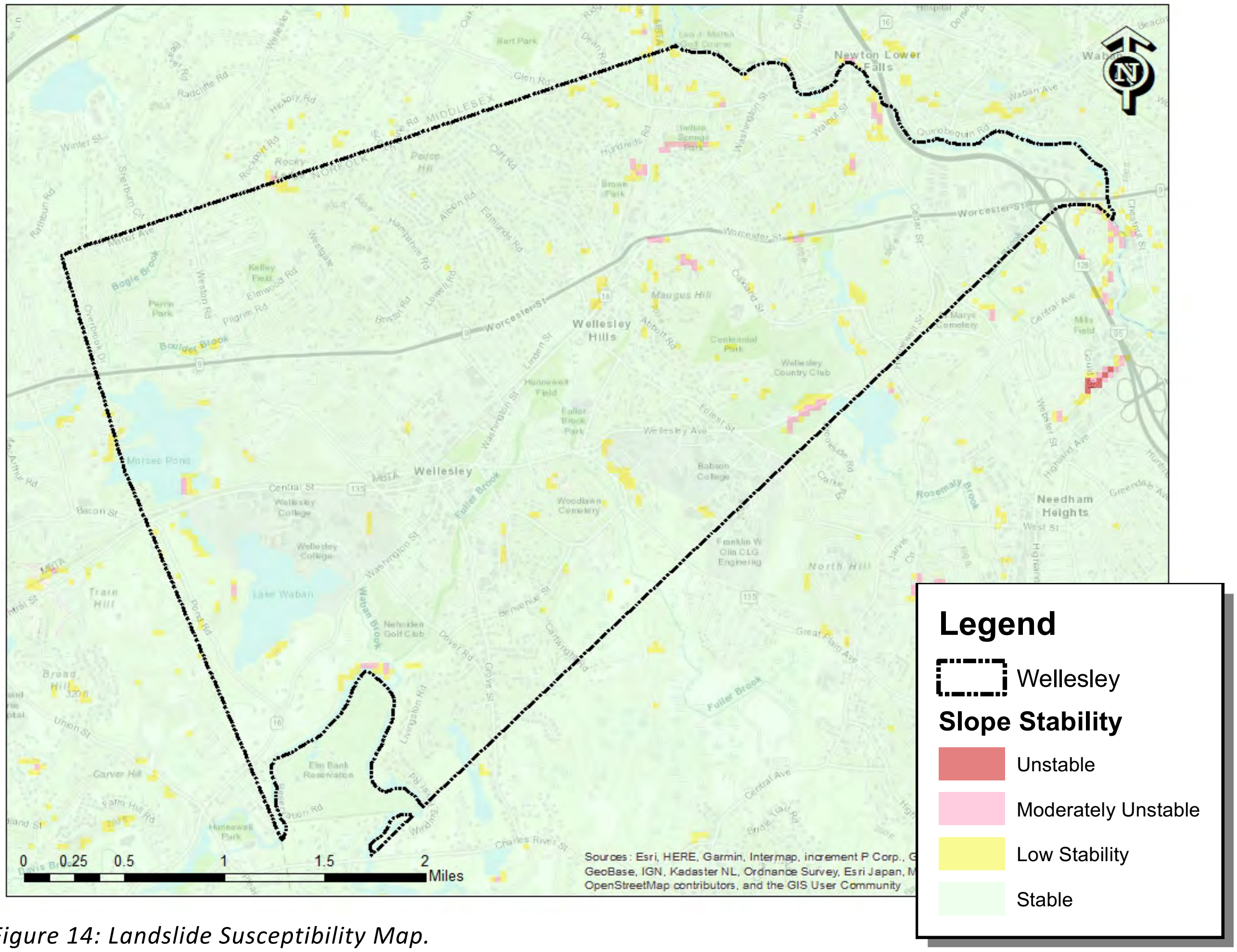


Figure 14: Landslide Susceptibility Map.

Built Environment Impacts

Historic data for landslide events indicate that between 1993 and 2022, no landslide events were recorded in Wellesley. Still, there is a likelihood even if it's slight. A total loss for a building due to a 100-year landslide event will be assumed. The average value of a building in the moderately susceptible zone is $433,826. This would result in an AAL of $4,338.

With an increased probability of extreme rainfall events, landslides may also become more likely to occur and adjacent structures and infrastructure more likely to be impacted.

Population Impacts

Populations considered most vulnerable to landslide impacts are identified based on a number of factors including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. Table 13 summarizes the senior and low-income populations in Wellesley. The Town should be aware of the potential needs of residents within these population segments in the event of a hazard occurrence.

With an increased probability of extreme rainfall events, landslides may also become more likely to occur and people in the adjacent structures and roadways more likely to be impacted.

Environment Impacts

There are unstable and moderately unstable areas around some transportation routes. These routes may be used to transport hazardous materials through the Town.

With an increased probability of extreme rainfall events, landslides may also become more likely to occur and adjacent roadways more like to be impacted. Those roadways may have hazardous materials transported on them.

Problem Statements for Landslides

Table 22. Problem Statements for Landslides.

Assets	**Problems Associated with Landslides**
People (including underserved communities and socially vulnerable populations)	• None apparent or projected
Structures (including facilities, lifelines, and critical infrastructure)	• None apparent or projected
Systems (including networks and capabilities)	• None apparent or projected
Natural, historic, and cultural resources	• None apparent or projected

Activities that have value to the community	• None apparent or projected

Primary Climate Change Interaction: Changing Temperatures

Extreme Temperatures

According to the SHMCAP, extreme heat for Massachusetts is usually defined as a period of three or more consecutive days above 90 degrees Fahrenheit (°F), but more generally as a prolonged period of excessively hot weather which may be accompanied by high humidity. Extreme cold is also considered relative to the normal climatic lows in a region. Extreme cold temperatures are characterized by the ambient air temperature dropping to approximately 0°F or below.

The Town of Wellesley Community Resilience Building Workshop Summary of Findings (2020) lists "Heat waves" as one of the top four hazards of concern.

Description

Extreme cold is a dangerous situation that can result in health emergencies for susceptible or vulnerable people, such as those without shelter or who are stranded or who live in homes that are poorly insulated or without heat. Extreme cold events are events when temperatures drop well below normal in an area. When winter temperatures drop significantly below normal, staying warm and safe can become a challenge. Extremely cold temperatures often accompany a winter storm, which may also cause power failures and icy roads. During cold months, carbon monoxide may be high in some areas because the colder weather makes it difficult for car emission control systems to operate effectively, and temperature inversions can trap the resulting pollutants closer to the ground. Extreme cold temperatures may stress the electric grid by making power lines stiff, changing normal grid operation, and increasing the potential for overloads and other problems. Extreme cold may lead to spikes in energy demand (especially as more people use electricity for heating) and may impact the functioning of power plants.

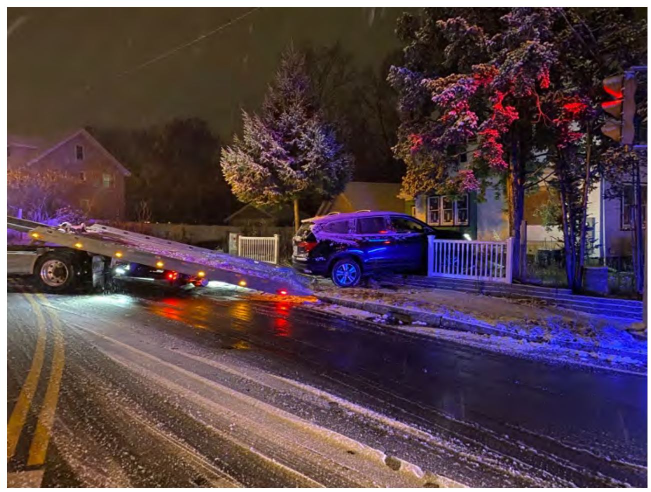


Figure 15. Accident from Icy Roads in Wellesley.

Likewise, extreme heat is a dangerous situation that can result in health emergencies for susceptible and vulnerable people, such as those without shelter or who are stranded or who live in homes that are poorly insulated or without adequate cooling. Extreme temperatures may also stress or cause failure to the electric grid which may result in emergencies such as those named above.

A heat wave is defined as three or more days of temperatures of 90°F or above. A basic definition of a heat wave implies that it is an extended period of unusually high atmosphere-related heat stress, which causes temporary modifications in lifestyle, and which may have adverse health consequences for the affected population. Heat waves cause more fatalities in the U.S. than the total of all other meteorological events combined. According to the SHMCAP, more than 9,000 Americans have died from heat-related ailments (EPA, 2016) since the 1970s.

Heat impacts can be particularly significant in urban areas. Buildings, roads, and other infrastructure replace open land and vegetation. Dark-colored asphalt and roofs also absorb more of the sun's energy. These changes cause urban areas to become warmer than the surrounding areas. This forms "islands" of higher temperatures, often referred to as "heat islands." Heat islands can affect communities by increasing peak energy demand during the summer, air conditioning costs, air pollution and Green House Gas emissions, heat-related illness and death, and water quality degradation (EPA).

Many conditions associated with heat waves or more severe events (including high temperatures, low precipitation, strong sunlight, and low wind speeds) contribute to a worsening of air quality in several ways. High temperatures can increase the production of ozone from volatile organic compounds and other aerosols. Weather patterns that bring high temperatures can also transport particulate matter air pollutants from other areas of the continent. Additionally, atmospheric inversions and low wind speeds allow polluted air to remain in one location for a prolonged period of time (UCI, 2017).

Location

According to NOAA, Massachusetts is made up of three climate divisions: Western, Central, and Coastal. Average annual temperatures vary slightly over the divisions, with annual average temperatures of around 46°F in the Western division, 49°F in the Central division, and 50°F in the Coastal division. Wellesley is located in the Central division. Because extreme temperature events occur more frequently and vary more in the inland regions where temperatures are not moderated by the ocean, Wellesley is believed at risk.

Previous Occurrences

<u>Extreme Cold</u>: The SHMCAP notes that since 1994, there have been 33 cold weather events within the Commonwealth, ranging from Cold/Wind Chill to Extreme Cold/Wind Chill events.

<u>Extreme Heat</u>: The SHMCAP notes that according to the NOAA's Storm Events Database (accessed in March 2018 for that planning process) there have been 43 warm weather events (ranging from Record Warmth/Heat to Excessive Heat events) since 1995. The most current event in the database occurred in July 2013. Excessive heat results from a combination of temperatures well above normal and high humidity. Whenever the heat index values meet or exceed locally or regionally established heat or excessive heat warning thresholds, an event is reported in the database.

In 2012, Massachusetts temperatures broke 27 heat records. Most of these records were broken between June 20 and June 22, 2012, during the first major heat wave of the summer to hit Massachusetts and the East Coast. In July 2013, a long period of hot and humid weather occurred throughout New England. One fatality occurred on July 6, when a postal worker collapsed as the Heat Index reached 100°F.

Notwithstanding the occurrences of heat waves in the Wellesley area, the NOAA Storm Events database (https://www.ncdc.noaa.gov/stormevents/) for Norfolk County does not list any extreme heat events for Wellesley in the timeframe 2012-2022. Although data was not available for July and August 2022 when this plan was being developed, evidence demonstrates that several extreme heat events occurred in Wellesley in July and August 2022. The Town noted that its three cooling centers were opened a few times in July and August 2022.

Cold events are typically reported with winter storms and will be described in the winter storm section of this chapter.

USDA declares agricultural disasters as needed for a variety of hazards. Information can be found at https://www.fsa.usda.gov/programs-and-services/disaster-assistance-program/disaster-designation-information/index. The events related to extreme temperatures in Norfolk County are listed below.

Table 23. USDA Disasters Events That Refer to Extreme Temperatures.

Year	Event	Event "Begin Dates"
2016	Drought, high winds, wildfire, excessive heat, insects	8/24/2016, 9/21/2016
2016	Frost/Freeze	5/4/2016 (event date)
2016	Heat, Excessive Heat, Frost, Freeze	4/30/2016 (event date)

Extent

Extreme Cold: The extent (severity or magnitude) of extreme cold temperatures is generally measured through the Wind Chill Temperature Index. 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 the 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). The NWS issues a Wind Chill Warning if the Wind Chill Index is forecast to fall to –25°F or colder for at least 3 hours. On November 1, 2001, the NWS implemented a Wind Chill Temperature Index designed to more accurately calculate how cold air feels on human skin. Figure 4-42 shows the Wind Chill Temperature Index.

Extreme Heat: The NWS issues a Heat Advisory when the NWS Heat Index is forecast to reach 100 to 104°F for 2 or more hours. The NWS issues an Excessive Heat Warning if the Heat Index is forecast to reach 105°F or higher for 2 or more hours. The NWS Heat Index is based both on temperature and relative humidity, and describes a temperature equivalent to what a person would feel at a baseline humidity level. It is scaled to the ability of a person to lose heat to their environment. The relationship between these variables and the levels at which the NWS considers various health hazards to become relevant are shown in Figure 4-43. It is important to know that the heat index values are devised for shady, light wind conditions. Exposure to full sunshine can increase heat index values by up to 15°F. Also, strong winds, particularly with very hot, dry air, can increase the risk of heat-related impacts.

Probability of Future Events

The SHMCAP notes that Massachusetts averaged 2.4 declared cold weather events and 0.8 extreme cold weather events annually between January 2013 and October 2017. The year 2015 was a particularly notable one, with seven cold weather events, including three extreme cold/wind chill events, as compared to no cold weather events in 2012 and one in 2013. The SHMCAP notes that an average of between four and five heat waves occur annually in Massachusetts.

There are a number of climatic phenomena that determine the number of extreme weather events in a specific year. However, there are significant long-term trends in the frequency of extreme hot and cold events. In the last decade, U.S. daily record high temperatures have occurred twice as often as record lows (as compared to a nearly 1:1 ratio in the 1950s). Models suggest that this ratio could climb to 20:1 by midcentury, if GHG emissions are not significantly reduced (C2ES, n.d.).

The NE CASC data support the trends of an increased frequency of extreme hot weather events and a decreased frequency of extreme cold weather events. High, low, and average temperatures in Massachusetts are all likely to increase significantly over the next century as a result of climate change. The graphics below (from resilient MA, 2018) show the projected annual days with maximum temperature above 90 degrees and projected annual days with minimum temperature below 32 degrees.

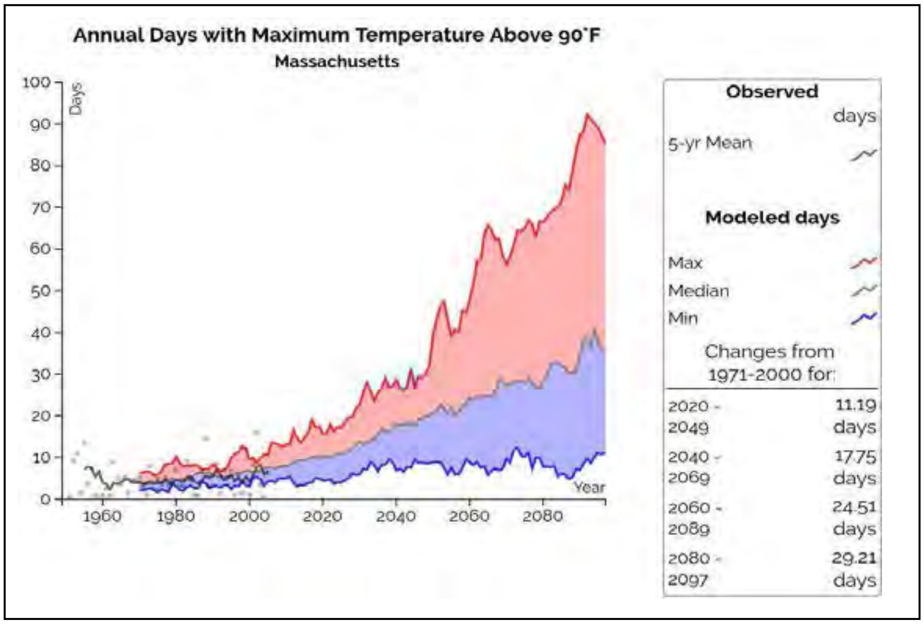


Figure 16. Annual Days with Maximum Temperature Above 90 F.

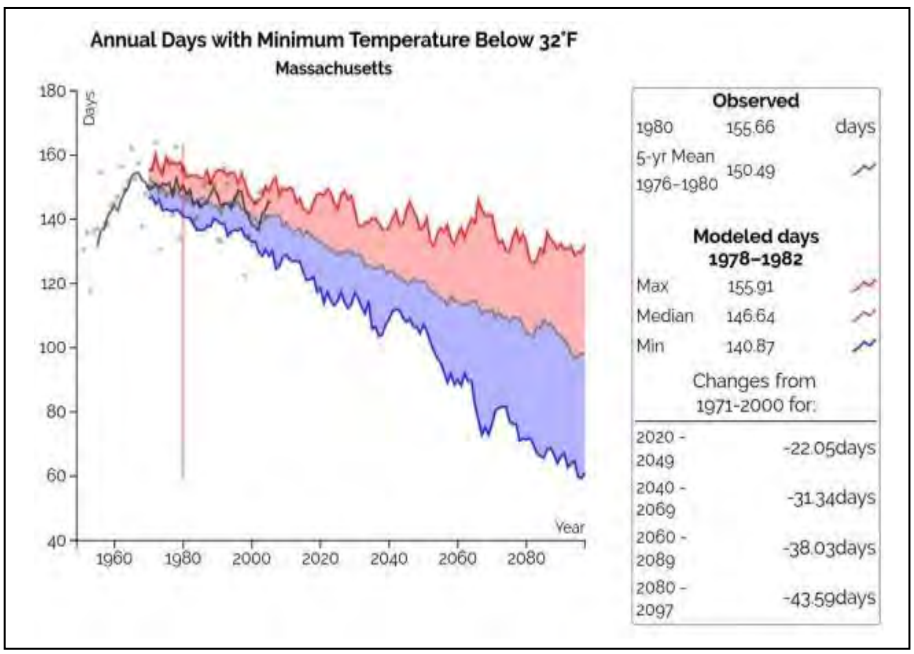


Figure 17. Annual Days with Minimum Temperature Below 32 F.

Vulnerability Assessment

Exposure

Extreme temperatures are not a hazard with a defined geographic boundary. The entire Town should be considered exposed to the hazard. Excessive heat can occur at any time during the year, but is most dangerous during the summer between June and August when average temperatures are at their highest.

Built Environment Impacts

The impact of excessive heat is most prevalent in developed areas, where the Town lacks a tree canopy. Secondary impacts of excessive heat are severe strain on the electrical power system and potential brownouts or blackouts. Extreme heat can have a negative impact on transportation. Highways and roads are damaged by excessive heat as asphalt roads soften and concrete roads expand and can buckle, crack, or shatter. Moreover, concrete has been known to "explode," lifting chunks of concrete and putting those nearby at serious risk. Stress is also placed on automobile cooling systems, diesel trucks, and railroad locomotives which lead to an increase in mechanical failures. Steel rails are at risk of overheating and warping which can lead to train derailments.

Extreme cold weather poses a significant threat to utility production, which in turn threatens facilities and operations that rely on utilities, specifically climate stabilization. As temperatures drop and stay low, increased demand for heating places a strain on the heating system, which can lead to temporary outages. These outages can impact operations throughout Town, which can result in interruptions and delays in services. Broken pipes may cause flooding in buildings, causing property damage and loss of utility service. Some of the secondary effects presented by extreme/excessive cold include dangerous conditions to livestock and pets.

Climate change will increase the probability of extreme temperatures which may impact utilities, transportation, and especially older structures. Future development should consider keeping more mature trees, less dark asphalt areas, and more natural areas.

Population Impacts

Extreme cold events are predicted to decrease in the future, while extreme heat days, as well as average temperatures are projected to increase. The projected increase in extreme heat and heat waves is the source of one of the key health concerns related to climate change. Prolonged exposure to high temperatures can cause heat-related illnesses, such as heat cramps, heat exhaustion, heat stroke, and death. Heat exhaustion is the most common heat-related illness and if untreated, it may progress to heat stroke. People who perform manual labor, particularly those who work outdoors, are at increased risk for heat-related illnesses. Prolonged heat exposure and the poor air quality and high humidity that often accompany heat waves can also exacerbate pre-existing conditions, including respiratory illnesses, cardiovascular disease, and mental illnesses.

The greatest danger from extreme cold is to people, as prolonged exposure can cause frostbite or hypothermia, and can become life threatening. Body temperatures that are too low affect the brain, making it difficult for the victim to think clearly or move well. This makes hypothermia particularly dangerous for those suffering from it, as they may not understand what is happening to them or what to do about it. Hypothermia is most likely at very cold temperatures but can occur at higher temperatures (above 40 degrees Fahrenheit) if the person exposed is also wet from rain, sweat, or submersion.

Warning signs of hypothermia include shivering, exhaustion, confusion, fumbling hands, memory loss, slurred speech, or drowsiness. In infants, symptoms include bright red, cold skin, and very low energy. A person with hypothermia should receive medical attention as soon as possible, as delays in medical treatment may result in death.

Older adults are often at elevated risk due to a high prevalence of pre-existing and chronic conditions. In Wellesley, 14.9% of the population is over age 64. People who live in older housing stock and in housing without air conditioning have increased vulnerability to heat-related illnesses. Power failures are more likely to occur during heat waves, affecting the ability of residents to remain cool during extreme heat. Individuals with pre-existing conditions and those who require electric medical equipment may be at increased risk during a power outage. Heat impacts are more likely to be felt by residents without air conditioning, by those who work outdoors, and those with underlying health conditions.

Extreme heat can pose severe and life-threatening problems for people. According to the NWS, it is one of the leading weather-related killers in the United States, resulting in hundreds of fatalities each year and even more heat-related illnesses. Extreme heat has a special impact on the most vulnerable segments of the population - the elderly, young children and infants, impoverished individuals, and persons who are in poor health. The high-risk population groups with specific physical, social, and economic factors that make them vulnerable include:

- Older persons (age > 65)
- Infants (age < 1)
- Homeless population
- Very low- and low-income persons
- People who are socially isolated
- People with mobility restrictions or mental impairments
- People taking certain medications (e.g., for high blood pressure, depression, insomnia)
- People engaged in vigorous outdoor exercise or work or those under the influence of drugs or alcohol.

Climate change will increase the rate of heat illness and need for cool spaces. Outdoor workers and vulnerable populations will need to be considered during extreme heat events.

Environment Impacts

The water temperatures elevated over a longer period will increase the number of times the Town will need to treat for algae blooms. More harmful blooms could result in more potential for injuries and death for swimmers and pets.

Problem Statements for Extreme Temperatures.

Table 24. Problem Statements for Extreme Temperatures.

Assets	Problems Associated with Extreme Temperatures
People (including underserved communities and socially vulnerable populations)	• Extreme heat will be a significant public health threat to all residents, but especially for vulnerable populations living in older homes or homes without air conditioning. • The elderly and those with mobility issues may not be able to leave their homes and travel safely. • People working in businesses without air conditioning may be at risk of heat illness. • First responders may also be impacted by extreme temperatures. • Pets may be adversely impacted by extreme heat.
Structures (including facilities, lifelines, and critical infrastructure)	• Older homes without insulation and single-pane glass are difficult to heat and cool and may not provide safe living conditions. • Businesses that require refrigerated trucks or refrigeration units may see business losses and increased utility costs.
Systems (including networks and capabilities)	• The electric grid may become stressed and fail during extreme heat and extreme cold events. • Extreme heat or cold mitigation and adaptation have not been fully integrated into existing Town plans and regulations for new development, though progress is being made.
Natural, historic, and cultural resources	• Extreme heat may lead to, or exacerbate, impacts to natural systems related to wildfires and invasive species (refer to the following sections). • Extreme heat may lead to additional algae blooms in lakes and ponds which would need to be treated.
Activities that have value to the community	• Recreational activities may be adversely impacted by extreme heat.

	• Boston Marathon and other outdoor events may be impacted by extreme heat.

Wildfires

A wildfire can be defined as any non-structure fire that occurs in vegetative wildland that contains grass, shrub, leaf litter, and forested tree fuels. Wildfires in Massachusetts are caused by natural events, human activity, or prescribed fire. Wildfires often begin unnoticed but spread quickly, igniting brush, trees, and potentially homes.

Description

The wildfire season in Massachusetts usually begins in late March and typically culminates in early June, corresponding with the driest live fuel moisture periods of the year. April is historically the month in which wildfire risk is the highest. Drought, snowpack level, and local weather conditions can impact the length of the fire season.

According to the National Fire Protection Agency, several elements (known as the fire tetrahedron) must be present in order to have any type of fire:

- <u>Fuel</u>: Without fuel, a fire will stop. Fuel can be removed naturally (when the fire has consumed all burnable fuel) or manually by mechanically or chemically removing fuel from the fire. In structure fires, removal of fuel is not typically a viable method of fire suppression. Fuel separation is important in wildfire suppression and is the basis for controlling prescribed burns and suppressing other wildfires. The type of fuel present in an area can help determine overall susceptibility to wildfires. According to the Forest Encyclopedia Network, four types of fuel are present in wildfires:
    - Ground Fuels: organic soils, forest floor duff, stumps, dead roots, buried fuels
    - Surface Fuels: the litter layer, downed woody materials, dead and live plants to 2 meters tall
    - Ladder Fuels: vine and draped foliage fuels
    - Canopy Fuels: tree crowns
- <u>Heat</u>: Without sufficient heat, a fire cannot begin or continue. Heat can be removed through the application of a substance, such as water, powder, or certain gases, that reduces the amount of heat available to the fire. Scraping embers from a burning structure also removes the heat source.
- <u>Oxygen</u>: Without oxygen, a fire cannot begin or continue. In most wildland fires, this is commonly the most abundant element of the fire triangle and is therefore not a major factor in suppressing wildfires.

- Uninhibited Chain Reaction: The chain reaction is the feedback of heat to the fuel to produce the gaseous fuel used in the flame. In other words, the chain reaction provides the sustained heat necessary to maintain the fire. Fire suppression techniques, such as dry chemical extinguishers, break up the uninhibited chain reaction of combustion to stop a fire.

Location

According to the SHMCAP, the ecosystems that are most susceptible to the wildfire hazard are pitch pine, scrub oak, and oak forests, as these areas contain the most flammable vegetative fuels. Other portions of the Commonwealth are also susceptible to wildfire, particularly at the urban-wildland interface. The draft edition of this plan notes that fires have been evenly distributed throughout the Town; no one specific area is considered to be higher risk.

Figure 18. Brush Fire in Wellesley.

Previous Occurrences

Several notable wildfires have occurred in Massachusetts history, although none has ever resulted in a FEMA disaster declaration. Smaller fires such as brush fires are somewhat easier to characterize. According to statewide data sets (https://www.mass.gov/service-details/fire-data-and-statistics), the number of brush fire events per year from 2012 through 2019 ranged from about 3,000 in 2019 to almost 8,000 in the drought year of 2016.

Table 25. Statewide Brush Fire Counts.

Year	Total # of Events	Injuries/deaths (civilians and fire service)	Losses
2019	2,974	12/0	$136,357
2018	3,253	1/5	$493,145
2017	4,206	20/0	$215,156
2016	7,834	40/0	$1,526,654
2015	6,962	35/0	$323,211
2014	4,627	25/0	$209,857
2013	4,968	31/3	$297,854
2012	5,857	38/0	$705,457

The previous edition of this plan notes that the Wellesley Fire Department responds to approximately 13 brush fires annually, and that none of these fires result in significant property damage, and there have been no deaths as a result of brush fires. According to this statewide data set, fire event counts back to 2012 were as follows for Wellesley:

Table 26. Outdoor and Total Fire Event Figures for Wellesley.

Year	Total Outdoor Fires	Total Fire Events	Reported Losses for Outdoor Fires
2019	13	41	$928,206
2018	11	32	$357,603
2017	21	53	$908,508
2016	32	60	$82,619
2015	14	37	$45,428
2014	14	50	$134,820
2013	18	57	$263,763
2012	15	43	$184,510

The figure of 13 from the previous edition of this plan matches the range of figures (11 to 32) provided by the data set, with the notable exception of 2016 which was a drought year (i.e., more outdoor fire events occurred).

Applying the fraction of outdoor fire incidents that are typically brush fires in Massachusetts (52%) and the fraction of fire losses that are typically from brush fires in Massachusetts (0.2%), an alternate set of figures for brush fires in Wellesley is:

Table 27. Estimated Brush Fire Event Figures for Wellesley.

Year	Estimated Brush Fires	Estimated Brush Fire Losses
2019	7	$5,562
2018	6	$1,977
2017	11	$4,357
2016	17	$294

2015	7	$228
2014	7	$915
2013	9	$1,587
2012	8	$1,005

The Town's planning committee for this update confirmed that the above figures for estimated brush fires are reasonable and realistic. The most problematic brush fire challenges in recent years have been related to accidental fires on mulch piles and where mulch has been applied.

Finally, USDA declares agricultural disasters as needed for a variety of hazards. Information can be found at https://www.fsa.usda.gov/programs-and-services/disaster-assistance-program/disaster-designation-information/index. The single line item related to wildfires in Norfolk County are listed below; this line corresponds to the drought of 2016.

Table 28. USDA Disasters Events That Refer to Wildfires.

Year	Event	Event "Begin Dates"
2016	Drought, high winds, wildfire, excessive heat, insects	8/24/2016, 9/21/2016

Extent

Unfragmented and heavily forested areas of the state are vulnerable to wildfires, particularly during droughts. The greatest potential for significant damage to life and property from fire exists in areas designated as wildland-urban interface areas. A wildland-urban interface area defines the conditions where highly flammable vegetation is adjacent to developed areas.

Fires can be classified by physical parameters such as their fireline intensity, or Byram's intensity, which is the rate of energy per unit length of the fire front (BTU [British thermal unit] per foot of fireline per second) (NPS, n.d.). Wildfires are also measured by their behavior, including total heat release during burnout of fuels (BTU per square foot) and whether they are crown-, ground-, or surface-burning fires. Following a fire event, the severity of the fire can be measured by the extent of mortality and survival of plant and animal life aboveground and belowground and by the loss of organic matter (NPS, n.d.).

The National Wildfire Coordinating Group defines seven classes of wildfires:

- Class A: 0.25 acre or less
- Class B: more than 0.25 acre, but less than 10 acres

- Class C: 10 acres or more, but less than 100 acres
- Class D: 100 acres or more, but less than 300 acres
- Class E: 300 acres or more, but less than 1,000 acres
- Class F: 1,000 acres or more, but less than 5,000 acres
- Class G: 5,000 acres or more

Early detection of wildfires is a key part of the overall efforts of the Massachusetts Bureau of Fire Control. Early detection is achieved by trained Bureau observers who staff the statewide network of 42 operating fire towers. During periods of high fire danger, the Bureau conducts county-based fire patrols in forested areas. These patrols assist cities and towns in prevention efforts and allow for the quick deployment of mobile equipment for suppression of fires during their initial stage. If a fire breaks out and spreads rapidly, residents may need to evacuate within days or hours. A fire's peak burning period generally is between 1 p.m. and 6 p.m. Once a fire has started, fire alerting is reasonably rapid in most cases. The rapid spread of cellular and two-way radio communications in recent years has further contributed to a significant improvement in warning time.

Probability of Future Events

It is difficult to predict the likelihood of wildfires in a probabilistic manner because a number of factors affect fire potential and because some conditions (e.g., ongoing land use development patterns, location, and fuel sources) exert changing pressure on the wildland-urban interface zone. The following discussion helps characterize the risk further for Wellesley. Additionally, the concern related to mulch piles and mulching mentioned above could affect future wildfire probabilities. The Massachusetts Climate Change Assessment report suggests that wildfire risk will increase over time in association with extreme heat events and changing precipitation and droughts.

Vulnerability Assessment

Exposure

To help identify potential wildfire areas for Wellesley, the U.S. Forest Service's Wildfire Risk to Communities spatial data was downloaded. This data was developed in 2020 using the vegetation and wildland fuels from the LANDFIRE 2014 model with the burn probability coming from the Forest Service Fire Simulation System (FSim). To create a product with a finer resolution, the data was upsampled to the native 30m resolution of the LANDFIRE fuel and vegetation data spreading the values of the modeled burn probability into developed areas represented in LANDFIRE fuels as non-burnable. The areas with a 0.01% probability of burning were identified and overlaid with the critical facilities and other buildings. There were no critical facilities found in the 0.01% burn probability areas and 249 buildings including single-family and multi-family homes, commercial, educations, and agricultural buildings found there. There were some water utilities located in the higher probability burn areas. Table 29 shows the result of this analysis.

Table 29. Buildings in 0.01% Annual Chance Area.

Building Type	Number of Buildings (Total in Town)	Building Value (Total in Town)
Single Family	210 (8,535)	$186,099,000 ($5,274,535,000)
Multi-Family	2 (318)	$919,000 ($467,875,000)
Commercial	6 (232)	$18,416,000 ($2,756,199,000)
Educational	16 (214)	$511,537,000 ($18,861,800,000)
Government	10 (106)	$6,749,000 ($111,511,000)
Religious/Non-Profit	1 (51)	$400,000 ($139,701,000)
Agriculture	1 (3)	$1,000 ($709,000)
Group Quarters	1 (8)	$1,225,000 ($49,407,000)
Garage/Outbuilding	1 (19)	$4,000 ($1,953,000)
Vacant	1 (37)	$1,355,000 ($61,363,000)
Total	**249 (9,523)**	**$726,705,000 ($27,725,053,000)**

The population exposed to the 0.01% probability area is shown in Table 30. The column in the left shows the population in and around the 0.01% probability wildfire area (wherever the Census Block overlapped with the wildfire area) while the column on the right shows the total population numbers for the Town. There is an older population exposed to the wildfire hazard with a lower annual income than the Town average.

Table 30. Population Exposed to 0.01% Annual Chance Wildfire (2020 U.S. Census).

Demographics	Population in and Adjacent to 0.01% Wildfire Area	Total Population
Population	2,689	29,550
Households	788	9,282
White	2002 (74.5%)	22,079 (74.7%)
Black	94 (3.5%)	622 (2.1%)
American Indian	5 (0.2%)	21 (0.1%)
Asian	364 (13.5%)	4,393 (14.9%)
Pacific Islander	1 (0.0%)	9 (0.0%)
Other Race	78 (2.9%)	531 (1.8%)
Two or More Races	145 (5.4%)	1,895 (6.4%)
Hispanic or Latino:	154 (5.7%)	1,523 (5.2%)
Population under 18:	510 (19.0%)	7,635 (25.8%)
Population over 64:	371 (13.8%)	4,394 (14.9%)
Annual Income < $30K/year	51 (1.9%)	602 (6.5%)
Population in EJ Zone*:	0 (0.0%)	3,638 (12.3%)

**Massachusetts Office of Energy and Environmental Affairs, 2022*

Figure 19 shows the burn probability map from the USFS overlaid on the Town.

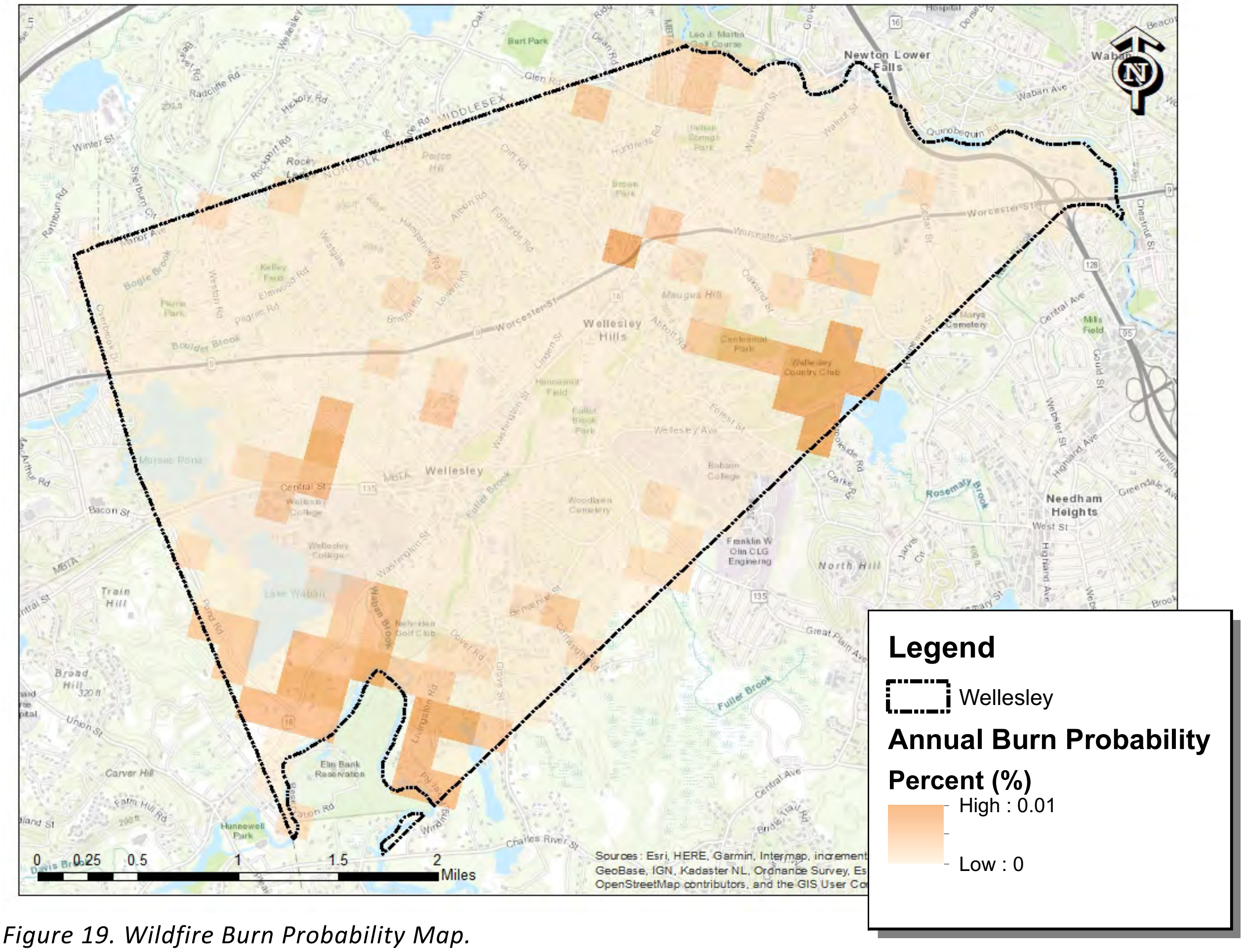


Figure 19. Wildfire Burn Probability Map.

Built Environment Impacts

A major out-of-control wildfire can damage property, utilities, and forested land; create smoke that can cause breathing problems; and injure or kill people. Other associated concerns are debris management issues including debris removal and identification of disposal sites.

No property damage, injuries or deaths have been recorded for the reported brushfires in Wellesley between 2004 and 2022. Using the wildfire probabilities and building values, a loss estimate was produced for the 0.01% scenario. The losses are $726,705,000 for the .01% event and the average annualized loss will be $72,671.

Climate change will increase the probability of brushfires which could lead to additional property damage. Future development in forested and other high-fuel areas also could lead to additional increases in the probability of brushfires.

Population Impacts

Populations considered most vulnerable to wildfire impacts are identified based on a number of factors including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. Table 13 summarizes the senior and low-income populations in Wellesley. The Town should be aware of the potential needs of residents within these population segments in the event of a hazard occurrence.

With the increased probability of brushfires outside of the Town in the future due to climate change, populations may be impacted more often due to air quality issues.

Environment Impacts

Many of the natural features in the Town are susceptible to wildfire including the trees and parks.

Problem Statements for Wildfires

Table 31. Problem Statements for Wildfires.

Assets	Problems Associated with Wildfires
People (including underserved communities and socially vulnerable populations)	• Populations with severe asthma may be adversely impacted by wildfires in the vicinity.
Structures (including facilities, lifelines, and critical infrastructure)	• Several residential structures are found in the higher probability burn areas. Structures without defensible zones are more susceptible to wildfires and brush fires. • Some commercial, educational, and government structures are found in the higher probability burn areas.
Systems (including networks and capabilities)	• Several water facilities (pumping stations and storage) are in forested areas with a higher burn probability and don’t have fire breaks. • Wildfires often cause roads to be closed requiring detours.
Natural, historic, and cultural resources	• Wildfires may adversely impact forested and other vegetated areas of Wellesley.

Activities that have value to the community	• Recreational activities may be adversely impacted by wildfires, depending on location.

Infectious Diseases

The SHMCAP does not address infectious diseases as a profiled hazard. While major disease outbreaks are uncommon, public health emergencies can become standalone disasters that compound the threat of other natural hazards and exceed local and state capacity. Precedent for federal assistance due to public health emergencies has been set including West Nile Virus (2000), a mosquito-borne disease, for which a federal emergency declaration was made in New York and New Jersey; and the COVID-19 pandemic, which resulted in a major disaster declaration in all states, territories, and the District of Columbia as well as an Emergency Declaration in Massachusetts. Given that COVID-19 has resulted in excessive public expenditures and resulted in a disaster declaration, and in light of heightened concerns about tick and mosquito-borne illnesses, this plan addresses infectious diseases.

Description

Public health risks, such as those presented by infectious diseases and vector-borne illnesses, are present within every community. An infectious disease is one that is caused by micro-organisms, such as bacteria, viruses, and parasites. A vector-borne illness is an infectious disease that is transmitted to humans by blood-feeding arthropods, including ticks, mosquitoes, and fleas, or in some cases by mammals (e.g., rabies). Infectious diseases cause illness, suffering and even death, and place an enormous financial burden on society.

Most infectious diseases are caused by pathogens that can be spread, directly or indirectly, from person to person. Such diseases may be seasonal (seasonal influenza) or result, in the case of new diseases, result in a global pandemic. Infectious disease dynamics depend on a range of factors, including land use, human behavior, climate, efficacy of healthcare services, population dynamics of vectors, population dynamics of intermediate hosts and the evolution of the pathogens themselves. Many of these diseases require continuous monitoring, as they present seasonal threats to the general population.

In Massachusetts, state public health officials rely on local boards of health, healthcare providers, laboratories, and other public health personnel to report the occurrence of notifiable diseases as required by law. An epidemic emerges when an infectious disease occurs suddenly in numbers that are more than normal expectancy. Infectious disease outbreaks put a strain on the healthcare system and may cause continuity issues for local businesses. These outbreak incidents are a danger to emergency responders, healthcare providers, schools, and the public. This can include influenza (e.g., H1N1), pertussis, West Nile virus, and many other diseases. A pandemic is an epidemic that has spread over a large area, that is, it is prevalent throughout an entire country, continent, or the whole world.

On March 11, 2020, the World Health Organization (WHO) officially declared the Coronavirus disease 2019 (COVID-19) outbreak a pandemic due to the global spread and severity of the disease. COVID-19 is a respiratory illness that can spread from person to person. COVID-19 is a highly contagious, viral upper respiratory illness that was first detected in China in late 2019. The virus quickly spread throughout the world and has resulted in a global pandemic ongoing at the time of this plan. COVID-19 symptoms include cough, difficulty breathing, fever, muscle pain, and loss of taste or smell. Severe cases may result in death, especially in individuals over the age of 65 or with underlying medical conditions, such as diabetes, lung disease, asthma, obesity, or those who are immunocompromised. COVID-19 spreads from person to person through respiratory droplets in the air or on surfaces.

Location

The entire Commonwealth of Massachusetts and Town of Wellesley are considered at risk to the infectious diseases addressed in this chapter.

Previous Occurrences

Pandemic influenza episodes that were considered to be global outbreaks spread were observed in 1918, 1957, 1968, and in 2009 with the novel H1N1 strain. The 2009 H1N1 outbreak, though not considered a serious threat, still affected some residents in Massachusetts with nearly 2,000 confirmed cases and 33 deaths. The great influenza epidemic of 1918 killed millions worldwide and would likely cause hundreds to thousands of deaths in Massachusetts should a similar outbreak occur today. It is anticipated that a more serious strain of the usual flu will occur some year and that vaccines might not be ready in time to combat rapid spread.

The most significant recent occurrence of infectious disease for Wellesley is that of COVID-19. Approximately 2 million cases and 22,000 deaths have been reported in Massachusetts. As of October 2022, approximately 162,000 cases were reported for Norfolk County. The federal designation for the Massachusetts Covid-19 Pandemic is DR-4496-MA, with incident period January 20, 2020, and continuing. The Major Disaster Declaration was issued March 27, 2020.

Vector-borne diseases continue to pose a significant threat to communities across Massachusetts. Blacklegged (deer) ticks and dog ticks are found throughout Massachusetts and may spread different diseases. The most common tick-borne diseases in Massachusetts are Lyme Disease, Babesiosis, and Anaplasmosis. Other diseases that are rare, but still occur, are Tularemia, Rocky Mountain spotted fever, Borrelia miyamotoi, and Powassan virus. Tickborne figures for Norfolk County are available at https://www.mass.gov/lists/monthly-tick-borne-disease-reports; a summary for the last three calendar years is provided below.

Table 32. Tick-Borne Illness Figures for County.

Year	Emergency Department Visits	Number of Tick-Borne Disease Visits	Rate (per 10,000) of Tick-borne Disease Visits
2022*	168,787	110	6.52
2021	247,415	209	8.45
2020	217,539	163	7.49
2019	260,583	173	6.64

**Through August 2022*

Mosquito-borne diseases are also a seasonal threat. West Nile Virus (WNV) and Eastern Equine Encephalitis (EEE or "Triple E") are viruses that occur in Massachusetts and can cause illness ranging from a mild fever to more serious disease like encephalitis or meningitis. Other diseases spread by mosquitoes may affect people when traveling in other regions of the world such as Zika virus, Dengue fever, and Chikungunya.

Extent

Well-established scales for characterizing total impacts of infectious diseases are not present for applied uses such as a hazard mitigation plan. Nevertheless, commonly accepted methods are in place for characterizing active transmission, such as color scales (yellow, orange, red). Future editions of this plan will provide updates to measures of extent. Johns Hopkins continues to provide a very comprehensive dashboard of information for all regions of the U.S. including Massachusetts. County-level data can also be accessed (https://coronavirus.jhu.edu/region/us/massachusetts).

Probability of Future Events

Probability of infectious disease in the planning area is extremely variable. Many public health risks occur seasonally and are ongoing, such as the common cold and influenza. Major disease outbreaks such as the current COVID-19 pandemic are much less common but can last for long periods. Based on the information available regarding occurrences of greatest concern, the infectious disease hazard has been assigned a probability of likely for the foreseeable future.

The COVID-19 pandemic has the potential to continue to some degree over the next several years, even as vaccines continue to be developed are distributed. The Town of Wellesley is continually updating community mitigation measures and guidance in close consultation with Massachusetts Department of Public Health and based on new information from the CDC.

The effects of climate change will result in an increase in the probability and/or frequency of some infectious diseases. Those infectious diseases that are currently present in Massachusetts and which may be exacerbated by climate change are already exhibiting increased prevalence in New England. For example, with both temperature and precipitation expected to increase in Massachusetts, West Nile Virus mosquito vector activity will likely increase, as well as the vector's period of activity. Similarly, between 1964 and 2010, counts of Eastern Equine Encephalitis (EEE) have continued to rise in New England, though they remain constant in the southeastern states. The Massachusetts Climate Change Assessment predicts that increases in vector-borne disease incidence and bacterial infections will occur in the region, including West Nile Virus and Lyme disease, due to more favorable conditions for ticks and mosquitoes.

The United States is already seeing a significant increase in vector-borne infectious diseases. According to the CDC, the number of reported disease cases from mosquito, tick, and flea bites tripled from 2004 to 2016, and mosquito-borne disease epidemics are happening more frequently. Annual cases of Lyme disease have increased over the last decade, and with shrinking winters, the potential for infection through tick bite continues to grow. Given increasing trends for global travel, several other diseases not typically observed in Massachusetts could continue to make their way back to the state through infected travelers. COVID-19 is the most recent and severe example of this threat. Another example is the Zika virus, transmitted from infected mosquitoes to humans, which received international attention during an outbreak in 2015 and persists today.

Vulnerability Assessment

Exposure

The risk associated with communicable disease in the region has not been formally quantified, due to the difficulty in predicting specific occurrences, and the lack of complete data on impacts. However, the potential risk and impact of communicable diseases is often presumed to be very high in the chaos that follows natural disasters (WHO, 2006).

Natural disasters, particularly meteorological and geological events such as hurricanes, floods, and earthquakes, can bring about serious health consequences. These disasters can affect vector breeding sites and vector-borne disease transmission. In a flood hazard area, initial flooding may wash away existing mosquito breeding sites, but standing water caused by heavy rainfall or overflow of rivers can create new breeding sites. This can result (with typically some weeks delay) in an increase of the vector population and potential for disease transmission, depending on the local mosquito vector species and its preferred habitat. The crowding of infected and susceptible hosts, a weakened public health infrastructure and interruptions of ongoing control programs are all risk factors for vector-borne disease transmission.

The major causes of communicable disease from natural disasters can be categorized into four areas: Infections due to contaminated food and water, respiratory infections, vector, and insect borne diseases, and infections due to wounds and injuries. The most common causes of morbidity and mortality in this situation are diarrheal disease and acute respiratory infections.

- Waterborne diseases: Diarrheal disease outbreaks can arise subsequent to drinking water contamination and have been reported after flooding and related movement. Hepatitis A and E have fecal-oral transmission in areas with poor water sanitation.
- Diseases associated with crowding: Acute respiratory infections are the main cause of morbidity and mortality among unsettled people and are seen predominantly in children less than 5 years old.
- Vector-borne diseases: The most common vector-borne diseases are carried by mosquitoes and ticks and include Lyme Disease, Rocky Mountain Spotted Fever, West Nile Virus, and Eastern equine encephalitis. Environmental changes after disaster could increase vector breeding sites and proliferation of disease vectors.
- Infections due to wounds and injuries: The potentially significant threats to persons suffering a wound are tetanus, staphylococci, and streptococci.

Built Environment Impacts

All human-occupied critical facilities are assumed to be at risk of contamination from a communicable disease. If facilities supporting emergency response lost their functionality because of contamination, delays in emergency services could result. Additionally, with a significant human disease outbreak, resources of health care systems such as ambulance services, hospitals, and medical clinics could quickly become overwhelmed. In most cases, critical infrastructure would not be affected by communicable disease. Scenarios that would affect infrastructure include the contamination of the water supplies and diseases that require special provisions in the treatment of wastewater. Should an epidemic necessitate quarantine or incapacitate a significant portion of the population, support of and physical repairs to infrastructure may be delayed, and services may be disrupted for a time due to limitations in getting affected employees to work.

Population Impacts

High death counts during a natural disaster (either human or animal) can indicate an increased risk of outbreaks associated with the size, health status, and living conditions of the population displaced by the natural disaster. Crowding, inadequate water and sanitation, and poor access to health services, often characteristic of sudden population displacement, increase the risk of communicable disease transmission.

Populations that are vulnerable to communicable diseases include the economically disadvantaged, racial and ethnic minorities, the uninsured, low-income children, the elderly, the homeless, and those with other chronic health conditions, including severe mental illness. It may also include rural residents, who often encounter barriers to accessing healthcare services, transportations, or the internet.

With climate change increasing the probability of infectious diseases with additional mosquito and tick activity occurring longer during the year, populations will be more at risk in the future.

Environment Impacts

Infectious diseases can also impact livestock and other animals. Some of the most common communicable diseases include Eastern Equine Encephalitis, Equine Herpes Virus, West Nile Virus, and Avian Influenza. While Zoonotic diseases (those transmissible between humans and animals or via an animal vector) are also a concern for the region, those events are best addressed in a pandemic or contagious disease plan rather than this hazard mitigation plan.

Problem Statements for Infectious Disease

Table 33. Problem Statements for Infectious Disease.

Assets	Problems Associated with Infectious Diseases
People (including underserved communities and socially vulnerable populations)	• Future flu pandemics may adversely impact all residents and present additional complications to the elderly and those with pre-existing conditions. • Tickborne and mosquito-borne infection rates are expected to increase as winter seasons become less severe and shorter in duration.
Structures (including facilities, lifelines, and critical infrastructure)	• Not applicable.
Systems (including networks and capabilities)	• May impact medical and response services. • Large scale closures/shutdowns due to pandemic response can negatively impact the Town's ability to deliver routine government operations and services.
Natural, historic, and cultural resources	• Not applicable.
Activities that have value to the community	• May impact in-person social events.

Invasive Species

According to the SHMCAP, invasive species are defined as non-native species that cause or are likely to cause harm to ecosystems, economies, and/or public health (NISC 2006). The focus of this section is on invasive terrestrial plants, as this is the most studied and managed typed of invasive; information for invasive aquatic flora and fauna (including marine species) is also provided when relevant.

Description

The Massachusetts Invasive Plant Advisory Group (MIPAG), a collaborative representing organizations and professionals concerned with the conservation of the Massachusetts landscape, is charged by EOEEA to provide recommendations to the Commonwealth to manage invasive species. MIPAG defines invasive plants as "non-native species that have spread into native or minimally managed plant systems in Massachusetts, causing economic or environmental harm by developing self- sustaining populations and becoming dominant and/or disruptive to those systems." These species have biological traits that provide them with competitive advantages over native species, particularly because in a new habitat they are not restricted by the biological controls of their native habitat. As a result, these invasive species can monopolize natural communities, displacing many native species and causing widespread economic and environmental damage.

MIPAG recognized 69 plant species as "Invasive," "Likely Invasive," or "Potentially Invasive." The criteria for an “Invasive” species are listed below; the other assigned categories are associated with lower scores on the criteria checklist. The criteria for invasive animal species are less well-defined, but many of the same characteristics (including a non-Massachusetts origin and the ability to out-compete native species) are similar. In order to be considered “Invasive” by MIPAG, a plant species must meet the following criteria:

- Be nonindigenous to Massachusetts.
- Have the biologic potential for rapid and widespread dispersion and establishment in minimally managed habitats.
- Have the biologic potential for dispersing over spatial gaps away from the site of introduction.
- Have the biologic potential for existing in high numbers away from intensively managed artificial habitats.
- Be naturalized in Massachusetts (persists without cultivation in Massachusetts).
- Be widespread in Massachusetts or at least common in a region or habitat in the state.
- Have many occurrences of numerous individuals in Massachusetts that have high numbers of individuals forming dense stands in minimally managed habitats.
- Be able to outcompete other species in the same natural plant community.

- Have the potential for rapid growth, for high seed or propagule production and dissemination, and for establishment in natural plant communities.

Some examples of invasive insect species include:

- Nantucket Pine Tip Moth (native pest) is a moth with heads, bodies, and appendages covered with gray scales with mottled rusty-red markings. Larvae causes damage to young trees (up to five years old) by feeding inside growing shoots, buds, and conelets. The preferred host is the loblolly pine.
- Bark Beetles (native pest) include more than 600 species of beetles which serve in important ecological roles in small numbers where they live in dead, weakened, and dying host conifer trees.
- Forest Tent Caterpillar (native pest) has the biggest footprint of any indigenous tent caterpillar in North America (Furniss and Carolin 1977) and is a major defoliator of a variety of deciduous hardwood trees. The caterpillars spin silken mats on the trunks and large branches of trees where they molt and feed. Forest Tent Caterpillars can reach outbreak proportions causing massive defoliation of host trees and becoming a nuisance to people.
- Pine Reproduction Weevils (native pest) is a very dark, elongate, oval insect up to 1/2 inch long with indistinct to distinct gray or pale orange spots of scales on the wings and thorax. They feed at night on the conifer seedlings or near the tips of branches of larger plants. Females lay their eggs on the roots of these trees. The weevils breed in all species of pines, hemlocks, junipers, spruces, firs, and cedars.
- Hardwood Borers (native pest) usually attack hardwoods experiencing some kind of stress although the clear-wing moths attack healthy trees. These insects attack the tree year after year and may eventually weaken it enough that it is prone to wind breakage. Some borers develop in the root system damaging young trees.
- Hemlock Wooly and Balsam Wooly Adelgid (non-native pest) is a very small, invasive, aphid-like insect that attacks North American hemlocks (Hemlock Wooly) and firs (Balsam Wooly). They can be identified by the white woolly masses that form on the underside of branches at the base of the tree’s needles. They stay at this location for the rest of their lives. Their feeding disrupts the flow of nutrients to the tree twigs and needles leading to a decline in tree health and mortality in 4 to 10 years.
- Gypsy Moth (non-native pest) is an insect which feeds on a large variety of tree leaves from oak, maple, apple, crabapple, hickory, basswood, aspen, willow, birch, pine, spruce, hemlock, and others. It does prefer oak tree leaves, however. Periodically, large populations can cause defoliation damaging and killing trees they are feeding on.
- Spotted Lanternfly (non-native pest) is an invasive insect first detected in the U.S. in 2014. It feeds on a variety of fruit, ornamental, and wood trees and could seriously impact the grape, orchard, and logging industries.

Location

The damage rendered by invasive species is significant. Experts estimate that about 3 million acres within the U.S. are lost each year to invasive plants (Pulling Together, 1997, from Mass.gov "Invasive Plant Facts"). The massive scope of this hazard means that the entire Commonwealth experiences impacts from these species. Furthermore, the ability of invasive species to travel distances (either via natural mechanisms or accidental human interference) allows these species to propagate rapidly over a large geographic area. Similarly, in open freshwater and marine ecosystems, invasive species can quickly spread once introduced, as there are generally no physical barriers to prevent establishment, outside of physiological tolerances, and multiple opportunities for transport to new locations (by boats, for example). The entire geographic area of Wellesley is believed at risk for invasive species propagation.

Previous Occurrences

Invasive species do not represent a singular event but rather an ongoing or emerging problem, so it is difficult to measure the frequency of occurrences. Invasives of current concern to forest health (https://www.mass.gov/service-details/current-forest-health-threats) in Norfolk County are reportedly:

- Gypsy Moth
- Winter Moth
- Hemlock Woolly Adelgid
- Southern Pine Beetle
- Emerald Ash Borer
- White Pine Needlecast

The annual budget to address invasive species in Massachusetts has fluctuated over time but, in general, appears to have decreased. This likely implies a lack of resources rather than a decrease in risk. The following figures are from https://budget.digital.mass.gov/summary/fy22/enacted/energy-and-environmental-affairs/environmental-affairs/20000100.

Table 34. Statewide Budgets for Addressing Invasive Species.

FY Year	Budget
2022	$277,838
2021	$146,348
2020	$4,150,000
2019	$3,831,135

FY Year	Budget
2018	$4,347,000
2017	$6,046,870

Specific occurrences in Wellesley have been documented in several reports and plans. The Town's Open Space and Recreation Plan (2015-2022) and its draft update (2022-2029) note that:

- Invasive species such as Asian Bittersweet, Purple Loosestrife, Garlic Mustard, Japanese Knotweed, and European Buckthorn are a growing problem in many wetland and wooded areas left in a semi-wild state.
- Morses Pond and Paintshop Pond have had problems with Water Chestnut, Eurasian Milfoil, and other aquatic weeds.
- In addition to invasive plants, the main invasive insect species that Wellesley's DPW is currently managing are the Wooly Adelgid Aphid, which attacks Eastern Hemlocks, and Winter Moth, which thrives primarily on young ornamental trees and fruit trees.
- The above invasive species challenges are being tackled by DPW crews as their budgets and work schedules permit.

The Town's planning committee for this update confirmed that the above list is a current representation of the invasive specific challenges. Gypsy moth eradication programs have also been tested in recent years, given that Wellesley does see some periodic pest damage from Gypsy Moth. However, the local Winter moth population has been more or less controlled by the introduction of a biological control at Centennial Reservation in Wellesley.

Relative to Morses Pond, the Open Space Plan and Recreation Plan notes that:

- "Discernible frequency reductions from harvesting are few. White water lily and yellow water lily showed decreases, while no apparent change is observed for the major invasive species fanwort, variable milfoil, and Eurasian milfoil. Harvesting does not remove the whole plant in most cases, but biomass is reduced, so the frequency of occurrence of the plants (presence/absence of a plant at a survey location) is largely unchanged while biovolume measures decrease. Those species that are reduced in frequency are more susceptible to harvesting; for example, the bulk of the plant biomass is at the surface for water lilies…. The plant community of Morses Pond would still be too dense in most areas without harvesting and is dominated by invasive species."

Extent

The MIPAG has developed a list of Early Detection plant species according to an established set of criteria that includes MIPAG classification as an *invasive, likely invasive,* or *potentially invasive* ecological threat and one of these three criteria: *limited prevalence in Massachusetts, partial containment potential,* or *public health threat.* The Early Detection table includes the documented distribution of a species by county.

Once established, invasive species often escape notice for years or decades. Introduced species that initially escaped many decades ago are only now being recognized as invasives. Because these species can occur anywhere (on public or private property), new invasive species often escape notice until they are widespread, and eradication is impractical. As a result, early and coordinated action between public and private landholders is critical to preventing widespread damage from an invasive species.

Probability of Future Events

The USDA Animal and Plant Health Inspection Service (APHIS) manages the Plant Protection and Quarantine (PPQ) Program which safeguards U.S. agriculture and natural resources from the introduction, establishment, and spread of plant pests and noxious weeds. PPQ is the lead federal agency for plant health emergencies and works closely with federal, state, and local agencies; universities; industries; and private entities in developing and implementing science-based framework designed to protect against invasive pests and diseases.

Massachusetts has a variety of laws and regulations in place that attempt to mitigate the impacts of these species. The Department of Agricultural Resources (DAR) maintains a list of prohibited plants for the state, which includes federally noxious weeds as well as invasive plants recommended by MIPAG and approved for listing by DAR. Species on the DAR list are regulated with prohibitions on importation, propagation, purchase, and sale in the Commonwealth. Additionally, the Massachusetts Wetlands Protection Act (310 CMR 10.00) includes language requiring all activities covered by the Act to account for, and take steps to prevent, the introduction or propagation of invasive species.

In 2000, Massachusetts passed an Aquatic Invasive Species Management Plan, making the Commonwealth eligible for federal funds to support and implement the plan through the federal Aquatic Nuisance Prevention and Control Act. MassDEP and CZM are part of the Northeast Aquatic Nuisance Species Panel, which was established under the federal Aquatic Nuisance Species Task Force. This panel allows managers and researchers to exchange information and coordinate efforts on the management of aquatic invasive species. The Commonwealth also has several resources pertaining to terrestrial invasive species, such as the Massachusetts Introduced Pest Outreach Project, although a strategic management plan has not yet been prepared for these species. All these efforts are aimed at reducing the probability of future occurrences.

Notwithstanding the above efforts, the presence of invasive species is ongoing, and it is difficult to quantify the future frequency of these occurrences. Increased rates of global trade and travel have created many new pathways for the dispersion of exotic species. As a result, the frequency with which these threats have been introduced has increased significantly. Increased international trade in ornamental plants is particularly concerning because many of the invasive plants species in the U.S. were originally imported as ornamentals. Furthermore, they are expected to be an increasing problem due to a changing climate and projected increases in non-native plant and animal infestations. For this reason and based on the fact invasive species are already an ongoing issue for the region, this hazard has been assigned a probability of highly likely.

Vulnerability Assessment

Exposure

The entire Town of Wellesley has the potential to be exposed to invasive pests. Climate change will make the area more attractive to pests who have not been found there traditionally.

Built Environment Impacts

Although the built environment is not as susceptible to pests as the natural environment, it can help spread the invasive species. This includes trains and vehicles that could move the species from one location to another. Trees, which are damaged or killed by invasive pests, can become hazards to people, property, utility lines, and roadways when they fall. Many dead trees in one area can also become fuel for wildfires interconnecting the two hazards.

Population Impacts

The direct population impacts are minimal. However, the indirect impacts could destroy livelihoods.

Environment Impacts

Most of the natural features in the Town have some susceptible pests including the parks and other forested areas. Trees that have been damaged by other events such as fire, wind, flooding, and animal browsing are more susceptible to diseases and pests. Certain species of trees are more susceptible based on the need of the damaging organism.

Climate change will increase the probability of invasive pests which will pose increased environmental impacts in the future.

Problem Statements for Invasive Species

Table 35. Problem Statements for Invasive Species.

Assets	Problems Associated with Invasive Species
People (including underserved communities and socially vulnerable populations)	• None apparent or projected.
Structures (including facilities, lifelines, and critical infrastructure)	• None apparent or projected.
Systems (including networks and capabilities)	• DPW capabilities are overtaxed as noted in the line below.
Natural, historic, and cultural resources	• Invasive species challenges are being tackled by DPW crews as their budgets and work schedules permit, including: ○ Asian Bittersweet, Purple Loosestrife, Garlic Mustard, Japanese Knotweed, and European Buckthorn are a growing problem in many wetland and wooded areas left in a semi-wild state. ○ Morses Pond and Paintshop Pond have had problems with Water Chestnut, Eurasian Milfoil, and other aquatic weeds. • Invasive insect species are the Wooly Adelgid Aphid, which attacks Eastern Hemlocks; and Winter Moth, which thrives primarily on young ornamental trees and fruit trees.
Activities that have value to the community	• Recreational activities may be adversely impacted, depending on location.

Primary Climate Change Interaction: Extreme Weather Events

Hurricanes and Tropical Storms

Flooding in Massachusetts is often the direct result of tropical storms and hurricanes. These powerful storms can also cause significant widespread damage due to high winds.

> The Town of Wellesley Community Resilience Building Workshop Summary of Findings (2020) lists "Intense storms" as one of the top four hazards of concern.

Description

Tropical cyclones (tropical depressions, tropical storms, and hurricanes) that affect New England form over the warm, moist waters of the Atlantic Ocean, Caribbean Sea, and Gulf of Mexico. Tropical systems customarily come from a southerly direction and when they accelerate up the East Coast of the U.S., most take on a distinct appearance that is different from a typical hurricane. Although rain is often limited in the areas south and east of the track of the storm, these areas can incur the worst winds and storm surge. Dangerous flooding occurs most often to the north and west of the track of the storm. An additional threat associated with a tropical system making landfall is the possibility of tornado generation. Tornadoes would generally occur in the outer bands to the north and east of the storm, a few hours to as much as 15 hours prior to landfall.

Hurricane season runs from June 1 to November 30. In New England, these storms are most likely to occur in August, September, and the first half of October. The SHMCAP notes that this is due in large part to the fact that it takes a considerable amount of time for the waters south of Long Island to warm to the temperature necessary to sustain the storms this far north. Also, as the region progresses into the fall months, the upper-level jet stream steering winds might flow from the Great Lakes southward to the Gulf States and then back northward up the eastern seaboard. This pattern is conducive for capturing a tropical system over the Bahamas and accelerating it northward.

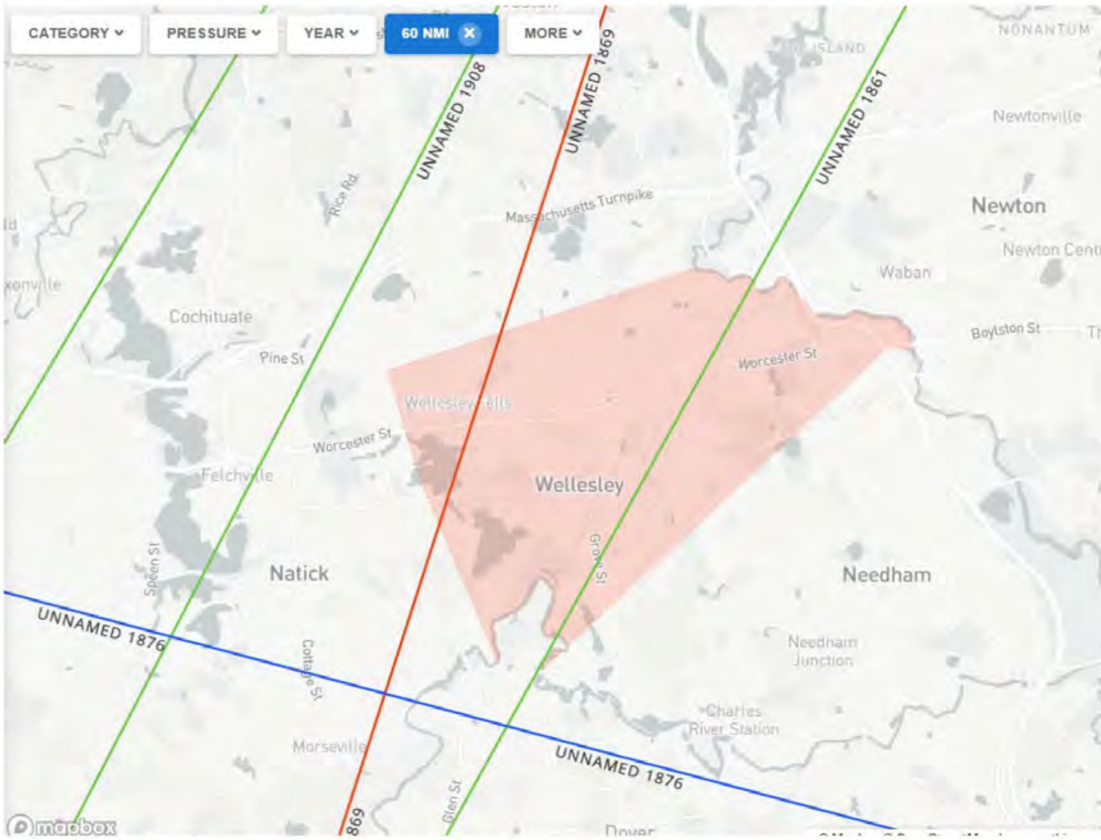
Location

Tropical storms and hurricanes can affect the entirety of Massachusetts, including the geographic extent of Wellesley.

Previous Occurrences

The SHMCAP notes that hurricanes and tropical storms occur somewhat regularly in Massachusetts. Historical tropical system tracks near and through Wellesley are depicted on the following page. This mapping is available from NOAA and updated continuously.

Historical Tropical Storm Tracks in the Town of Wellesley



Graphic courtesy of NOAA

A handful of tropical storms and hurricanes have passed near Wellesley or crossed over the town since recordkeeping began. Storms crossed the town in 1861 and 1869, one passed to the south in 1876, and one passed to the west in 1908. The hurricane of 1869 is commonly known as the "New England Gale of 1869." This was one of only a few hurricanes to pass over New England as an estimated Category 3 hurricane. At landfall, the hurricane was relatively compact, estimated around 60 miles wide.

Figure 20. Historical Tropical Storm Tracks In and Near Wellesley.

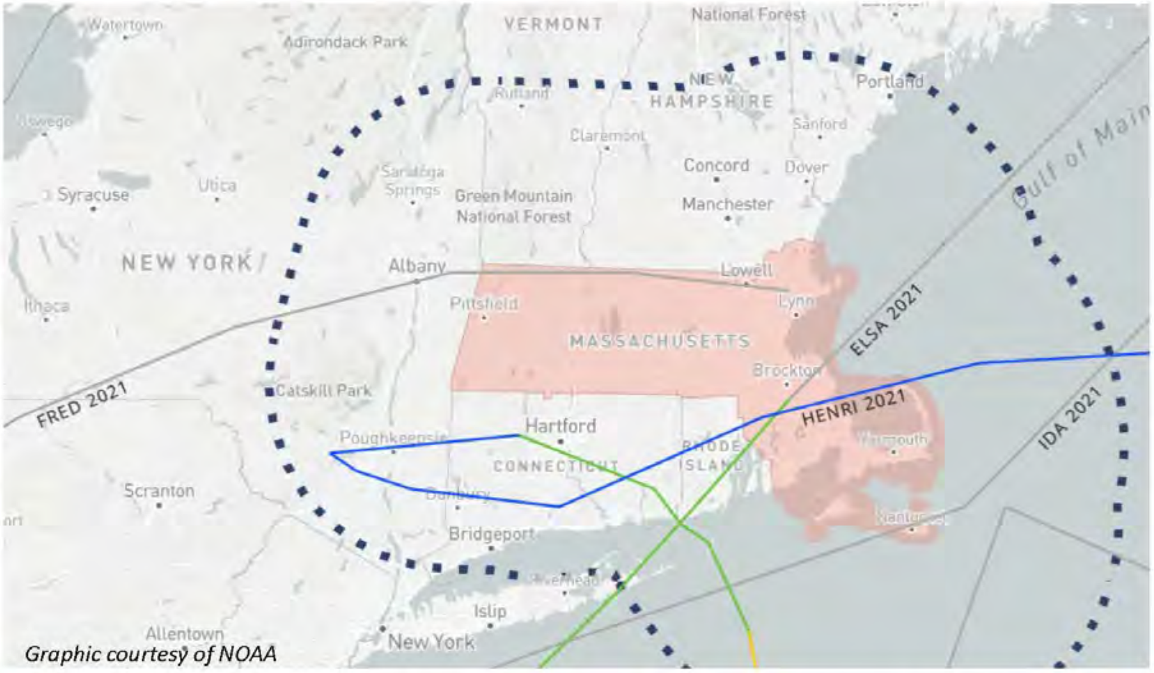
As noted elsewhere, this plan update relies primarily on a ten-year lookback (2012 through 2021) ending with the date of plan development. During that ten-year period, only one declared disaster in Massachusetts (SuperStorm Sandy of October 2012) was associated with a tropical system, and the impacts to the Wellesley region were minimal. The NOAA Storm Events database for Norfolk County (https://www.ncdc.noaa.gov/stormevents/) provided the following description of impacts in Wellesley: "A tree was downed on Route 9 Westbound at Westgate Road in Wellesley, blocking Route 9. A tree was downed blocking River Street, also in Wellesley."

Nevertheless, Wellesley was impacted by the series of tropical and post-tropical storm systems that impacted Massachusetts in 2021. These storms occurred in July, August, and September 2021 as follows:

- T.S. Elsa - July 9, 2021
- T.S. Fred - August 19, 2021
- T.S. Henri - August 22-23, 2021
- T.D. Ida - September 1, 2021

Wellesley experienced only moderate precipitation impacts from at least two of these events (Elsa and Ida). The recorded precipitation associated with storm Elsa was 4.47 inches of rain according to WHDH; and T.S. Ida dropped 3.99 inches of rain according to Wickedlocal.com. Notwithstanding these rainfall totals, the Town's planning committee noted that severe flooding did not result from any of the four named storms in 2021.

Impacts of the 2021 Hurricane Season on Massachusetts



Graphic courtesy of NOAA

T.S. Elsa crossed eastern Massachusetts on July 9, delivering wind and flooding rains while transitioning to an extratropical storm later that day. Approximately 2 to 4 inches of rain were recorded in many towns. MBTA commuter rail trains were delayed on the Worcester line due to flooding, and Route 146 was flooded. About 11,000 Eversource customers in Massachusetts lost power.

Extratropical Storm Fred crossed northern Massachusetts lengthwise on August 19 and 20, delivering flooding rains to parts of southern New England. Flooding in Massachusetts was worst in the Worcester area. Approximately 2 to 4 inches of rain were recorded in many towns.

T.D. Henri crossed eastern Massachusetts on August 24, delivering flooding rains to parts of southern New England. Prior to crossing Massachusetts, the storm looped through Connecticut and New York on August 22-24. The path and slow movement of the storm contributed to widespread flooding in all three states, made worse due to the conditions caused by storm Fred only a few days before. Approximately 1 to 4.5 inches of rain were recorded in many towns. About 12,000 Eversource customers in Massachusetts lost power.

Extratropical Storm Ida passed south of New England and crossed Nantucket on September 2, delivering flooding rains to parts of southern New England. The precipitation from Ida was more intense than expected, and it caused widespread flooding. Approximately 2 to 6 inches of rain were recorded in many towns. About 4,000 people in Massachusetts lost power.

Figure 21. Tracks for Tropical Storms that Impacted Massachusetts 2021.

Even without the presence of a catastrophic hurricane striking Wellesley in the last few decades, less severe tropical storms and remnants have created significant disruptions and necessitated public expenditures.

Extent

Hurricanes are measured according to the Saffir-Simpson scale, which categorizes or rates hurricanes from 1 (minimal) to 5 (catastrophic) based on their intensity. This is used to give an estimate of the potential property damage and flooding expected along the coast from a hurricane landfall. Wind speed is the determining factor in the scale, inherently leaving out any measure of precipitation and flooding.

Table 36. Saffir-Simpson Scale.

Saffir-Simpson Hurricane Wind Scale

	Sustained Winds	Types of Damage Due to Hurricane Winds
1	74-95 mph 64-82 kt 119-153 km/h	**Damaging winds will produce some damage:** Well-constructed framed homes could have damage to roof, shingles, vinyl siding, and gutters. Large branches of trees will snap, and shallow-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 83-95 kt 154-177 km/h	**Very strong, damaging winds will cause widespread damage:** Well-constructed framed homes could sustain major roof and siding damage. Many shallow-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 (major)	111-129 mph 96-112 kt 178-208 km/h	**Dangerous winds will cause extensive damage:** 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 (major)	130-156 mph 113-136 kt 209-251 km/h	**Extremely dangerous winds will cause devastating damage:** 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 (major)	157 mph or higher 137 kt or higher 252 km/h or higher	**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.

Source: National Hurricane Center, NOAA

Tropical storms and tropical depressions, while generally less dangerous than hurricanes, can be deadly. The winds of tropical depressions and tropical storms are usually not the greatest threat; rather, the rains, flooding, and severe weather associated with the tropical storms are what customarily cause more significant problems. Nevertheless, serious power outages can also be associated with these types of events.

The NWS issues a hurricane warning when sustained winds of 74 mph or higher are expected in a specified area in association with a tropical, subtropical, or post-tropical cyclone. A warning is issued 36 hours in advance of the anticipated onset of tropical-storm-force winds. A hurricane watch is announced when sustained winds of 74 mph or higher are possible within the specified area in association with a tropical, subtropical, or post-tropical cyclone. A watch is issued 48 hours in advance of the anticipated onset of tropical-storm-force winds (NWS, 2013).

Probability of Future Events

The SHMCAP notes that Massachusetts experiences an average of one storm every other year or 0.5 storms per year. Storms severe enough to receive FEMA disaster declarations are far rarer, occurring every 9 years on average. According to NOAA, a Category 1 hurricane can be expected to make landfall in/near southern New England once every 17 years. A Category 2 hurricane could be expected to make landfall once every 39 years, and a Category 3 hurricane has a calculated return period of 68 to 70 years.

Some researchers have suggested that the intensity of tropical cyclones has increased over the last 40 years, with some believing that there is a connection between this increase in intensity and climate change. While most climate simulations agree that greenhouse warming enhances the frequency and intensity of tropical storms, models of the climate system are still limited by resolution and computational ability. However, given the history of major storms and the possibility of increased frequency and intensity of tropical storms due to climate change, it is prudent to expect that there will be hurricanes impacting Wellesley in the future that may be of greater frequency and intensity than in the past.

Vulnerability Assessment

Exposure

High winds and heavy rain and/or hail associated with hurricanes and tropical storms can cause damage to utilities, structures, roads, trees (potentially causing vehicle accidents) and injuries and death. Other associated concerns are debris management issues including debris removal and identification of disposal sites. All assets in Wellesley should be considered exposed to high winds. Figure 22 shows the 100-year windspeeds identified in the ASCE 7-98 publication.

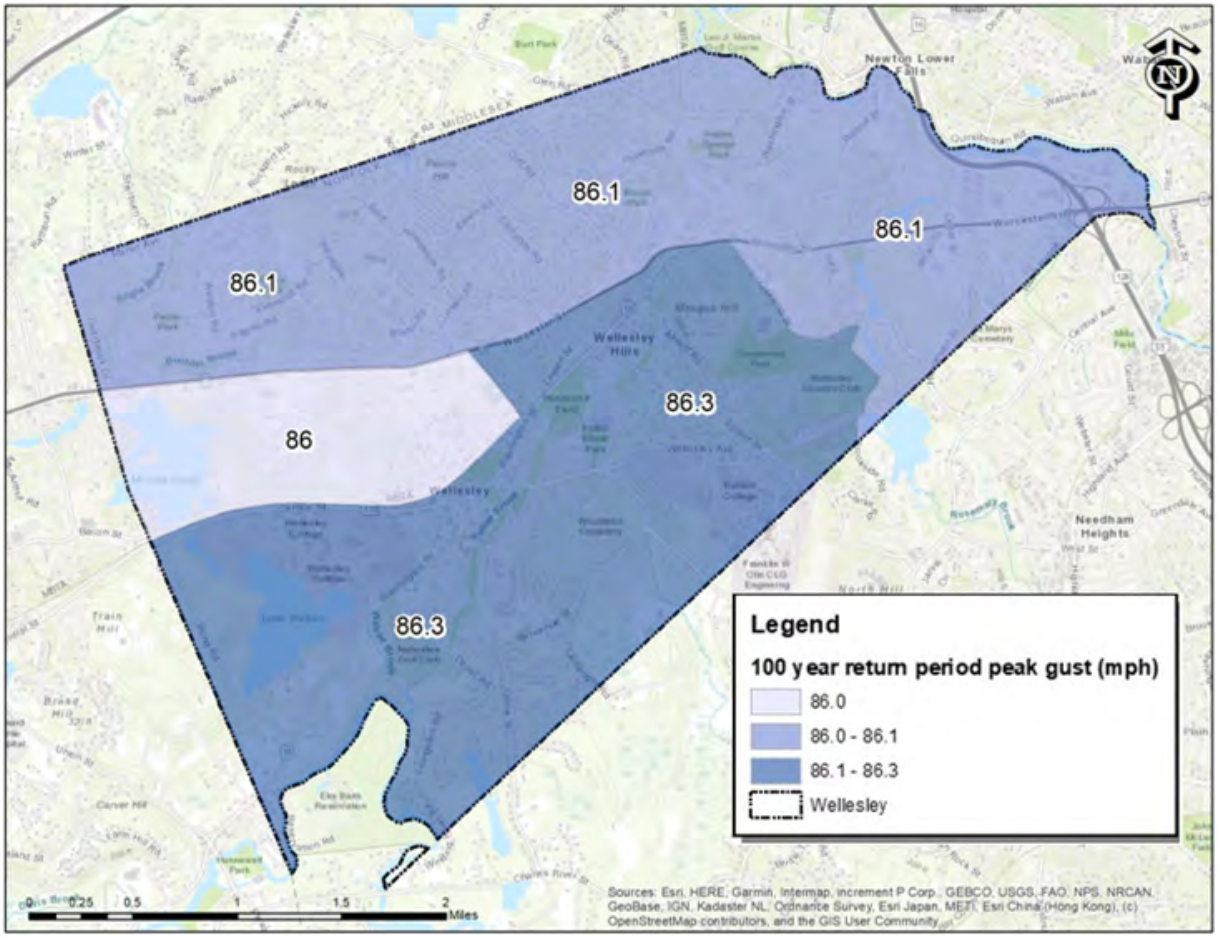


Figure 22. 100-Year Windspeeds (ASCE 7-98).

Built Environment Impacts

To identify built environment impacts to the Town, FEMA's risk assessment software, Hazus, was implemented. The economic loss results of the 500-year event are shown in Table 37 while the results for the 1000-year event are shown in Table 38. The Town's Average Annual Loss (AAL) is calculated to be $1,415,000.

Table 37. Building Loss for a 500-Year Scenario.

Loss Type	Residential ($Million)	Commercial ($Million)	Other Occupancy ($Million)	Total ($Million)
Building Loss	76.3	6.8	1.4	**84.5**
Content Loss	27.3	1.6	0.4	**29.3**
Business Inventory Loss	0.0	0.0	0.0	**0.0**
Business Income Loss	0.0	1.1	0.1	**1.2**
Business Relocation Loss	2.1	1.1	0.1	**3.3**
Rental Income Loss	1.1	0.7	0.0	**1.8**
Wage Loss	0.0	0.8	0.5	**1.3**
Total	**106.8**	**12.1**	**40.3**	**159.2**

Table 38. Building Loss for a 1000-Year Scenario.

Loss Type	Residential ($Million)	Commercial ($Million)	Other Occupancy ($Million)	Total ($Million)
Building Loss	119.2	11.8	2.5	**133.5**
Content Loss	44.6	3.3	0.8	**48.7**
Business Inventory Loss	0.0	0.0	0	**0.0**
Business Income Loss	0.0	1.3	0.2	**1.5**
Business Relocation Loss	5.1	1.8	0.4	**7.3**
Rental Income Loss	2.4	1.0	0	**3.4**
Wage Loss	0.0	1.1	0.6	**1.7**
Total	**171.3**	**20.3**	**4.5**	**196.1**

Population Impacts

Populations considered most vulnerable to hurricane and tropical storm impacts in Wellesley are identified based on a number of factors including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. For high windspeeds, it’s important to maintain the building envelope during the event. If a window or door fails, damage to the structure will be much greater. Table 13 summarizes the senior and low-income populations in Wellesley. It should be noted that there may be overlap within the two categories, so that the total number of persons exposed may be lower than what is shown in the table. However, the Town should be aware of the potential needs of residents within these population segments in the event of a hazard occurrence.

For the 500-year event, Hazus predicts that there will be up to 50 displaced households with 25 to 50 people seeking public shelter from the high windspeeds alone. However, if the rainfall leads to flooding, families may be displaced (see flood section). For the 1000-year event, Hazus predicts nearly 100 displaced households with 50 to 75 people seeking public shelter.

Environment Impacts

Hurricanes can cause damage to parks, and other, natural areas. Some areas of the Town may be out of service until trees are removed.

Problem Statements for Hurricanes/Tropical Storms

Table 39. Problem Statements for Hurricanes/Tropical Storms.

Assets	Problems Associated with Hurricanes and Tropical Storms
People (including underserved communities and socially vulnerable populations)	• Vulnerable populations may need to be evacuated and could be displaced from their homes.
Structures (including facilities, lifelines, and critical infrastructure)	• Consistent flood events have impacted Route 9, numerous other roads, and water and sewer infrastructure as noted in the problem statements for flooding. • Wind may cause trees to fall into structures, electric and other infrastructure, and roadways. • Wind damage to wind-susceptible buildings such as carports, greenhouses, and open-walled recreational buildings. Additional damage to commercial buildings with HVAC located on roofs.
Systems (including networks and capabilities)	• The emergency preparedness and response capabilities of DPW and the Town's Municipal Light Plant (MLP) may be stretched thin immediately before and after a major hurricane impacting the region. • Electric grid may go down during high wind event.

Natural, historic, and cultural resources	• Historic buildings may experience damage during high wind events, especially the roofing and windows. Water entering these buildings could impact important historic and cultural artifacts.
Activities that have value to the community	• A severe hurricane wind and rain event could negatively impact outdoor activities in the Town.

Severe Winter Storms

Severe winter storms include ice storms, nor'easters, heavy snow, blowing snow, and other extreme forms of winter precipitation. These are often accompanied by very low temperatures which were previously addressed.

The Town of Wellesley Community Resilience Building Workshop Summary of Findings (2020) lists "Intense storms" as one of the top four hazards of concern.

Description

Blizzard: A blizzard is a winter snowstorm with sustained or frequent wind gusts to 35 mph or more, accompanied by blowing snow that reduces visibility to or below a quarter of a mile (NWS, 2018). These conditions must be the predominant condition over a 3-hour period. Extremely cold temperatures are often associated with blizzard conditions but are not a formal part of the definition. However, the hazard created by the combination of snow, wind, and low visibility increases significantly with temperatures below 20ºF. A severe blizzard is categorized as having temperatures near or below 10°F, winds exceeding 45 mph, and visibility reduced by snow to near zero.

Storm systems powerful enough to cause blizzards usually form when the jet stream dips far to the south, allowing cold air from the north to clash with warm air from the south. Blizzard conditions often develop on the northwest side of an intense storm system. The difference between the lower pressure in the storm and the higher pressure to the west creates a tight pressure gradient, resulting in strong winds and extreme conditions due to the blowing snow. Blowing snow is wind-driven snow that reduces visibility to 6 miles or less, causing significant drifting. Blowing snow may be snow that is falling and/or loose snow on the ground picked up by the wind.

Ice Storms: Ice storm conditions are defined by liquid rain falling and freezing on contact with cold objects, creating ice buildups of one-fourth of an inch or more. These can cause severe damage to vegetation, utilities, and structures. An ice storm warning, which is now included in the criteria for a winter storm warning, is issued when a half inch or more of accretion of freezing rain is expected. This may lead to dangerous walking or driving conditions and the pulling down of power lines and trees. Ice pellets are another form of freezing precipitation, formed when snowflakes melt into raindrops as they pass through a thin layer of warmer air. The raindrops then refreeze into particles of ice when they fall into a layer of subfreezing air near the surface of the earth. Finally, sleet occurs when raindrops fall into subfreezing air thick enough that the raindrops refreeze into ice before hitting the ground. The difference between sleet and hail is that sleet is a wintertime phenomenon whereas hail falls from convective clouds (usually thunderstorms), often during the warm spring and summer months.

Nor'easters: A nor'easter is a storm that occurs along the East Coast of North America. A nor'easter is characterized by a large counterclockwise wind circulation around a low-pressure center that often results in heavy snow, high winds, and rain. A nor'easter gets its name from its continuously strong northeasterly winds blowing in from the ocean ahead of the storm and over the coastal areas.

Nor'easters are among winter's most ferocious storms. These winter weather events are notorious for producing heavy snow, rain, and oversized waves that crash onto Atlantic beaches, often causing beach erosion and structural damage. These storms occur most often in late fall and early winter. The storm radius is often as much as 100 miles, and nor'easters often sit stationary for several days, affecting multiple tide cycles and causing extended heavy precipitation. Sustained wind speeds of 20 to 40 mph are common during a nor'easter, with short-term wind speeds gusting up to 50 to 60 mph.

Location

Although the entire Commonwealth may be considered at risk to the hazard of severe winter storms, higher snow accumulations appear to be prevalent at higher elevations in Western and Central Massachusetts, and along the coast where snowfall can be enhanced by additional ocean moisture. Ice storms occur most frequently in the higher-elevation portions of Western and Central Massachusetts. Overall, winter storms can affect the entirety of Massachusetts, including the geographic extent of Wellesley.

Previous Occurrences

Winter storms occur somewhat regularly in Massachusetts. Four of the disasters declared in Massachusetts from 2012 through 2021 were associated with winter storms, and all four covered Norfolk County and therefore the Town of Wellesley:

- Massachusetts Severe Winter Storm, Snowstorm, and Flooding (DR-4110-MA)
  Incident Period: February 8, 2013 - February 9, 2013
  Major Disaster Declaration declared on April 19, 2013
  Public Assistance (PA) reimbursements eligible for entire state

- Massachusetts Severe Winter Storm, Snowstorm, and Flooding (DR-4214-MA)
  Incident Period: January 26, 2015 - January 28, 2015
  Major Disaster Declaration declared on April 13, 2015
  PA reimbursements eligible for Worcester County and eastward

- Massachusetts Severe Winter Storm and Flooding (DR-4372-MA)
  Incident Period: March 2, 2018 - March 3, 2018
  Major Disaster Declaration declared on June 25, 2018
  PA reimbursements eligible for Norfolk, Essex, Bristol, Plymouth, Cape and Islands

- Massachusetts Severe Winter Storm and Snowstorm (DR-4379-MA)
  Incident Period: March 13, 2018 - March 14, 2018
  Major Disaster Declaration declared on July 19, 2018
  PA reimbursements eligible for Worcester, Middlesex, Suffolk, Norfolk, Essex Counties

The storms of January 2015 and March 2018 were subject to Emergency Declarations in Massachusetts, as well. The PA assistance reimbursements associated with the winter storms of 2013, 2015, and 2018 for the Town and its two universities totaled $808,433. This indicates that severe winter storms comprised a substantial expenditure for Wellesley and the two universities over the course of a decade.

The NOAA Storm Events database (https://www.ncdc.noaa.gov/stormevents/) for Norfolk County does not list any severe winter storm events impacting Wellesley for the period 2012-2021.

Extent

Snowfall is a component of multiple hazards, including nor'easters and severe winter storms. Two scores, the *Regional Snowfall Index (RSI) and the NESIS*, are described in this section.

Since 2005, the RSI has become the descriptor of choice for measuring winter events that impact the eastern two-thirds of the U.S. The RSI ranks snowstorm impacts on a scale system from 1 to 5. The RSI is like the Fujita scale for tornadoes or the Saffir-Simpson scale for hurricanes, except that it includes an additional variable: population. The RSI is based on the spatial extent of the storm, the amount of snowfall, and population (NOAA, n.d.).

The RSI is a regional index. Each of the six climate regions (identified by the NOAA National Centers for Environmental Information) in the eastern two-thirds of the nation has a separate index. The RSI incorporated region-specific parameters and thresholds for calculating the index. The RSI is important because, with it, a storm event and its societal impacts can be assessed within the context of a region's historical events. Snowfall thresholds in Massachusetts (in the Northeast region) are 4, 10, 20, and 30 inches of snowfall, while thresholds in the Southeast U.S. are 2, 5, 10, and 15 inches.

Table 40. RSI Scale.

Category	RSI Value	Event Description
1	1 to 3	Notable
2	3 to 6	Significant
3	6 to 10	Major
4	10 to 18	Crippling
5	18+	Extreme

Source: NOAA

Prior to the use of the RSI, the Northeast Snowfall Impact Scale, developed by Paul Kocin of The Weather Channel and Louis Uccellini of the NWS, was used to characterize, and rank high- impact northeast snowstorms with large areas of 10-inch snowfall accumulations and greater. In contrast to the RSI, which is a regional index, NESIS is a quasi-national index that is calibrated to Northeast snowstorms. NESIS has five categories. The RSI and NESIS approaches do not include separate scales for ice storms; in general, ice storm extent is expressed on a case-by-case basis, and forecasts will provide the information needed to determine how to prepare and respond.

Meteorologists can often predict the likelihood of a severe storm or nor'easter. This can give several days of warning time. The NOAA's NWS monitors potential events and provides extensive forecasts and information several days in advance of a winter storm to help the state to prepare for the incident.

Probability of Future Events

The SHMCAP notes that Massachusetts experiences high-impact snowstorms at approximately the rate of one per year, although there is significant interannual variability in the frequency and severity of winter storms. The Town of Wellesley should assume that winter storms are likely, even if the impacts of climate change will shift the timing to a shorter winter season. Heavy wet snowfall may be more common in the future. The overall probability of winter storms of all kinds, including blizzards and ice storms, is believed high.

Vulnerability Assessment

Exposure

Heavy snowfall coupled with low temperatures often results in increases in traffic accidents; disruptions in transportation, commerce, government, and education; utility outages due to falling trees, branches, and other objects; personal injuries associated with slippery surfaces and freezing temperatures; and numerous other problems. Specific damages associated with severe winter storm (snow) events include:

- Injuries and fatalities associated with accidents, low temperatures, power loss, falling objects and accidents associated with frozen and slippery surfaces and snow accumulation.
- Increases in the frequency and impact of traffic accidents, resulting in personal injuries .
- Ice-related damage to trees, building and infrastructure inventory, and utilities (power lines, bridges, substations, etc.).
- Roads damaged through freeze and thaw processes.
- Stress on the local shelters and emergency response infrastructure.
- Lost productivity that occurs when people cannot go to work, school, or stores due to inclement conditions.

The entire Town should be considered exposed to the severe winter storm hazard.

Built Environment Impacts

The entire built environment of Wellesley is vulnerable to a severe winter storm. New England's climate offers no immunity to the potential damaging effects of severe winter storms. Some minimum damage is anticipated annually, with potential extensive damage occurring about once every 10 years.

Figure 23. Ice Storm Tree Damage in Wellesley.

Since Hazus doesn't support severe winter storms and there aren't other readily available severe winter storm models, historical data was used to determine potential losses and probabilities. From 2012 until 2021, there was $808,433 in storm damage to Wellesley. This equates to an AAL of $80,843.

Population Impacts

As discussed above, some traffic accidents associated with storm events include injuries and in limited cases, deaths. However, the number of injuries and deaths reported for accidents is generally low. Populations considered most vulnerable to severe winter storm impacts are identified based on a number of factors including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. Table 13 summarizes the senior and low-income populations in Wellesley. It should be noted that there may be overlap within the two categories, so that the total number of persons exposed may be lower than what is shown in the table. However, the Town should be aware of the potential needs of residents within these population segments in the event of a hazard occurrence.

Environment Impacts

Severe winter storms can cause damage to parks and other, natural areas. Some areas of the Town may be out of service until roads are cleared and trees are removed.

Problem Statements for Severe Winter Storms

Table 41. Problem Statements for Severe Winter Storms.

Assets	Problems Associated with Severe Winter Storms
People (including underserved communities and socially vulnerable populations)	• Vulnerable populations may be stranded during a winter storm event and may not be able to travel to emergency services.
Structures (including facilities, lifelines, and critical infrastructure)	• Ice dams may cause damage to structures.
Systems (including networks and capabilities)	• Severe winter storms comprised a substantial expenditure for Wellesley and the two universities in Wellesley over the course of the last decade. • Electrical grid and roadways are susceptible to failure during storms.
Natural, historic, and cultural resources	• Severe storms may damage trees in natural areas, and historical and cultural sites.
Activities that have value to the community	• Outdoor activities may be adversely impacted by severe winter storms.

Tornadoes

Tornadoes are a relatively infrequent occurrence but can be very destructive when they occur. While small tornadoes in outlying areas cause little to no damage, larger tornadoes in populated sections of Massachusetts have historically caused significant damage, injury, and death through the destruction of trees, buildings, vehicles, and power lines.

The Town of Wellesley Community Resilience Building Workshop Summary of Findings (2020) lists “Intense storms” as one of the top four hazards of concern.

Description

A tornado is a narrow rotating column of air that extends from the base of a cumulonimbus cloud to the ground. The observable aspect of a tornado is the rotating column of water droplets, dust, and debris caught in the column. Tornadoes are the most violent of all atmospheric storms.

Tornadoes can form from individual cells within severe thunderstorm squall lines. They can also form from an isolated supercell thunderstorm. They can be spawned by tropical cyclones or the remnants thereof, and weak tornadoes can even occur from little more than a rain shower if air is converging and spinning upward.

Most tornadoes occur in the late afternoon and evening hours when the heating is the greatest. The most common months for tornadoes to occur are June, July, and August, although the Great Barrington tornado (1995) occurred in May.

A waterspout is a rapidly rotating column of air extending from the cloud base (typically a cumulonimbus thunderstorm) to a water surface, such as a bay or the ocean. They can be formed in the same way as regular tornadoes or can form on a clear day with the right amount of instability and wind shear. Tornadic waterspouts can have wind speeds of 60 to 100 mph, but since they do not move very far, they can often be navigated around. They can become a threat to land if they drift onshore.

Location

The U.S. experiences an average of 1,253 tornadoes per year, more than any other country (NOAA, n.d.). Because Massachusetts experiences fewer tornadoes than other parts of the country, residents may be less prepared to react to a tornado. The SHMCAP notes that the area at greatest risk for a tornado touchdown runs from central to northeastern Massachusetts. Wellesley is just outside this area.

Previous Occurrences

The most devastating tornado to occur in New England was the Worcester Tornado of July 9, 1953, a category F4 tornado. The tornado passed through Barre, Rutland, Holden, Worcester, Shrewsbury, Westborough, and Southborough causing 90 deaths and over 1,300 injured. Damage estimates were placed more than $52 million. The National Storm Prediction Center has ranked this as one of the deadliest tornados in the nation's history. The most recent severe tornado to impact Massachusetts occurred June 1, 2011, affecting communities in Hampden and Worcester Counties. The EF3 tornado touched down in Westfield and traveled through West Springfield, Springfield, Wilbraham, Monson, Brimfield, and Sturbridge. The tornado caused extensive property damage and resulted in a FEMA disaster declaration.

Notwithstanding previous occurrences in Massachusetts, no known tornados have touched down in Wellesley. The NOAA Storm Events database (https://www.ncdc.noaa.gov/stormevents/) for Norfolk

County lists a variety of severe storms in Wellesley from 2012 through 2021, but none were caused by or associated with tornadoes.

Extent

The NWS rates tornadoes using the Enhanced Fujita scale (EF scale), which does not directly measure wind speed but rather the amount of damage created. This scale derives 3-second gusts estimated at the point of damage based on the assignment of 1 out of 8 degrees of damage to a range of different structure types. These estimates vary with height and exposure. This method is considerably more sophisticated than the original Fujita scale, and it allows surveyors to create more precise assessments of tornado severity.

Table 42. Enhanced Fujita Scale.

EF Rating	Wind Speeds	Expected Damage		
EF-0	65-85 mph	'Minor' damage: shingles blown off or parts of a roof peeled off, damage to gutters/siding, branches broken off trees, shallow rooted trees toppled.		
EF-1	86-110 mph	'Moderate' damage: more significant roof damage, windows broken, exterior doors damaged or lost, mobile homes overturned or badly damaged.		
EF-2	111-135 mph	'Considerable' damage: roofs torn off well constructed homes, homes shifted off their foundation, mobile homes completely destroyed, large trees snapped or uprooted, cars can be tossed.		
EF-3	136-165 mph	'Severe' damage: entire stories of well constructed homes destroyed, significant damage done to large buildings, homes with weak foundations can be blown away, trees begin to lose their bark.		
EF-4	166-200 mph	'Extreme' damage: Well constructed homes are leveled, cars are thrown significant distances, top story exterior walls of masonry buildings would likely collapse.		
EF-5	> 200 mph	'Massive/incredible' damage: Well constructed homes are swept away, steel-reinforced concrete structures are critically damaged, high-rise buildings sustain severe structural damage, trees are usually completely debarked, stripped of branches and snapped.		

Source: National Weather Service

Tornado watches and warnings are issued by the local NWS office. A tornado watch is released when tornadoes are possible in an area. A tornado warning means a tornado has been sighted or indicated by weather radar. The current average lead time for tornado warnings is 13 minutes. Occasionally, tornadoes develop so rapidly that little, if any, advance warning is possible.

Probability of Future Events

According to the SHMCAP, the Commonwealth experienced 171 tornadoes from 1950 to 2017, or an average annual occurrence of 2.6 tornado events per year. In the last 20 years, the average frequency of these events has been 1.7 events per year (NOAA, 2018). Massachusetts experienced an average of 1.4 tornadoes per 10,000 square feet annually between 1991 and 2010, less than half of the national average of 3.5 tornadoes per 10,000 square feet per year (NOAA, n.d.). As highlighted in the National Climate Assessment, tornado activity in the U.S. has become more variable, and increasingly so in the last two decades. While the number of days per year that tornadoes occur has decreased, the number of tornadoes on these days has increased. Climate models show projections that the frequency and intensity of severe thunderstorms (which include tornadoes, hail, and winds) will increase (USGCRP, 2017).

Vulnerability Assessment

Exposure

High winds, heavy rain, lightning and/or hail associated with tornados, thunderstorms and microbursts can cause damage to utilities, structures, roads, trees (potentially causing vehicle accidents) and injuries and death. The entire Town should be considered exposed to the tornado hazard.

Built Environment Impacts

Since Hazus doesn't support tornadoes and there aren't other readily available tornado models, historical data will be used to determine potential losses and probabilities. From 1955 until 2021, there was $1.606M in property damage to Norfolk County. This equates to an AAL of $23,970. To make this more relevant to the Town itself the population of Wellesley (29,550) was divided by the population of Norfolk County (725,981) to create a population index (0.0407). That index is then multiplied by the county's AAL to get $976, the Town's AAL.

Population Impacts

Populations considered most vulnerable to tornado impacts in Wellesley are identified based on a number of factors including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. Table 13 summarizes the senior and low-income populations in Wellesley. It should be noted that there may be overlap within the two categories, so that the total number of persons exposed may be lower than what is shown in the table. However, the Town should be aware of the potential needs of residents within these population segments in the event of a hazard occurrence.

Environment Impacts

Tornadoes can cause damage to parks, and other, natural areas. Some areas of the Town may be out of service until trees are removed.

Problem Statements for Tornadoes

Table 43. Problem Statements for Tornadoes.

Assets	Problems Associated with Tornadoes
People (including underserved communities and socially vulnerable populations)	• Vulnerable populations may need support seeking protected shelter. Those without cell phones may not get weather alerts. • People without basements are susceptible to tornado impacts.
Structures (including facilities, lifelines, and critical infrastructure)	• Structures and critical infrastructure can all be impacted by tornadoes. • Roadways may be blocked due to downed trees and other debris.
Systems (including networks and capabilities)	• Electric grid may be impacted by winds and downed trees.
Natural, historic, and cultural resources	• Historic and cultural resources may be impacted by tornado winds. • Winds may damage trees and cause natural areas to close for cleanup.
Activities that have value to the community	• Outdoor events could be impacted by potential tornado activity.

Other Severe Weather

Several frequent natural hazards in Massachusetts – particularly strong winds and extreme precipitation events – occur outside of notable storm events. This section discusses the nature and impacts of these hazards, as well as ways in which they are likely to respond to climate change.

The Town of Wellesley Community Resilience Building Workshop Summary of Findings (2020) lists “Intense storms” as one of the top four hazards of concern.

Description

Thunderstorms: A thunderstorm is a storm originating in a cumulonimbus cloud. Cumulonimbus clouds produce lightning, which locally heats the air to 50,000 degrees Celsius, which in turn produces an audible shock wave known as thunder. Frequently during thunderstorm events, heavy rain and gusty winds are present. Less frequently, hail is present, which can become very large in size. Tornadoes can also be generated during these events. An average thunderstorm is 15 miles across and lasts 30 minutes, but severe thunderstorms can be much larger and longer.

Figure 24. Thunderstorm Flooding in Wellesley.

Three basic components are required for a thunderstorm to form: moisture, rising unstable air, and a lifting mechanism. The sun heats the surface of the earth, which warms the air above it. If this warm surface air is forced to rise, it will continue to rise as long as it weighs less and stays warmer than the air around it. As the warm surface air rises, it transfers heat from the surface of the earth to the upper levels of the atmosphere (the process of convection). The water vapor it contains begins to cool, releasing the heat, and the vapor condenses into a cloud. The cloud eventually grows upward into areas where the temperature is below freezing. Some of the water vapor turns to ice, and some of it turns into water droplets. Both have electrical charges. When a sufficient charge builds up, the energy is discharged in a bolt of lightning, which causes the sound waves we hear as thunder.

Downbursts: A downburst is a severe localized wind blasting down from a thunderstorm. They are more common than tornadoes. Depending on the size and location of downburst events, the destruction to property may be significant. Downbursts fall into two categories:

1. Microbursts affect an area less than 2.5 miles in diameter, last 5 to 15 minutes, and can cause damaging winds up to 168 mph.
2. Macrobursts affect an area at least 2.5 miles in diameter, last 5 to 30 minutes, and can cause damaging winds up to 134 mph.

An organized, fast-moving line of microbursts traveling across large areas is known as a “derecho.” These occasionally occur in Massachusetts. Downburst activity is, on occasion, mistaken for tornado activity. Both storms have very damaging winds (downburst wind speeds can exceed 165 mph) and are very loud. These "straight line" winds are distinguishable from tornadic activity by the pattern of destruction and debris such that the best way to determine the damage source is to fly over the area.

Hail: Hailstones are chunks of ice that grow as updrafts in thunderstorms keep them in the atmosphere. Most hailstones are smaller in diameter than a dime, but stones weighing more than 1.5 pounds have been recorded. NOAA has estimates of the velocity of falling hail ranging from 9 meters per second (m/s) (20 mph) for a 1-centimeter (cm)-diameter hailstone to 48 m/s (107 mph) for an 8 cm, 0.7 kilogram stone.

Lightning: Lightning is a discharge of electricity that occurs between the positive and negative charges within the atmosphere or between the atmosphere and the ground. According to NOAA, the creation of lightning during a storm is a complicated process that is not fully understood. In the initial stages of development, air acts as an insulator between the positive and negative charges. However, when the potential between the positive and negative charges becomes too great, a discharge of electricity (lightning) occurs. In-cloud lightning occurs between the positive charges near the top of the cloud and the negative charges near the bottom. Cloud-to-cloud lightning occurs between the positive charges near the top of the cloud and the negative charges near the bottom of a second cloud. Cloud-to-ground lightning is the most dangerous. In summertime, most cloud-to-ground lightning occurs between the negative charges near the bottom of the cloud and positive charges on the ground.

Location

High wind events, thunderstorms, lightning, and hail can affect the entirety of Massachusetts, including the geographic extent of Wellesley.

Previous Occurrences

The NOAA Storm Events database (https://www.ncdc.noaa.gov/stormevents/) for Norfolk County lists numerous severe storms affecting Wellesley from 2012 through 2021. The individual damage figures for these events appear nominal but given the frequency of events, the overall losses from severe storms are striking. Some of these events were truly associated with winter storms, but the lack of snowfall contributed to them being classified as high wind events by NOAA.

- 1/13/2012 – Strong Wind: A cold front moved across Southern New England ushering in a period of strong cold air advection. Strong to damaging, high winds resulted. Trees were reported down in Wellesley across Forest Street and Suffolk Road. Damage of $10,000 was reported.
- 2/25/2012 – High Wind: Deepening low pressure moving across Maine resulted in strong and damaging winds across southern New England. Trees were downed in Brookline and Wellesley. Damage of $20,000 was reported.
- 8/10/2012 – Thunderstorm Wind: A series of upper-level disturbances rotated around a vertically stacked low pressure system in the Great Lakes. These provided a focus for showers and thunderstorms to develop across southern New England. A tree and wires were downed in Wellesley by thunderstorm winds. Damage of $5,000 was reported.

- 5/21/2013 – Hail: A backdoor cold front pushing south through New England produced isolated severe thunderstorms in western and central Massachusetts during the afternoon and evening, including Wellesley.
- 7/29/2013 – Thunderstorm Wind: A cold front moving across Southern New England provided enough lift for showers and thunderstorms to develop in the warm, unstable environment ahead of the front. A few of these storms became severe resulting in both large hail and damaging winds. Up to one and a half inch diameter hail was reported as well as some tree damage. A tree on Route 135 East near Wellesley College was downed by thunderstorm winds. Another tree on Chatham Circle and power lines on Howe Street also were downed by thunderstorm winds. Damage in Wellesley was $20,000.
- 11/1/2013 – Strong Wind: An anomalously strong low pressure region (976mb) moved from Ontario into southern Quebec. Southern New England was sandwiched in between this and high pressure off the coast to the southeast, creating a very tight pressure gradient over the region. This resulted in strong gusty winds which caused some damage, especially to areas where the trees were still fully leaved. The Automated Surface Observing System at Norwood Memorial Airport (KOWD) recorded sustained wind speeds of 29 mph and gusts to 44 mph. Wires were downed onto Hundreds Road in Wellesley. A tree was downed in Wellesley, blocking two lanes of Route 9 Eastbound. Damage of $20,000 was reported for all affected towns.
- 3/26/2014 – Strong Wind: A large ocean storm intensified very quickly off the east coast. This storm brought extremely strong winds (gusting to over 80 mph) and heavy snow to the Cape and Islands. A utility pole was downed onto Sylvan Road in Wellesley. Damage of $8,000 was reported.
- 7/3/2014 – Thunderstorm Wind: An approaching cold front, combined with tropical moisture in advance of Hurricane Arthur, produced two rounds of showers and thunderstorms during the afternoon and evening. The storms produced wind damage primarily along and north of the Massachusetts Turnpike. A tree was downed onto a house on Crescent Street which damaged the windows. Another tree was downed on Wellesley Avenue. A large limb was downed on Weston Road and wires were downed on College Road. Damage of $20,000 was reported.
- 10/22/2014 – High Wind: Low pressure moving up the east coast brought a soaking rain and strong winds to much of southern New England. The strongest winds were along the east coast of Massachusetts where many trees were still fully leaved. This resulted in significant tree damage along with power outages. In Wellesley, trees were downed on River Street and blocking Route 16 near Wellesley College. Damage of $100,000 was reported among all towns, including Wellesley.
- 1/5/2015 – Strong Wind: Low pressure intensifying in the Maritimes led to blustery conditions across southern New England. While most locations remained below high wind warning criteria (40 mph sustained, 58 mph gusts), winds did damage in other parts of the state as well. In Wellesley, a utility pole was downed near the intersection of Washington Street and Wellesley Avenue. Damage of $15,000 was reported among all towns, including Wellesley.

- 8/4/2015 – Thunderstorm Wind: The second severe weather event for the day occurred north of the Massachusetts Turnpike. This severe weather was triggered by an approaching cold front from the west. As these storms developed across western Massachusetts, they began to produce wind gusts of 50 to 60 mph. Trees on Weston and Dover Roads were downed by thunderstorm winds. Damage of $10,000 was reported in Wellesley.
- 8/15/2015 – Thunderstorm Wind: A weak cold front moving through southern New England brought showers and thunderstorms to the region. These storms produced hail and damaging winds as well as some poor drainage street flooding. A large tree and wires on Pine Street were downed by thunderstorm winds. Damage of $5,000 was reported.
- 7/18/2016 – Thunderstorm Wind: A cold front moved through southern New England during the peak heating of the day, taking full advantage of the available instability. This resulted in showers and thunderstorms that produced damaging winds. Trees and branches on Dewing Path, Route 16, Brooke Street, Leighton Road, and Weston Road were downed by thunderstorm winds. One of the trees fell onto a house and another broke a utility pole. Damage of $50,000 was reported in Wellesley.
- 12/18/2016 – Strong Wind: Low pressure moving up the St Lawrence Valley brought strong gusty southwest winds to Southern New England. This caused scattered tree and wire damage in Massachusetts. A tree was reported down on route 9 in Wellesley across from Upwey Road. The Automated Surface Observation System at Blue Hill reported a wind gust to 52 mph. Damage of $700 was reported.
- 3/22/2017 – Strong Wind: Low pressure crossing Canada drew a cold front across New England the night of March 21. Brief snow squalls and strong gusty northwest winds followed on March 22. At 5:25 PM EST, the Automated Surface Observation System platform at Blue Hill Observatory on the Milton-Canton town line measured a wind gust of 49 mph. At 539 pm a tree was down on a house on Woodcliff Road in Wellesley. Damage of $15,000 was reported.
- 6/23/2017 – Thunderstorm Wind: Sea breeze front inland of the Massachusetts North Shore and strong winds at 5000 feet above the surface combined to bring damaging afternoon thunderstorms to the north and west of Boston. At 12:45 PM EST, a tree was brought down blocking Crescent Street in Wellesley. Damage of $1,000 was reported.
- 10/24/2017 – High Wind: Low pressure moved north through the Great Lakes. This swung a cold front slowly east into Southern New England on October 25. The front stalled over the region during the 25th before moving off to the east on the 26th. Strong low level winds brought a flow of tropical moisture ahead of the front. The strong winds aloft were brought to the surface in damaging wind gusts, with speeds reaching 45 to 55 mph. Trees were down on Indian Spring Way at Hillside Road in Wellesley. Damage of $10,000 was reported from all affected towns.
- 10/27/2018 – High Wind: Low pressure from the Gulf of Mexico moved up the East Coast on October 27th and 28th, bringing strong winds to Central and Eastern Massachusetts and minor

coastal flooding. At 10:16 AM, wires were down on Fairbanks Avenue in Wellesley. Damage of $5,000 was reported.

- 2/25/2019 – High Wind: A storm moving north through the Great Lakes redeveloped along the Mid Atlantic coast on the 24th, then moved up the coast past Southern New England. This coastal storm brought damaging west-northwest winds to Massachusetts as it moved off through the Maritimes on the 25th. At 1:43 PM EST an amateur radio operator at Wrentham reported a wind gust to 61 mph. At 5:38 PM EST a large tree was down on a house on Radcliffe Road in Wellesley. Damage of $33,000 was reported from all affected towns.
- 1/12/2020 – Strong Wind: High pressure offshore and a weather system over the Midwest combined to bring southwest winds along the Eastern Seaboard that led to some minor damage. An amateur radio operator reported a pole and wires down on Rt 9 in Wellesley. Damage of $1,000 was reported.
- 2/7/2020 – High Wind: Powerful low pressure moved from eastern Pennsylvania across central Connecticut and central Massachusetts on February 7, 2020. A southerly jet of 85 to 95 mph was just above the surface at 925 mb. Damaging winds occurred across much of eastern Massachusetts. There were widespread power outages and numerous trees down, some falling on homes and vehicles. In Wellesley, a large tree fell, closing Route 135 for a time. Damage of $15,000 was reported.
- 3/4/2020 – Strong Wind: Low pressure over Maine strengthened into a powerful cyclone over the Canadian maritime provinces. The cold front swept across New England, with strong west-northwest winds causing scattered damage in mainly northern and eastern Massachusetts. Winds generally were gusting to 45 to 55 mph. In Wellesley at 11:25 AM EST, a large branch was down on a house on Intervale Road. Damage of $1,800 was reported from all affected towns.
- 4/13/2020 – High Wind: A powerful low pressure system tracked across the Great Lakes and brought strong and damaging winds to all of Massachusetts Monday late morning through the evening. At the Norwood Airport a wind gust of 62 mph was reported at 2:39 PM EST (3:39 PM EDT). In Wellesley at 10:02 AM EST law enforcement reported a tree down across Washington Street and at 10:21 AM EST amateur radio reported a tree down on an access road to Rt 9. Damage of $1,100 was reported.
- 5/9/2020 – High Wind: Strong low pressure in the Gulf of Maine was exiting the region, but there was a strong northwest flow of air in its wake. Winds gusted to 45 to 55 mph across the region, causing scattered areas of downed trees, some which fell onto cars and homes. At 10:01 AM EST (11:01 AM EDT), the ASOS at Norwood Airport (KOWD) recorded a wind gust to 56 mph. In Wellesley at 9:45 AM EST, a tree was down on wires on Route 16. Damage of $6,800 was reported from all effected towns.
- 6/6/2020 – Thunderstorm Wind: A cold front pushed into a warm, humid air mass and produced two rounds of severe thunderstorms. One moved across the region in the afternoon and a

second round impacted eastern sections in the evening. In Wellesley, multiple trees were down on Kingsbury Street, Abbott Street, and Washington Street. Damage of $2,500 was reported.

- 7/2/2020 – Thunderstorm Wind: Late in the afternoon and early evening, a surface trough dropped southward from New Hampshire and caused severe thunderstorms in central and eastern Massachusetts and northern Rhode Island. In Wellesley, trees were down and into a house on Aberdeen Road. Also, a tree was down into a house on Bobolink Road. Damage of $30,000 was reported.
- 7/23/2020 – Thunderstorm Wind: A short-wave trough approached the region aloft while a pre-frontal trough moved into the area at the surface. producing severe thunderstorms in the afternoon. In Wellesley, a tree was down on Burke Lane at McLean Street. Damage of $500 was reported.
- 3/14/2021 – Strong Wind: An arctic cold front moved from north to south across southern New England during the afternoon and early evening, producing scattered snow squalls and strong west-northwest winds gusting to 45 to 55 mph. In Wellesley at 6 PM EDT (5 PM EST), a tree was down on State Road. Damage of $1,300 was reported.
- 6/21/2021 – Thunderstorm Wind: Hot, humid conditions prevailed across the region. Without much atmospheric forcing, it took a sea breeze boundary to set off strong thunderstorms, which became severe in eastern Massachusetts during the afternoon hours. A microburst with winds of approximately 65 mph caused damage in Waltham, Weston, and Wellesley. In Wellesley, a tree was downed, blocking Wall Street at Alba Road. Another tree was down at Bernard and Alba Roads. A large tree branch was down at the corner of Washington Street (Route 16) and Cliff Road. Damage of $1,200 was reported in Wellesley.
- 7/27/2021 – Thunderstorm Wind: A cold front entered a marginally unstable, but highly sheared environment during the late afternoon and evening hours. In Wellesley, a tree was down at the intersection of Walnut Street and Whittier Road. Also, a large branch was down at 33 Cedar Street. Damage of $800 was reported.

The Town's planning committee remembered the microburst of June 2021 and remarked that it was quite strong and caused widespread damage in Wellesley.

USDA declares agricultural disasters as needed for a variety of hazards. Information can be found at https://www.fsa.usda.gov/programs-and-services/disaster-assistance-program/disaster-designation-information/index. The single line item of events related to severe winds and hail in Norfolk County are listed below.

Table 44. USDA Disasters Events That Refer to Severe Storms.

Year	Event	Event "Begin Dates"
2016	Drought, high winds, wildfire, excessive heat, insects	8/24/2016, 9/21/2016

Extent

The strength of thunderstorms is typically measured in terms of its effects, namely the speed of the wind, the presence of significant lightning, and the size of hail. High winds are defined by the NWS as sustained non-convective winds of 35 knots (40 mph) or greater lasting for 1 hour or longer, or gusts of 50 knots (58 mph) or greater for any duration (NCDC, 2018). A thunderstorm is classified as "severe" when it produces damaging wind gusts in excess of 58 mph (50 knots), hail that is 1 inch in diameter or larger (quarter size), or a tornado (NWS, 2013).

Probability of Future Events

According to the NWS, an average of 100,000 thunderstorms per year occur in the United States. The SHMCAP notes that over the ten-year period between January 1, 2008, and December 31, 2017, a total of 435 high wind events occurred in Massachusetts on 124 days, and an annual average of 43.5 events occurred per year. This is consistent with the figure from the SHMCAP that thunderstorms typically occur on 20 to 30 days each year in Massachusetts, which is a subset of the 43.5 high wind event days.

NOAA reports that there are 10 downburst reports for every tornado report in the United States. This implies that there are approximately 10,000 downbursts reported in the United States each year and further implies that downbursts occur in approximately 10% of all thunderstorms in the United States annually. This figure suggests that downbursts are a relatively uncommon yet persistent hazard.

An average of 33 people per year died from lightning strikes in the United States from 2004 to 2013. Most lightning deaths and injuries occur outdoors, with 45% of lightning casualties occurring in open fields and ballparks, 23% under trees, and 14% involving water activities. The SHMCAP notes that 8 fatalities and 145 injuries have occurred in Massachusetts as a result of lightning events between 1993 and 2017 (NCDC, 2017).

According to NOAA's National Weather Service, hail caused two deaths and an average of 27 injuries per year in the United States from 2004 to 2013.

Climate models show projections that the frequency and intensity of severe thunderstorms (which include tornadoes, hail, and winds) will increase (USGCRP, 2017).

Vulnerability Assessment

Exposure

The entire built environment of Wellesley is vulnerable to the high winds and/or flooding from a severe weather event.

Figure 25. Storm Related Tree Damage in Wellesley.

Built Environment Impacts

Severe thunderstorms, and their associated hail and lightning events, brought about property damage in Wellesley in previous years. These storms with associated wind damage, caused an average annual property loss of $40,970K over 10 years to Wellesley.

Population Impacts

Some traffic accidents associated with storm events include injuries and deaths. However, the number of injuries and deaths reported for accidents is generally low. Populations considered most vulnerable to tornado, microburst and thunderstorm impacts in Wellesley are identified based on a number of factors including their physical and financial ability to react or respond during a hazard. Table 13 summarizes the senior and low-income populations in Wellesley. It should be noted that there may be overlap within the two categories, so that the total number of persons exposed may be lower than what is shown in the table. However, the Town should be aware of the potential needs of residents within these population segments in the event of a hazard occurrence.

Environment Impacts

Thunderstorms and microbursts can cause damage to parks and other, natural areas. Some areas of the Town may be out of service until trees are removed.

Problem Statements for Other Severe Weather

Table 45. Problem Statements for Other Severe Weather.

Assets	Problems Associated with Other Severe Weather
People (including underserved communities and socially vulnerable populations)	• People in Wellesley are disrupted by severe weather events such as the microburst of June2021 and other, more frequent wind and thunderstorm events.

Assets	Problems Associated with Other Severe Weather
Structures (including facilities, lifelines, and critical infrastructure)	• The individual damages for frequent severe weather events appear nominal, but given the frequency of events in Wellesley, the total damage to structures and property from severe storms is striking.
Systems (including networks and capabilities)	• The individual damage figures for frequent severe weather events appear nominal, but given the frequency of events in Wellesley, the total financial losses, and costs to recover from severe storms is significant.
Natural, historic, and cultural resources	• These can be adversely impacted depending on the specific locations of damage.
Activities that have value to the community	• These can be adversely impacted depending on the specific locations of damage.

Non Climate-Induced Hazards

Earthquakes

An earthquake is the vibration of the Earth's surface that follows a release of energy in the Earth's crust. New England experiences intraplate earthquakes because it is located within the interior of the North American plate. Although damaging earthquakes are rare in Massachusetts, low-magnitude earthquakes occur regularly in the state.

Description

An earthquake is a sudden rapid shaking of the earth caused by the breaking and shifting of rock beneath the earth's surface. Earthquakes can cause buildings and bridges to collapse; disrupt gas, electric, and telephone lines; and often cause landslides, flash floods, fires, avalanches, and tsunamis. Earthquakes can occur at any time without warning.

The underground point of origin of an earthquake is called its focus; the point on the surface directly above the focus is the epicenter. Earthquakes are described based on their magnitude and intensity as explained below under *Extent*.

New England's earthquakes appear to be the result of the cracking of the crustal rocks due to compression as the North American Plate is being very slowly squeezed by the global plate movements. As a result, New England epicenters do not follow the major mapped faults of the region, nor are they confined to particular geologic structures or terrains. Because earthquakes have been detected all over

New England, seismologists suspect that a strong earthquake could be centered anywhere in the region. Furthermore, the mapped geologic faults of New England currently do not provide any indications detailing specific locations where strong earthquakes are most likely to be centered.

In addition to earthquakes occurring within the Commonwealth, earthquakes in other parts of New England can impact widespread areas. Large earthquakes in Canada, which is more seismically active than New England, can affect buildings Massachusetts. This is due in part to the fact that earthquakes in the eastern U.S. are felt over a larger area than those in the western U.S. The difference between seismic shaking in the East versus the West is primarily due to the geologic structure and rock properties that allow seismic waves to travel farther without weakening (USGS, 2012).

In some places in New England, including locations in Massachusetts, small earthquakes seem to occur with some regularity. For example, since 1985 there has been a small earthquake approximately every 2.5 years within a few miles of Littleton. It is not clear why some localities experience such clustering of earthquakes, but clusters may indicate locations where there is an increased likelihood of future earthquake activity.

Location

Given the above discussion, the potential exists for earthquakes to occur within Wellesley or to occur elsewhere and be felt anywhere in Wellesley.

Previous Occurrences

According to the previous edition of this plan, no documented earthquakes have been centered in the Town of Wellesley. To determine whether earthquakes have occurred *recently* near or in Wellesley, all events listed by Weston Observatory were reviewed for all towns in Massachusetts for a five-year lookback. Listed earthquakes above magnitude 2.0 include:

- 12/21/18 – 3 km WSW of Gardner, 2.1/2.1 [Mn*/Mc**]
- 8/21/19 – 2 km SSE of Wareham, 1.7/2.4
- 12/3/19 – 4 km SSE of Plymouth, 1.6/2.2
- 11/8/20 – 11 km SW of New Bedford, 3.8/3.4
- 11/22/20 – 12 km WSW of New Bedford, 1.7/2.6

*Mn is the Nuttli Magnitude (see *Extent* below)
**Mc is the Coda Duration Magnitude (see *Extent* below)

These are very minor earthquakes.

On June 22, 2010, a magnitude 5.8 earthquake in Canada could be felt in Norfolk County. No damage was reported, but residents stated they felt the quake and were unnerved by the experience. On August 23, 2011, an earthquake measuring 5.8 on the Richter scale centered in Virginia was felt throughout the northeast, including in Wellesley.

Extent

Magnitude is an estimate of the relative size or strength of an earthquake and is related to the amount of seismic energy released at the hypocenter of the earthquake. It is based on the amplitude of earthquake waves recorded on instruments that have a common calibration. The magnitude of an earthquake is thus represented by a single instrumentally determined value recorded by a seismograph, which records the varying amplitude of ground oscillations.

The Richter scale was developed in 1935 and was used exclusively until the 1970s. It set the magnitude of an earthquake based on the logarithm of the amplitude of recorded waves. Being logarithmic, each whole number increase in magnitude represents a tenfold increase in measured strength. Earthquakes with a magnitude of about 2.0 or less are usually called "microearthquakes" and are generally only recorded locally. Earthquakes with magnitudes of 4.5 or greater are strong enough to be recorded by seismographs all over the world.

As more seismograph stations were installed around the world following the 1930s, it became apparent that the method developed by Richter was valid only for certain frequency and distance ranges, particularly in the southwestern United States. New magnitude scales that are an extension of Richter's original idea were developed for other areas. In particular, the Moment magnitude scale (Mw) was developed in the 1970s to replace the Richter scale and has been in official use by the USGS since 2002.

According to USGS, these multiple methods are used to estimate the magnitude of an earthquake because no single method is capable of accurately estimating the size of all earthquakes. Some magnitude types are calculated to provide a consistent comparison to past earthquakes, and these scales are calibrated to the original Richter scale. However, differences in magnitude of up to 0.5 can be calculated for the same earthquake through different techniques. In general, Moment magnitude provides an estimate of earthquake size that is valid over the complete range of magnitudes and so is commonly used today.

Although Moment magnitude is the most common measure of earthquake size for medium and larger earthquakes, the USGS does not calculate Mw for earthquakes with a magnitude of less than 3.5 which is the more common situation for Massachusetts. Localized Richter scales or other scales are used to calculate magnitudes for smaller earthquakes.

Regionally, the Weston Observatory utilizes two scales to track the magnitude of earthquakes. These include the Nuttli magnitude (Mn) for North America east of the Rocky Mountains and is more appropriate for the relatively harder continental crust in Connecticut compared to California. Weston

Observatory also utilizes the Coda Duration magnitude (Mc), which is based on the duration of shaking at a particular station. The advantages of the Coda Duration magnitude are that this method can quickly estimate the magnitude before the exact location of the earthquake is known.

The effect of an earthquake on the earth's surface is called the intensity. The Modified Mercalli Intensity Scale consists of a series of key responses such as people awakening, movement of furniture, damage to chimneys, and total destruction. This scale, composed of 12 increasing levels of intensity that range from imperceptible shaking to catastrophic destruction, is designated by Roman numerals. It is an arbitrary ranking based on observed effects.

Table 46. Modified Mercalli Intensity.

Modified Mercalli Intensity	Description
I	Not felt except by a very few under especially favorable conditions
II	Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing.
III	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibration similar to the passing of a truck. Duration estimated.
IV	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V	Felt by nearly everyone; many awakened. Some dishes and windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
VIII	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
IX	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.
XI	Few, if any (masonry), structures remain standing. Bridges destroyed. Rails bent greatly.
XII	Damage total. Lines of sight and level are distorted. Objects thrown in the air.

Source: USGS

A comparison of Richter magnitude to typical Modified Mercalli intensity is presented below.

Table 47. Modified Mercalli Intensity and Moment Magnitude.

Moment Magnitude	Typical Maximum Modified Mercalli Intensity
1.0 to 3.0	I
3.0 to 3.9	II to III
4.0 to 4.9	IV to V
5.0 to 5.9	VI to VII
6.0 to 6.9	VII to IX
7.0 and above	VIII or higher

Source: USGS

Probability of Future Events

Earthquake location and magnitude probabilities are exceptionally difficult to predict in Massachusetts. Minor earthquakes are relatively common in New England, but damaging earthquakes are not. Therefore, USGS instead characterizes the probability of ground acceleration rather than estimating a probability of magnitude. The Seismic Hazard Map for the state of Massachusetts (USGS) shows a peak ground acceleration of 14% to 16% of gravity in Wellesley having a 2% probability of being exceeded in 50 years.

Vulnerability Assessment

Exposure

A major earthquake could cause severe damage to Wellesley buildings, including older structures that were built before a 1975 law requiring new buildings to withstand earthquakes. Other associated concerns are debris management issues including debris removal and identification of disposal sites.

Built Environment Impacts

Historic data for earthquake events indicate that between 1991 and 2022, no major (>5.0 magnitude) earthquakes were recorded in Norfolk County during this period, causing no damage to property. The entire built environment of Wellesley is vulnerable to earthquakes. Older, unreinforced masonry buildings are very susceptible to earthquakes.

To identify built environment impacts to the Town, FEMA's risk assessment software, Hazus, was implemented. The economic loss results of the 1500-year event are shown in Table 48 while the results for the 2500-year event are shown in Table 49. The Town's Average Annual Loss (AAL) is modeled to be $229,904.

Table 48. Building Loss for a 1500-Year Scenario.

Loss Type	Residential ($Million)	Commercial ($Million)	Other Occupancy ($Million)	Total ($Million)
Building Loss	35.8	18.6	4.4	**58.8**
Content Loss	9.6	8.5	2.1	**20.2**
Business Inventory Loss	0.0	0.1	0.1	**0.2**
Business Income Loss	0.1	3.0	0.1	**3.2**
Business Relocation Loss	1.4	3.2	0.7	**5.3**
Rental Income Loss	1.1	2.3	0.1	**3.5**
Wage Loss	0.2	3.3	0.2	**3.7**
Total	**48.2**	**39.0**	**7.7**	**94.9**

Table 49. Building Loss for a 2500-Year Scenario.

Loss Type	Residential ($Million)	Commercial ($Million)	Other Occupancy ($Million)	Total ($Million)
Building Loss	67.2	34.9	8.3	**110.4**
Content Loss	23.3	15.6	4.0	**42.9**
Business Inventory Loss	0.0	0.2	0.2	**0.4**
Business Income Loss	0.2	5.7	0.2	**6.0**
Business Relocation Loss	2.7	6.1	2.5	**10.2**
Rental Income Loss	2.1	4.2	0.3	**6.5**
Wage Loss	0.4	6.3	1.2	**7.1**
Total	**95.9**	**73.0**	**14.6**	**183.5**

Population Impacts

Populations considered most vulnerable to earthquake impacts are identified based on a number of factors including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. Table 13 summarizes the senior and low-income populations in Wellesley. It should be noted that there may be overlap within the two categories, so that the total number of persons exposed may be lower than what is shown in the table. However, the Town should be aware of the potential needs of residents within these population segments in the event of a hazard occurrence.

Hazus was used to model injuries and fatalities for the 1500- and 2500-year events. For the 1500-year event, there are 5 to 15 minor injuries not requiring medical attention with no injuries requiring medical attention. For the 2500-year event there are 10 to 30 minor injuries not requiring medical attention with up to 5 injuries requiring medical attention.

Environment Impacts

The environment may be impacted by cascading impacts from the earthquake, such as a train derailment caused by track damage, landslide, or dam breach. This could result in a hazardous material release.

Problem Statements for Earthquakes

Table 50. Problem Statements for Earthquakes.

Assets	Problems Associated with Earthquakes
People (including underserved communities and socially vulnerable populations)	• Vulnerable populations located in unreinforced masonry structures may sustain injuries. • Elderly population falls during event.
Structures (including facilities, lifelines, and critical infrastructure)	• Unreinforced masonry and utility lifelines impacted.
Systems (including networks and capabilities)	• Utility systems impacted.
Natural, historic, and cultural resources	• Historical buildings constructed out of unreinforced masonry are susceptible and may be impacted.

Assets	Problems Associated with Earthquakes
Activities that have value to the community	• None apparent or projected.

National Flood Insurance Repetitive Loss Properties

B4. Does the Plan address NFIP insured structures within the jurisdiction that have been repetitively damaged by floods? (Requirement §201.6(c)(2)(ii))

***REPETITIVE LOSS STRUCTURE** means a structure 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.*

***SEVERE REPETITIVE LOSS** structure means a structure 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 been made, with cumulative amount of such claims exceeding the value of the insured structure.*

According to FEMA, repetitive loss properties are those for which two or more losses of at least $1,000 each have been paid under the National Flood Insurance Program (NFIP) within any 10-year period since 1978. Severe repetitive loss properties are residential properties that have at least four NFIP payments over $5,000 each and the cumulative amount of such claims exceeds $20,000, or at least two separate claims payments with the cumulative amount exceeding the market value of the building.

According to data provided by MEMA, six repetitive loss facilities, all residential homes, collectively have experienced 16 loss events, with $86,800 total building payments and $21,104 total content payments. Severe repetitive loss properties are not present in the Town. A summary of the Town's participation and compliance with the NFIP, including current policy and historical claims statistics, is provided in Table 61 of Chapter 5 (Capability Assessment).

Hazard Ranking

Ranking hazards helps the Town set goals and mitigation priorities. To compare the risk of different hazards, and prioritize which are more significant, requires a scoring system for equalizing the units of analysis. As not all hazards assessed in this plan have precisely quantifiable probability or impact data, a scoring system based on multi-criteria decision analysis (MCDA) methodology was developed to rank all the hazards. This multi-criterion ranking analysis approach prioritizes hazard risk based on a blend of quantitative factors from the available data, such as historical data, local knowledge, public survey, and Hazus assessment. This hazard ranking analysis assigns varying degrees of risk to five categories for each of the hazards, including: probability (how often it can occur), impact (economic, social, and environmental loss), spatial extent (the size of the area affected), warning time (how long does a community have to prepare for the event), and duration. Each degree of risk was assigned a value ranging from 1 to 4. The weighting factor derived from a review of best practice plans. Some of these hazard characteristics, like probability and impact, are more important than others and are weighted more heavily.

To calculate a rank score value for a given hazard, the assigned risk value for each category was multiplied by the weighting factor. The sum of all five categories represents the final rank score, as demonstrated in the following equation:

Hazard Score Value = [(Probability x 30%) + (Impact x 30%) + (Spatial Extent x 20%) + (Warning Time x 10%) + (Duration x 10%)]

Table 51 provides the hazard characteristic, level description, level criteria, level index value, and weighting value.

Table 51. Hazard Ranking Criteria.

Hazard Characteristic	Degree of Risk			Assigned Weighting Factor
	Level	Criteria	Index Value	
Probability	Unlikely	Less than 1% annual probability	1	30%
	Possible	Between 1 and 10% annual probability	2	
	Likely	Between 10 and 100% annual probability	3	
	Highly Likely	100% annual probability	4	
Impact	Minor	Very few injuries, in any. Only minor property damage and minimal disruption on quality of life. Temporary shutdown of critical facilities.	1	30%
	Limited	Minor injuries only. More than 10% of property in affected area damaged or destroyed. Complete shudown of critical facilities for more than one day.	2	
	Critical	Mulitiple deaths/injuires possible. More than 25% of property in affected area damaged or destroyed. Complete shutdown of critical faicliteis for more than one week.	3	
	Catastrophic	High number of deaths/injuries possible. More than 50% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for 30 days or more.	4	
Spatial Extent	Negligible	Less than 1% of area affected	1	20%
	Small	Between 1 and 10% of area affected	2	
	Moderate	Between 10 and 50% of area affected	3	
	Large	Between 50 and 100% of area affected	4	
Warning Time	Long	More than 24 hours	1	10%
	Moderate	12 to 24 hours	2	
	Short	6 to 12 hours	3	
	Very short or no warning	less than 6 hours	4	
Duration	Very short	Less than 6 hours	1	10%
	Short	Less than 24 hours	2	
	Moderate	Less than one week	3	
	Long	More than one week	4	

Table 52 provides the final hazard ranking for Wellesley. Each hazard characteristic is assigned a value between 1 (lowest value) and 4 (highest value). When the risk values were calculated, if the value was greater than 3, it was assigned as a high risk hazard. If the value was greater than 2 and less than or equal to 3, it was assigned as a moderate risk. If the value was less than or equal to 2, it was assigned as a low risk hazard. The flood, extreme temperatures, and severe winter storms hazards were ranked highest. The wildfires/brushfires, hurricanes/wind, thunderstorms, drought, infectious disease, invasive species, hazardous materials, and earthquakes are all ranked as moderate. The landslide and tornado hazards are ranked as low.

Table 52. Final Hazard Ranking of Hazards for Wellesley.

Hazards	Probability	Impact	Spatial Extent	Warning Time	Duration	Value	Rank
Flood	4	4	2	4	2	3.4	High
Severe Winter Storms	4	3	4	1	3	3.3	High
Extreme Temperatures	4	2	4	2	2	3	High
Other Severe Weather Events	4	2	4	2	1	2.9	Mod.
Drought	2	3	4	1	4	2.8	Mod
Infectious Disease	4	2	4	2	2	2.7	Mod
Invasive Species	3	2	4	3	4	2.6	Mod
Hurricanes/Wind	2	3	4	1	2	2.6	Mod.
Earthquakes	1	3	4	4	1	2.5	Mod.
Wildfires/Brushfires	2	1	3	3	3	2.1	Mod.
Landslide	1	2	1	4	1	1.6	Low
Tornadoes	1	1	1	3	1	1.2	Low

Problem Statements Summary

The following problem statements reflect a summary of the problem statements included at the end of each hazard profile. They were designed to briefly summarize the key hazard risks and vulnerabilities to the community based on potential impacts and losses from future events. They are among the issues of greatest concern and were used to assist in the identification and analysis of potential mitigation actions for Chapter 6 (Mitigation Strategy). These problem statements will be reviewed and revised as needed during plan updates to reflect the most current information resulting from the risk assessment.

Table 53. Problem Statements Summary.

Hazard	**Problem Summary**
Flood	• The High School is adjacent to the floodplain and several critical facilities and infrastructures are in areas of flood risk. • Consistent flood events have impacted Route 9, and increasing precipitation intensities will ensure that challenges continue to impact this critical roadway. The Town and State will need to work together to reduce flood impacts. • The Town has long recognized five specific areas of flood-related challenges.

Hazard	Problem Summary
	1. Lexington Road, which crosses Boulder Brook just upstream of the Worcester Street crossing near the Natick town line. 2. Cedar Brook Road, which crosses Boggle Brook at the outlet of Reed Pond near the Natick line. 3. River Street, which runs along the Charles River between Washington Street and Walnut Street. 4. #1 Washington Street, bordering the Charles River (opposite River Street). 5. Windsor Road, which parallels Academy Brook just south of Centennial Reservation. • Pumping stations and ejectors located in the floodplain may be impacted during a significant flood event which would impact utility customers including vulnerable populations. • Residents and business owners may not realize they are located in a dam inundation area which are often different than the 100-year floodplain. They may be impacted during a dam breach causing property and social impacts. High hazard dam inundation areas are found in the Dam's Emergency Action Plan but are not always available to the public.
Severe Winter Storms	• Winter storms may lead to power outages and extreme temperatures posing an increased risk to vulnerable populations. • The electric grid is susceptible to power failure during winter storms. • Trees may damage historic and cultural sites as well as natural areas.
Extreme Temperatures	• Extreme heat events will be on the rise impacting the entire Town including vulnerable groups who may not have access to a cooling center or heating center if power goes out. • Extreme temperatures pose a threat to public health, especially to the elderly or those with medical conditions. • Power outages may occur further challenging people and businesses. • Wildfires and invasive species may flourish during extreme heat.

Hazard	Problem Summary
Other Severe Weather Events	• Microbursts and thunderstorms may impact people and cause power outages and property damage.
Drought	• Drought may impact quantity and quality of the water supply which could impact business operations. Vulnerable communities may have difficulty accessing potable water. Agricultural areas may suffer without irrigation.
Infectious Disease	• As seen from the Covid 19 Pandemic, infectious disease may impact people and the economy. Future pandemics are possible and may lead to large scale closures and the inhibit the ability of the government to deliver services. • Bugs carrying disease may spread through the human population.
Invasive Species	• The Department of Public Works is overtaxed managing invasive species in wetland and wooded areas. • Invasive species may kill trees creating an increased wildfire hazard.
Hurricanes/Wind	• Vulnerable populations may need to be evacuated if they are displaced from their homes. • Flooding may impact Route 9 and many other roads, as well as create overflow and problems for water and sewer infrastructure. • Wind damage may bring down trees and damage susceptible buildings and infrastructure. • The Town's Municipal Light Plan may experience outages for extended periods of time impacting people and businesses.
Earthquakes	• Damage to unreinforced masonry structures and utilities could cause impacts to vulnerable populations during and after an earthquake.
Wildfires/Brushfires	• Wildfires pose a health risk to people with asthma and other breathing issues.

Hazard	Problem Summary
	• Homes, businesses, and infrastructure without defensible space are most susceptible; this includes pumping stations and water storage tanks in wooded areas.
Landslides	• Landslides have not impacted the community and are not expected to.
Tornadoes	• Vulnerable populations may need support seeking shelter and those without cell phones may not receive alerts. • Infrastructure and critical facilities may be damaged, and roadways may be blocked by debris.

Chapter 5. Capability Assessment

Capability Assessment Purpose

The purpose of conducting a capability assessment is to determine the ability of a community to mitigate hazard risks and to identify potential opportunities for establishing or enhancing specific mitigation policies, programs, projects, or other activities. Coupled with the risk assessment, the capability assessment serves as the foundation for designing an actionable and effective hazard mitigation strategy.

As in any planning process, it is important to establish which goals or actions are feasible based on the organizational capacity of those agencies or departments tasked with their implementation. A capability assessment helps to determine which types of mitigation actions are practical and likely to be implemented over time based on a community's existing authorities, policies, programs, and resources available to support such implementation. This analysis will identify any critical capability gaps or limitations to address through corrective actions, as well the key strengths or positive measures in place that should continue to be supported and/or expanded upon to improve local mitigation capabilities.

This capability assessment was completed to not only help establish the goals and actions for the Town of Wellesley's hazard mitigation plan, but to also help ensure that those goals and actions are realistically achievable under current local conditions. As highlighted in FEMA's 2022 Local Mitigation Planning Policy Guide, *"describing the current capabilities provides a rationale for which mitigation projects can be undertaken to address the vulnerabilities identified in the Risk Assessment."*[60]

The capability assessment for the Town of Wellesley includes a comprehensive examination of several components as summarized in Table 8.

Table 54. Capability Assessment Components.

Components	**Description**
Planning and Regulatory Capabilities	Local plans, policies, codes, and ordinances that are relevant to reducing the potential impacts of hazards.
Administrative and Technical Capabilities	Local human resources and their skills/tools that can be used to support mitigation activities.
Financial Capabilities	Fiscal resources the community has access to for helping to fund hazard mitigation projects.

[60] Local Mitigation Planning Policy Guide. FEMA. April 2022. P. 25.

Components	Description
Education and Outreach Capabilities	Local programs and methods already in place that can be used to support mitigation activities.
NFIP Participation and Compliance	Summary of information relevant to the community's participation in the NFIP and continued compliance with NFIP requirements.

Review and Incorporation of Existing Plans, Studies, and Reports

A4. Does the Plan describe the review and incorporation of existing plans, studies, reports, and technical information? (Requirement §201.6(b)(3))

The first step in completing the updated capability assessment was to gather and review any relevant local plans, studies, or reports completed or updated since the previous mitigation planning process in 2010. This information was used to help gain a current understanding of the Town's current ability to mitigate risk, and how local capabilities may have changed over the past 10+ years. The 2018 Massachusetts State Hazard Mitigation and Climate Adaptation Plan, as well as other plans adopted by the Town of Wellesley in the recent past, were reviewed for consistency as well as opportunities for plan integration. The goal of this review was to support updates to this plan that easily align with and possibly incorporate key aspects of relevant plans at the state and local level.

Table 55 provides a summary of the most relevant plans, studies, reports, or sources of other technical information consulted as part of this process and how they were incorporated into this plan update.

Table 55. Relevant Plans, Studies, and Reports for Incorporation.

Plan / Study / Report	Summary Description / Incorporation
Massachusetts State Hazard Mitigation and Climate Adaptation Plan (2018)	The SHMCAP is an innovative, first-of-its-kind statewide plan that fully integrates a traditional hazard mitigation plan with a climate change adaptation plan. The SHMCAP fulfills two important requirements, including (1) updating the 2013 State Hazard Mitigation Plan as required by Federal regulations (44 CFR Part 201.4); and (2) fulfilling requirements for a state climate adaptation plan per Massachusetts Executive Order 569. The SHMCAP has five goals as shown below: 1. Enhance the Commonwealth's resiliency to natural hazards and climate change by integrating programs and building institutional capacity. 2. Reduce the impacts of natural hazards and climate change with forward-looking policies, plans, and regulations.

Plan / Study / Report	Summary Description / Incorporation
	3. Understand our vulnerabilities and risks and develop immediate and long-term risk reduction strategies for current and future conditions using the best available science. 4. Increase the resilience of State and local government, people, natural systems, the built environment, and the economy by investing in performance-based solutions. 5. Support implementation of this plan through increased education, awareness, and incentives for action for state agencies, local governments, private industry, non-profits, and the public. The SHMCAP was incorporated as a key source of information for this plan update. The Town of Wellesley's Hazard Mitigation Plan was also updated to be consistent and aligned with the SHMCAP. For example, the goals and actions identified in Chapter 6 address several of the key themes identified in the SHMCAP, including the integration of hazard mitigation and climate adaptation strategies in local policies, plans, and regulations; improving public education and awareness; building local capacity; and reducing risk to people, property, and infrastructure to natural hazards and climate change. In addition, as seen in Chapter 4, the risk assessment has been updated to be organized using the same hazard classification scheme as used for the SHMCAP.
Town of Wellesley Municipal Vulnerability Preparedness (MVP) Program / Community Resilience Building (CRB) Summary of Findings Report (2020)	The Commonwealth's Municipal Vulnerability Preparedness (MVP) program provides support for cities and towns in Massachusetts to plan for resiliency and implement key climate change adaptation actions for resiliency. In 2019, Wellesley was awarded an MVP Planning Grant to assess its vulnerability to and prepare for climate change impacts, build community resilience, and receive designation from the Executive Office of Energy and Environmental Affairs (EEA) as an MVP Community. Communities with this designation become eligible for MVP Action Grant funding and other opportunities to support the implementation of priority climate adaptation actions. In completing the MVP planning process, the Town of Wellesley followed the Community Resilience Building (CRB) framework with technical assistance provided by a state-certified MVP Provider, Kim Lundgren Associates, Inc. The CRB methodology is an "anywhere at any scale" format that draws on stakeholders' wealth of information and experience to foster dialogue about a community's strengths and vulnerabilities. Two four-hour CRB Workshops were held in November 2019, with the following central objectives: 1. Define top local natural and climate-related hazards of concern. 2. Identify existing and future strengthen and vulnerabilities. 3. Develop prioritized actions for the community.

Plan / Study / Report	Summary Description / Incorporation
	4. Identify immediate opportunities to collaboratively advance actions to increase resilience. The resulting Summary of Findings Report and supporting materials served as a primary source of information and community-based inputs for incorporation into the update of this plan. These inputs include the identification of top climate-influenced hazards (intense storms, flooding, heat waves, and drought) and vulnerable areas or community assets (infrastructural, societal, and environmental), current community concerns and challenges presented by these hazards, current strengths and assets, and specific, prioritized recommendations to improve resilience in Wellesley.
Climate Action Plan (2022)	Wellesley's Climate Action Plan is a comprehensive, town-wide roadmap for lowering the Town's carbon emissions while building resilience to climate change impacts. The plan builds on more than a decade of sustainability initiatives and outlines specific actions Wellesley must take to reduce greenhouse gas (GHG) emissions to meet the climate goals and targets adopted by Town Meeting. The plan includes recommended actions and metrics for measuring progress on action implementation. The Climate Action Plan served as a primary source of information and community-based inputs for incorporation into the update of this plan. Information that was reviewed and incorporated into the plan includes updated data on current trends and projections for climate impacts in Wellesley (including intense storms, flooding, drought, and heat waves) for the risk assessment. It also included the review and integration of guiding principles, goals, and actions for building community resiliency to the impacts of climate change into the discussion and decision-making process for mitigation actions to be included in the mitigation strategy. For example, this includes prioritizing nature-based solutions to enhance the Town's resilience to hazards and projected future conditions caused by climate change.
Open Space and Recreation Plan (2022)	The Town's 2022-2029 Open Space and Recreation Plan is Wellesley's fourth iteration of the plan and reflects the Town's diverse open space system and the complex needs and goals of the community. The Plan begins by laying out the community setting of Wellesley, including a brief history of the Town's development, open space patterns, and infrastructure. There is an inventory of the Town's environmental resources, including a detailed inventory of parks and sanctuaries. These sections are followed by a Needs Analysis, followed by Goals, Objectives, and an Action Plan, which have been designed to meet the open space needs identified by the community.

Plan / Study / Report	Summary Description / Incorporation
	The Open Space and Recreation Plan served as a key source of information related to the community's natural and built environment, with specific content regarding natural hazards and mitigation activities being incorporated into this updated plan. This includes details on environmental challenges such as local flood hazards (including the identification of areas prone to chronic flooding) and invasive species for the risk assessment, and information on existing goals and recommended or planned activities that will help the community to mitigate hazards or adapt to climate change for the mitigation strategy.
The Wellesley Unified Plan (2019)	Wellesley's Unified Plan is an innovative combination of a Comprehensive Plan and a Town-wide Strategic Plan, representing the community's vision for the future. It articulates the core values of the community, establishes a vision for the future of Wellesley, sets town-wide priorities and goals, and provides guidelines on strategies, tools, and specific actions to make the plan a reality. The Unified Plan addresses issues ranging from land use planning, economic development, housing, transportation, and education to Town government operations and finance. It's a plan created collaboratively by Wellesley residents, Town staff and members of the Town's boards and commissions and is to be used alongside the Town-wide Financial Plan and the Five-year Capital Budget Program. The Unified Plan served as a primary source of information for this plan update, providing a range of input across a broad range of topics as described above. Any relevant land use, natural hazard, climate change. or mitigation/resilience-themed content was also incorporated into this plan as applicable. For example, this includes information on specific risks, problems or challenges associated with hazards for the risk assessment. It also includes reviewing and integrating applicable goals and actions from the Unified Plan into the discussion of goals and actions for the mitigation strategy.
Housing Production Plan (2018)	The main purpose of the Town's Housing Production Plan is to help Wellesley implement the new Unified Plan (described above) and make steady progress toward meeting and exceeding the 10 percent statutory minimum for affordable housing in compliance with State law (Chapter 40B). Staying above the 10 percent requirement provides housing options for a diversity of households and gives the Town more control over its growth and development with respect to comprehensive permit projects. The plan includes a housing needs assessment, identifies potential barriers to affordable housing development, establishes housing goals, and identifies housing development strategies with an action plan.

Plan / Study / Report	Summary Description / Incorporation
	The HPP served as another relevant source for information on the Town's vision and strategies for future development, in addition to some key information on environmental limitations/challenges to new housing development (including flooding) as well preservation priorities and the Town's regulatory framework. Some of this information was incorporated into the risk and capability assessments as applicable, and the Town's expressed housing goals and proposed housing development strategies were entered into the discussion of goals and actions for the mitigation strategy.
FEMA Flood Insurance Study for Norfolk County (2023)	Last revised by FEMA on April 7, 2023, this report constitutes the revised preliminary Flood Insurance Study (FIS) report for Norfolk County. This latest FIS revises and updates information from the currently effective (2021) FIS report on the existence and severity of flood hazards for the study area, which includes the Town of Wellesley. The studies described in this report provide flood hazard data that will, once formally adopted as final/effective, be used to establish actuarial flood insurance rates and to assist communities in efforts to implement sound floodplain management. The FIS and accompanying Flood Insurance Rate Maps (FIRMs) include relevant data and information on flood hazards for Wellesley, including but not limited to descriptions of principal flood problems, flooding sources, FEMA flood zone designations, base flood elevations, and discharge rates of flooding sources. This data and information were reviewed and incorporated into the plan update process by informing the risk assessment, especially as it relates to the hazard profile and GIS-based vulnerability assessment that was prepared for the flood hazard.

In addition to the above plans which were determined to be most relevant for incorporation into the hazard mitigation plan update, the following plans, studies, reports, and other technical documents were reviewed to gain a clearer understanding of local capabilities and their existing or potential effects on hazard risk reduction. More information on some of these documents is provided in Table 56 in the next section.

- ***Charles River Climate Adaptation & Flood Mitigation Implementation Plan (2022)*** – This regional plan provides an overview of the development of the Charles River Flood Model (CRFM), a new tool developed to predict where and when flooding is likely to occur as our climate changes and to test flood mitigation actions prior to making investments or policy decisions. The model demonstrates that flooding from both typical and extreme rain events will be considerably worse by 2070. The plan also documents the work conducted to identify and test flood reduction strategies across the watershed, at both large and small scales. The Town of Wellesley participated but none of the recommended actions for the region are in the planning area.

- ***Sustainable Mobility Plan (2022)*** – The Sustainable Mobility Plan addresses and enhances the use of current and alternative modes of transportation in Wellesley with a renewed focus on sustainability to reduce the Town's largest source of greenhouse gas emissions. It highlights various transportation modes and the supporting infrastructure to increase access while reducing environmental impacts, inefficiencies, and costs. The plan provides a transformative vision for the future of transportation in Wellesley, establishes goals and strategies, and provides a roadmap for implementing the proposed strategies.
- ***Stormwater Management Plan (2021)*** – The Town's SWMP is maintained in compliance with MS4 permit requirements as administered by the U.S. Environmental Protection Agency and Massachusetts Department of Environmental Protection (MassDEP). The SWMP describes and details the activities and measures that will be implemented to meet the terms and conditions of the MS4 permit. It is focused on reducing pollutants in stormwater runoff versus mitigating flood hazards. The main elements of the Town's stormwater management program are (1) a public education and outreach program in order to affect public behavior causing stormwater pollution, (2) an opportunity for the public to participate and provide comments on the stormwater program, (3) a program to effectively find and eliminate illicit discharges within the MS4 (4) a program to effectively control construction site stormwater discharges to the MS4, (5) a program to ensure that stormwater from development projects entering the MS4 is adequately controlled by the construction of stormwater controls, and (6) a good housekeeping program to ensure that stormwater pollution sources on municipal properties and from municipal operations are minimized.
- ***Town Forest Management Plan (2018)*** – Serves as a Forestry Stewardship Plan and Bird Habitat Assessment for Wellesley Town Forest. The plan guides management options for a 10-year period to achieve goals set out by the Town. Maintaining the highest quality trail system is one of the stated goals for the plan, along with increasing biodiversity, ensuring water protection, and assessing bird habitat. The plan is also intended inform management strategies for the Town's other woodlands.
- ***Comprehensive Plan Update (2007-2017)*** – This plan served as the Town's last full comprehensive plan update (prior to the development of the Unified Plan), covering a wide range of elements regarding the future growth and development of the community as addressed and adopted back in 2007.

Planning and Regulatory Capabilities

C1. 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 §201.6(c)(3))

Table 56 is based off Worksheet 4.1 from FEMA's *Local Mitigation Planning Handbook*.[61] It was used by the HMPC to document and review the current planning and regulatory capabilities of the Town including local plans, policies, codes, and ordinances that are relevant to reducing the potential impacts of hazards. Some additional information on how effectively these plans and regulatory tools are being used for hazard mitigation purposes can be found under the Safe Growth Survey and NFIP Participation and Compliance sections of this chapter.

Table 56. Planning and Regulatory Findings.

Planning/Regulatory Tool	Responsible Authority	General Description and Effectiveness for Hazard Risk Reduction
Plans		
Comprehensive/Master Plan	Planning Board / Select Board	As described in Table 55, Wellesley's Unified Plan is an innovative combination of a Comprehensive Plan and a Town-wide Strategic Plan. The plan addresses challenges related to natural hazards and climate change as well as many related issues such as other environmental hazards, pond management, stormwater best management practices, regional stormwater management, promoting residential energy efficiency, and expanding sustainable and resilient building practices. Considered a very effective tool for guiding and promoting hazard risk reduction through numerous municipal capabilities.
Open Space & Recreation Plan	Natural Resources Commission	As described in Table 55, the Town's OSRP describes environmental challenges such as local flood hazards and seeks to use the preservation and enhancement of the community's open space and natural features as another tool for supporting hazard risk reduction.
Housing Production Plan	Planning Board / Select Board, WHDC	As further described in Table 55, the Town's 2018 HPP addresses flood hazard areas, wetland and wildlife habitat, and environmental hazards including two Tier 1 hazardous waste sites. Not considered a tool for hazard risk reduction but is supportive of mitigation/resilience principles and practices.
Economic Development Plan	Planning Board / Select Board	Addressed in Chapter 7 of the Unified Plan. Not focused on hazard risk reduction but resiliency concepts are integrated throughout plan, and some economic development actions can be effective in promoting mitigation and sustainability (for example,

[61] Local Mitigation Planning Handbook. FEMA. March 2013.

Planning/Regulatory Tool	Responsible Authority	General Description and Effectiveness for Hazard Risk Reduction
		amending zoning regulations to "require or provide incentives for green approaches to stormwater management…").
Capital Improvements Plan (CIP)	Select Board	A Five-Year Capital Budget Program is prepared and presented annually at Town Meeting. Each Town Board and Department is required every year to provide to the Selectmen information on its proposed capital requests and anticipated capital needs. Can be an effective funding mechanism for supporting risk reduction projects. The purpose of the CIP is to facilitate long range planning so that the Town may, in an orderly fashion, prepare for major capital expenditures over a five-year period.
Emergency Operations Plan	Fire Department / EMD	The Town's Community Emergency Management Plan (CEMP) is developed and maintained by the Emergency Management Director. The CEMP is a resource manual for core emergency management functions and responsibilities and is based on a standard risk-assessment tool. The plan, last updated in 2017, is more focused on emergency preparedness and response resources versus hazard mitigation.
Transportation Plan	Select Board / Police / DPW	Addressed in Chapter 10 of the Unified Plan (Mobility and Transportation. Not focused on hazard risk reduction but resiliency concepts are integrated throughout plan, making this an effective tool for the Town. Wellesley also has a Sustainable Mobility Plan (described in previous section), is a part of Complete Streets, and has a traffic committee comprised of individuals from Police, DPW, Engineering, Select Board, and Municipal Light Plant. All plans evaluate safety and contemplate some level of infrastructure investment.
Stormwater Management Plan	DPW	The Town has a SWMP that is updated annually (described in previous section). It includes information on the SPCC plan, CSO, sediment and erosion control and outfall inspections. The SWMP is a very comprehensive program for the MS4 Permit and overlaps some aspects of hazard risk reduction.

Planning/Regulatory Tool	Responsible Authority	General Description and Effectiveness for Hazard Risk Reduction
Historic Preservation Plan	Historic District Commission	Not a plan but the Town does have Historic Preservation Design Guidelines which outline the character defining qualities and features of residences within historic districts and provide guidelines for accommodating change while preserving and building upon those qualities and features. They emphasize best practices of historic preservation and specifically address issues associated with preservation and stewardship within historic neighborhoods. Does not address hazards or mitigation beyond lead paint concerns.
Other special plans? *(e.g., brownfields redevelopment, disaster recovery, climate adaptation)*		Climate Action Plan, Sustainable Mobility Plan, Town Forest Management Plan (described in previous section).
Building Code, Permitting, and Inspections		
Building Code		Version/Year: MA State Building Code (780 CMR), Ninth Edition, 2017 The Town enforces the most current version of the Massachusetts State Building Code (MSBC), which includes numerous provisions for reducing risks posed by natural hazards (e.g., flood-resistant construction, seismic design standards, wind, and snow load requirements, etc.). This includes a requirement for the design and construction of structures located in flood hazard areas to be in accordance with American Society of Civil Engineers (ASCE) standards, which are consistent with, and in some cases, exceed minimum NFIP requirements. * *More detailed information on the MSBC is provided below this table.*
Building Code Effectiveness Grading Schedule (BCEGS)		BCEGS Commercial Score: 5 BCEGS Residential Score: 5
ISO Fire Protection Rating		Public Protection Classification: Class 02
Site Plan Review Requirements	Zoning Board of Appeals	Site plan approvals required per Zoning Bylaw (Section 16A.C.2) for major construction projects and projects of significant impact. Site plan reviews look

Planning/Regulatory Tool	Responsible Authority	General Description and Effectiveness for Hazard Risk Reduction
		at off-site impacts to capital infrastructure including water, sewer, transportation, fire, and life safety, electric, stormwater, and refuse. Effective tool for helping to ensure compliance with all regulations and any conditions for development projects per applicable requirements.
Land Use, Zoning, and Development Regulations		
Zoning Bylaws/Ordinances	Planning Board / Zoning Board of Appeals	Zoning Bylaw includes numerous rules and regulations that help to secure safety and mitigate the impacts of natural hazards, including site plan reviews as described above and those regulations described below. Very effective tool for the Town to enact land use and development regulations outside the arena of State Building Code requirements.
Subdivision Regulations	Planning Board	Adopted by Planning Board for the purpose of protecting the safety, convenience, and welfare of Town inhabitants (including the safety in the case of fire, flood, panic, or other emergencies). Subdivision rules and regulations contain several requirements that address flood hazard mitigation as well as other hazards. Wellesley has very few subdivisions so not considered as effective or applicable as other regulations/guidelines for new development.
Floodplain Regulations	Planning Director / Planning Board	The Planning Director and Planning Board oversees implementation of any requirements for the Town regarding Floodplain Management through the Zoning Bylaw (Section 3.7 Flood Plain or Watershed Protection Districts). The Floodplain District is an overlay district to all other districts. All development in the district, including structural and nonstructural activities, whether permitted by right or by special permit must be in compliance with all state regulations and minimum standards of the NFIP. This includes sections of the State Building Code (780 CMR) which address floodplain and coastal high hazard areas which exceed minimum NFIP standards as described in other areas of this chapter.

Planning/Regulatory Tool	Responsible Authority	General Description and Effectiveness for Hazard Risk Reduction
Stormwater Management Regulations	DPW / Planning Board	The Town and US EPA regulates stormwater through the MS4 Permit described in the previous section (see Stormwater Management Plan). The MS4 Permit is a 5-year permit that regulates stormwater runoff that enters US waterways. The permit is administered by the DPW and includes annual reporting on six Minimum Control Measures. It is more focused on reducing pollutants in stormwater runoff versus mitigating flood hazards but is considered an effective tool for doing both in combination with other Town rules and regulations, including Zoning Bylaw Section 5.8 (Drainage Review) the municipal stormwater drainage system rules and regulations adopted therein.
Other hazard-specific regulations or ordinances?		Municipal Sustainable Building Guidelines – Adopted in 2020, will help Wellesley pursue its energy and emissions goals by outlining a process and criteria by which to design, construct, and operate its municipal buildings. The guidelines also encourage buildings to be resilient to climate hazards and adaptable to changing climate conditions.

Massachusetts State Building Code

All municipalities in the state must adopt and enforce the current Massachusetts State Building Code (MSBC). The MSBC consists of a series of international model codes and any state-specific amendments adopted by the Board of Building Regulations and Standards (BBRS). The BBRS regularly updates the state building codes as new information and technology becomes available and change is warranted.

The MSBC is separated into two distinct volumes: The Residential volume regulates all one- and two-family structures and townhouses that are three stories or less, as well as their accessory structures. The Base volume regulates all structures that are not covered by the Residential regulations.

The current version of the MSBC is the Ninth Edition, which became effective on October 20, 2017. The Town of Wellesley began enforcing the Ninth Edition for all applicable projects as required by January 1, 2018. The Ninth Edition code is based on modified versions of the following 2015 codes as published by the International Code Council (ICC). *

- The International Building Code (IBC)

- International Residential Code (IRC)
- International Existing Building Code (IEBC)
- International Mechanical Code (IMC)
- International Energy Conservation Code (IECC)
- International Swimming Pool and Spa Code (ISPSC)
- Portions of the International Fire Code (IFC)

** Although the Ninth Edition of the code is still in effect, members of the BBRS have voted that the next edition of the MSBC will be based on modified versions of the 2021 International Codes. The content of these codes is still under review by the BBRS, but it is anticipated that the Tenth Edition of the code will be available for use in 2023.*

The Commonwealth of Massachusetts requires mandatory enforcement of the MSBC and does not allow local amendments to the residential code. In addition, the Commonwealth adopts a plumbing and electrical code. The Commonwealth also has a program in place for code official certification, which includes taking code classes prior to examination and certification, requires continuing education, and allows consumers to file complaints against inspectors. Massachusetts also requires licensing of general, plumbing, electrical, and roofing contractors; requires licensing candidates to pass an examination prior to licensing; and requires continuing education.

Massachusetts continues to perform well in terms of objective assessments of the MSBC. For example, in its most recent “Rating the States” report, the Insurance Institute for Business and Home Safety (IBHS) ranked Massachusetts 9th (scoring 78 out of a possible 100 points on the IBHS scale). Now in its fourth edition, IBHS’s 2021 report evaluates the 18 states along the Atlantic and Gulf coasts, all vulnerable to catastrophic hurricanes, based on building code adoption, enforcement, and contractor licensing.

Lastly, as noted in the table above, the MSBC contains a series of requirements for flood-resistant design and construction that are in accordance with the ASCE 24 standard, which incorporates—and in certain areas exceeds—FEMA’s NFIP construction standards. Highlights of ASCE 24 that complement the NFIP minimum requirements include requirements for building performance; flood-damage-resistant materials, utilities and service equipment, and siting considerations. Specific requirements for design flood elevations and the use of flood-resistant materials may be found in the ASCE Tables included in 780 CMR Section 1612.4. For example, a higher regulatory standard that affects development and redevelopment in the Town’s mapped special flood hazard areas include a requirement that new or substantially improved buildings must be elevated so that the lowest floor surface is at least 1 foot above the FEMA base flood elevation.

Safe Growth Survey

As part of the assessment for planning and regulatory capabilities, the Town's planning staff completed a *Safe Growth Survey*. This unique survey instrument was drawn from the Safe Growth Audit concept developed for the American Planning Association (APA) to help communities evaluate the extent to which they are positioned to grow safely relative to natural hazards. The survey covered six topic areas including the following:

- Land Use
- Transportation
- Environmental Management
- Public Safety, Zoning Ordinance
- Subdivision Regulations
- Capital Improvement Program and Infrastructure Policies

While somewhat of a subjective exercise, the Safe Growth Survey was used to provide some measure of how adequately existing planning mechanisms and tools for the Town of Wellesley were being used to address the notion of safe growth. In addition, the survey instrument was aimed at further integrating the subject of hazard risk management into the dialogue of local community planning and to possibly consider and identify new actions as it relates to those local planning policies or programs already in place or under development. It is anticipated that the Safe Growth Survey will be used again during future plan updates to help measure progress over time and to continue identifying possible mitigation actions as it relates to future growth and community development practices, and how such actions may better be incorporated into local planning mechanisms.

The results of the Safe Growth Survey are summarized in Table 57. This includes describing how strongly the Town's planning staff agrees or disagrees with 25 statements as they relate to Wellesley's current plans, policies, and programs for guiding future community growth and development, according to the following scale:

1=Strongly Disagree 2=Somewhat Disagree 3=Neutral 4=Somewhat Agree 5=Strongly Agree

Table 57. Safe Growth Survey Results.

COMPREHENSIVE/MASTER PLAN	
Land Use	
1. The comprehensive/master plan includes a future land use map that clearly identifies natural hazard areas.	1 2 3 4 $\boxed{5}$

2. Current land use policies discourage development and/or redevelopment within natural hazard areas.	1 2 3 $\boxed{4}$ 5
3. The comprehensive/master plan provides adequate space for expected future growth in areas located outside of natural hazard areas.	1 $\boxed{2}$ 3 4 5
Transportation	
4. The transportation element limits access to natural hazard areas.	1 2 $\boxed{3}$ 4 5
5. Transportation policy is used to guide future growth and development to safe locations.	1 2 $\boxed{3}$ 4 5
6. Transportation systems are designed to function under disaster conditions (e.g., evacuation, mobility for fire/rescue apparatus, etc.).	1 2 3 4 $\boxed{5}$
Environmental Management	
7. Environmental features that serve to protect development from hazards (e.g., wetlands, riparian buffers, etc.) are identified and mapped.	1 2 3 4 $\boxed{5}$
8. Environmental policies encourage the preservation and restoration of protective ecosystems.	1 2 3 $\boxed{4}$ 5
9. Environmental policies provide incentives to development that is located outside of protective ecosystems.	1 $\boxed{2}$ 3 4 5
Public Safety	
10. The goals and policies of the comprehensive/master plan are related to and consistent with those in the hazard mitigation plan.	1 2 3 4 $\boxed{5}$
11. Public safety is explicitly included in the comprehensive/master plan's growth and development policies.	1 2 3 $\boxed{4}$ 5
12. The monitoring and implementation section of the comprehensive/master plan covers safe growth objectives.	1 2 3 $\boxed{4}$ 5
ZONING BYLAWS	
13. The zoning bylaws conform to the comprehensive/master plan in terms of discouraging development and/or redevelopment within natural hazard areas.	1 2 3 $\boxed{4}$ 5

14. The bylaws contain natural hazard overlay zones that set conditions for land use within such zones.	1 2 3 4 $\boxed{5}$
15. Rezoning procedures recognize natural hazard areas as limits on zoning changes that allow greater intensity or density of use.	1 2 $\boxed{3}$ 4 5
16. The bylaws prohibit development within, or filling of, wetlands, floodways, and floodplains.	1 2 3 $\boxed{4}$ 5
SUBDIVISION REGULATIONS	
17. The subdivision regulations restrict the subdivision of land within or adjacent to natural hazard areas.	1 2 3 $\boxed{4}$ 5
18. The regulations provide for conservation subdivisions or cluster subdivisions to conserve environmental resources.	$\boxed{1}$ 2 3 4 5
19. The regulations allow density transfers where hazard areas exist.	$\boxed{1}$ 2 3 4 5
CAPITAL IMPROVEMENT PROGRAM AND INFRASTRUCTURE POLICIES	
20. The capital improvement program limits expenditures on projects that would encourage development and/or redevelopment in areas vulnerable to natural hazards.	1 2 3 4 $\boxed{5}$
21. Infrastructure policies limit the extension of existing facilities and services that would encourage development in areas vulnerable to natural hazards.	1 2 3 4 $\boxed{5}$
22. The capital improvements program provides funding for hazard mitigation projects identified in the hazard mitigation plan.	1 2 $\boxed{3}$ 4 5
OTHER	
23. Small area or corridor plans recognize the need to avoid or mitigate natural hazards.	1 2 $\boxed{3}$ 4 5
24. The building code contains provisions to strengthen or elevate new or substantially improved construction to withstand hazard forces.	1 2 3 4 $\boxed{5}$
25. Economic development and/or redevelopment strategies include provisions for mitigating natural hazards or otherwise enhancing social and economic resiliency to hazards.	1 2 3 $\boxed{4}$ 5

Administrative and Technical Capabilities

Table 58 is based off Worksheet 4.1 from FEMA's *Local Mitigation Planning Handbook*. It was used by the HMPC to document and review the current administrative and technical capabilities of the Town. These include staff and their skills and tools that can be used for mitigation planning and to implement specific mitigation actions.

Table 58. Administrative and Technical Findings.

Administrative/Technical Resource	Full-time (FT) / Part-time (PT) / Volunteer (V)	General Description and Effectiveness for Hazard Risk Reduction
Administration		
Planning Board	4 FT, 1 PT Staff	The role of the Planning Board is to make short and long term decisions related to land use in the Town of Wellesley. The Planning Board seeks to realize the vision of Wellesley residents for their community through the judicious use of municipal planning and project review. As a result, the Planning Board is responsible for the maintenance and update of the Town's Zoning Bylaw and Zoning Map, divisions of land, and the review of large-scale projects with Town-wide impacts. Very effective.
Wetlands Protection Committee	5 V / 3 FT	Wetlands Protection Committee (often referred to as the Conservation Commission in other MA towns) is a 5-member board of volunteers who are appointed by Wellesley's Natural Resources Commission. The WPC has the power and authority to administer and enforce the provisions of the Massachusetts Wetlands Protection Act and the Wellesley Wetlands Protection Bylaw. With this authority the WPC is responsible for reviewing and permitting any proposed work within a Wetland Buffer Zone, a Riverfront Area, or a Wetland Resource Area. Very effective.
Hazard Mitigation Planning Committee	FT	The HMPC consists of mostly Town staff along with community stakeholders as identified in Chapter 3. Very effective in terms of providing input and overseeing the update and implementation of this plan.

Administrative/Technical Resource	Full-time (FT) / Part-time (PT) / Volunteer (V)	General Description and Effectiveness for Hazard Risk Reduction
Climate Action Committee	FT / PT / V	The Climate Action Committee (CAC) works with municipal departments, residents, businesses, institutions, and civic organizations to reduce greenhouse gas emissions and promote sustainability. Very effective in promoting climate adaptation and hazard resiliency as well.
Maintenance Programs to Reduce Risk (e.g., tree trimming, drainage clearance)	DPW	The Town has a significant maintenance program for stormwater and tree health administered by the Park and Tree and Highway divisions of DPW. All catch basins are cleaned over a two-year period (half are cleaned each year). The Town provides service for certain businesses and emergency areas; all other service contracted out. MLP also prunes on a three-year cycle for line trimming. The Town has an inventory system that is used to help manage the tree maintenance program. In addition, the Town is broken up into ten maintenance zones to help coordinate post-storm cleanup.
Mutual Aid Agreements	Yes	Multiple agreements in place for Fire, Police, Refuse, Health Services, etc.
Staff		
Chief Building Official	FT (4 Building Officials)	Very effective in terms of enforcement and administration of the State Building Code and Town Zoning Bylaw. Specific duties include public safety inspection of commercial and municipal buildings and structures, and places of public assembly; inspection of building/construction activities; inspection of electrical wiring and systems; inspection of plumbing and fuel gas systems; and enforcement of handicap access laws.
Floodplain Administrator	FT (Planning Director serves this function in an auxiliary capacity)	Very effective administration of floodplain management regulations and other activities in combination with the Planning Board and other special permit granting authorities.

Administrative/Technical Resource	Full-time (FT) / Part-time (PT) / Volunteer (V)	General Description and Effectiveness for Hazard Risk Reduction
Emergency Manager	FT (Fire Chief also serves as Emergency Management Director)	The Wellesley Fire Department is committed to protecting people, property, and environment. It is responsive to the needs of Town by providing rapid, professional, humanitarian services essential to the health, safety, and well-being of the community. It accomplishes its mission through training, preparedness, education, fire suppression, medical service, hazard mitigation and other related activities.
Community Planner	(3) FT	The Planning Department supports multiple boards and committees including the Planning Board, Design Review Board, Historic District Commission, Historical Commission, Denton Road Neighborhood Conservation District Commission, and Fair Housing Committee. By analyzing economic, demographic, and development trends, the department helps develop long-range goals and objectives to shape the future of the community. Specific responsibilities include drafting recommendations for zoning amendments, providing support to residents and developers through the permitting process, working on housing and mobility issues, and overseeing design guidelines to help maintain the historical integrity and character of Wellesley.
Civil Engineer	(4)?	The Engineering Division provides the Town with professional engineering, landscape architecture and technical services required to plan, coordinate, develop, design, construct, operate, and maintain Town facilities and infrastructure. Very effective, however the Town is reportedly understaffed to enforce the MS4 Permit which would include inspectional services for the program.
GIS Coordinator	2 FT	The GIS Office, housed in the Town's Information Technology Department, is responsible for: managing tools to develop, maintain, display, and analyze digital map layers; implementing policies

Administrative/Technical Resource	Full-time (FT) / Part-time (PT) / Volunteer (V)	General Description and Effectiveness for Hazard Risk Reduction
		and procedures to ensure geographic data quality; building applications that link base map layers to other spatially referenced data; producing maps and applications for all Town Departments, Boards, and Committees; and providing GIS training and support to Town employees.
Resource Development Staff or Grant Writers	N/A	Grant writing and grant administration duties are performed within each department. There is no grant support at the Town Administration level.
Public Information Officer	1 FT	Staffing is partially effective due to decentralized government structure; limited training on hazards & mitigation; coordination and information delivery can be improved.
Technical		
Staff with knowledge of land development and land management practices	Yes	Building, Engineering, DPW, Planning, Health, and the Natural Resource Commission (NRC) all have trained staff knowledgeable on land management.
Staff trained in construction practices related to buildings and/or infrastructure	Yes	Building and Facilities Management departments both have knowledgeable staff.
Staff with an understanding of natural hazards and risk mitigation	Yes	Fire, Health, DPW, NRC, Planning, and Select Board have knowledge of hazards and risk mitigation.
Hazards data and information		
Warning systems/services (e.g., Reverse 911, outdoor warning signals, etc.)	Yes	The Town has a Community Notification / Emergency Alert service for multiple categories that residents can sign up for, in addition to Reverse 911 for serious emergency events. The Town utilizes text messages, emails, and voice (phone) calls to communicate with the public

Financial Capabilities

Table 59 is based off Worksheet 4.1 from FEMA's *Local Mitigation Planning Handbook*. It was used by the HMPC to identify the Town's eligibility and access to funding sources that can be used to support the implementation of hazard mitigation projects.

Table 59. Financial Findings.

Financial Tool/Source	Accessible for Hazard Mitigation (Yes/No)	General Description and Effectiveness for Hazard Risk Reduction
General funds	Potentially	The annual operating and capital budgets are submitted as part of the Select Board's annual budget. The Select Board and Advisory Committee review the annual budget January through March and submit their recommendations to Town Meeting. Town Meeting then votes to adopt both the operating and capital budgets at the Annual Town Meeting.
Capital Improvement Program (CIP) funding	Yes	The Town's Five Year Capital Budget Program represents all department capital requests for the years preferred by each department. Because the Town doesn't have the funding to afford every project in the requested year, capital needs are discussed and re-evaluated annually. The CIP has helped the Town complete a lot of drainage infrastructure work in recent years as part of its very comprehensive stormwater management program. Also, in October 2020, Town Meeting approved a Climate Action Resolution proposed by the Select Board in accordance with the Unified Plan. The resolution requires the Town to proactively consider the impacts of Town-funded projects and programs by including in any capital request a rationale for how the project or programs may influence greenhouse gas emissions and the Town's climate resiliency overall.
Special purpose taxes	No	N/A
Fees for water, sewer, gas, or electric services	Yes	The Town owns and operates a self-supporting municipal light plant (MLP) which generates fees that help with numerous risk reduction efforts (i.e., tree maintenance) as well as disaster response/recovery (i.e., storm cleanup, debris removal, power restoration, etc.)

Financial Tool/Source	Accessible for Hazard Mitigation (Yes/No)	General Description and Effectiveness for Hazard Risk Reduction
Stormwater utility fee	Potentially	The Town is currently considering a Stormwater Utility Fee to more equitably distribute the necessary expenses that are required to meet increasing demands associated with the Town's stormwater management program (including increased investment in stormwater/drainage infrastructure). If approved the generated fees will be used to comply with MS4 permit requirements, maintain, and replace drainage infrastructure, and flood prevention.
Development impact fees	No	N/A
Incur debt through general obligation bonds and/or special tax bonds	Potentially	
Incur debt through private activities	No	N/A
FEMA Hazard Mitigation Assistance (HMA)	Yes	FEMA's current HMA grant programs (BRIC, FMA, HMGP) remain a good source of external funding for the implementation of eligible and cost-effective mitigation projects through coordination with MEMA.
HUD Community Development Block Grant (CDBG)	No	N/A
Other federal funding programs	Yes	EPA, USACE, and other federal agencies do make grant funding available for a variety of resilience-themed projects and initiatives that the Town may be eligible to pursue in the future.
State funding programs	Yes	The Commonwealth makes a variety of funding programs available on a routine basis to support local risk reduction projects. Some of the most applicable opportunities for the Town include MVP Action Grants and other annual grant programs through EEA, such as the Culvert Replacement Municipal Assistance Grant Program.

Education and Outreach Capabilities

Table 60 is based off Worksheet 4.1 from FEMA's *Local Mitigation Planning Handbook*. It was used by the HMPC to identify education and outreach programs that can be used to support mitigation activities.

Table 60. Education and Outreach Findings.

Program/Method	Yes/No	Description and Effectiveness for Hazard Risk Reduction
Local citizen groups or non-profit organizations focused on environmental protection, emergency preparedness, access, and functional needs populations, etc.	Yes	The Town has a variety of community action/advocacy groups and NGOs that are supportive of environmental protection, climate change mitigation and resilience, emergency preparedness, community sustainability, human/social services, etc. Also, Wellesley's Community Emergency Response Team (CERT) is a group of citizen volunteers that are trained to operate a community shelter in the event of a disaster and to assist professional rescuers in many support roles as required to meet the needs of the community during a disaster.
Ongoing public education or information program (e.g., responsible water use, fire safety, household preparedness, environmental education)	Yes	The Fire Department receives a Senior SAFE grant which is used to educate seniors on fire safety. In October of each year, the Fire Department visits all elementary schools and presents a fire safety program, funded through the SAFE program. The Fire Department also runs a Teen Rescuer program for one week during the summer which covers topics that include fire safety.
Natural disaster or safety-related school programs	Yes	See above.
StormReady certification	No	N/A
Firewise USA® certification	No	N/A
Public-private partnership initiatives addressing disaster-related issues	No	N/A
Other programs/methods?	Yes	Town website, social media, cable access television, etc. The Town and some departments have Facebook, Twitter, and Instagram for notifications and emergency communication.

National Flood Insurance Program (NFIP) Participation and Compliance

C2. Does the Plan address each jurisdiction's participation in the NFIP and continued compliance with NFIP requirements, as appropriate? (Requirement §201.6(c)(3)(ii))

The National Flood Insurance Program (NFIP) is a program created by the United States Congress in 1968. The NFIP has two purposes: to share the risk of flood losses through flood insurance and to reduce flood damages by restricting floodplain development. The program enables property owners in participating communities to purchase insurance protection, administered by the government, against losses from flooding, and requires flood insurance for all federally backed loans or lines of credit that are secured by existing buildings, manufactured homes, or buildings under construction, that are located in FEMA-mapped special flood hazard areas in a community that participates in the NFIP. The availability of NFIP policy coverage is limited to communities that adopt adequate land use and control measures with effective enforcement provisions to reduce flood damages by restricting development in areas exposed to flooding. There are now more than 20,000 participating communities across the United States and its territories.

The Town of Wellesley has participated in the NFIP since 1979. As summarized in Table 61, the HMPC used Worksheet 4.3 from FEMA's *Local Mitigation Planning Handbook* to collect information regarding the Town's participation in and compliance with the NFIP. This worksheet, in addition to a separate *NFIP Survey* for the Town's designated Floodplain Administrator, helped the HMPC to identify areas for improvement and other ideas that could be potential mitigation actions. These actions, including those related to continued compliance with NFIP requirements, are identified and further discussed in Chapter 6 (Mitigation Strategy).

Table 61. NFIP Participation and Compliance Findings.

NFIP Topic	Source of Information	Comments
Insurance Summary		
How many NFIP policies are in the community? What is the total premium and coverage?	FEMA NFIP Services, Flood Insurance Data and Analytics; State NFIP Coordinator	As of August 31, 2022, a total of 102 NFIP policies are in force. The total premium is $91,267 for a total of $33,444,000 in coverage.
How many claims have been paid in the community? What is the total amount of paid claims? How many of the	FEMA NFIP Services, Flood Insurance Data	There has been a total of 57 claims paid since 1979, totaling $205,038 in losses. There have been no paid claims for substantial damage.

NFIP Topic	Source of Information	Comments
claims were for substantial damage?	and Analytics (HUDEX report)	
How many structures are exposed to flood risk within the community?	GIS analysis (FEMA FIRMs + building footprint data)	It has been estimated that 41 structures are at risk to the 1-percent annual chance flood, and 158 are at risk to the 0.2 percent annual chance flood for a combined total of 199 structures exposed to flood risk.
Describe any areas of flood risk with limited NFIP policy coverage.	HMPC	No address-specific data has been made available by FEMA, but it is generally assumed that owners of property located in special flood hazard areas are underinsured when it comes to flood insurance coverage (based on only 102 current policies under the NFIP in comparison to nearly 200 structures estimated to be exposed to moderate to high flood risk).
Staff Resources		
Is the Community FPA or NFIP Coordinator certified?	Community FPA	No
Is floodplain management an auxiliary function?	Community FPA	Yes, for the Planning Director (designated per Zoning Bylaw Section 3.7.G).
Provide an explanation of NFIP administration services (e.g., permit review, GIS, education or outreach, inspections, engineering capability)	Community FPA	The Town complies with the NFIP by enforcing floodplain regulations, maintaining up-to-date floodplain maps, and providing information to property owners and builders regarding floodplains and building requirements. Floodplain and land subject to flooding considerations are also a component of all capital project improvement design and review processes.
What are the barriers to running an effective NFIP program in the community, if any?	Community FPA	No impediments identified.
Compliance History		
Is the community in good standing with the NFIP?	Community FPA, State NFIP Coordinator, FEMA	Yes

NFIP Topic	Source of Information	Comments
Are there any outstanding compliance issues (i.e., current violations)?	Community FPA	No
When was the most recent Community Assistance Visit (CAV) or Community Assistance Contact (CAC)?	State NFIP Coordinator, FEMA (CIS)	Last CAC was 6/2/2005 Last CAV was 2/8/2017
Is a CAV or CAC scheduled or needed?	Community FPA	No
Regulation		
When did the community enter the NFIP?	State NFIP Coordinator, FEMA (CIS)	9/5/1979 (Regular Entry) 12/22/1972 (Emergency Entry)
Are the FIRMs digital or paper?	Community FPA	Digital (updated as of July 17, 2012) FIRMs are currently being reviewed by FEMA and updated maps are expected in December 2023 or January 2024.
Do floodplain development regulations meet or exceed FEMA or State minimum requirements? If so, in what ways?	Community FPA	Floodplain regulations are administered through the enforcement of the Town's Zoning Bylaw (Section 3.7 – Flood Plain Or Watershed Protection Districts) which exceed current FEMA/NFIP minimum requirements. No new building or structure shall be constructed or used in whole or in part, and no existing building or structure lying wholly within a designated Flood Plain or Watershed Protection District shall be altered, enlarged, reconstructed, or used in a manner which would increase ground coverage within the Flood Plain, also requires adequate drainage paths in zones AO and AH. Any project triggering this provision is subject to Site Plan review by the Zoning Board of Appeals. These regulations will be routinely updated as necessary to maintain compliance with existing NFIP and State minimum standards for floodplain management. As described earlier in this chapter, higher regulatory standards are also met through the Town's enforcement of the Massachusetts State Building Code. Other NFIP development

NFIP Topic	Source of Information	Comments
		requirements are included in the Town's administration of the Commonwealth's Wetlands Protection Act Regulations (CMR 10) and Title V (310 CMR 15) requirements for sewage treatment and disposal.
Provide an explanation of the permitting process.	Community FPA	The Town has local permitting procedures, site plan review, field inspections, and retains records as required by the Commonwealth of Massachusetts retention schedule. The Town requires a permit for all proposed construction or other development in the Flood Plain District, including new construction or changes to existing buildings, placement of manufactured homes, placement of agricultural facilities, fences, sheds, storage facilities or drilling, mining, and paving. The Town has multiple layers of review, pending project size for review of stormwater impacts. The Town has a drainage bylaw for disturbance of areas of an acre or more for residential projects. The Town has Large House review provision which is a residential site plan review for larger single family projects. The Town has a Project of Significant Impact bylaw for projects greater than 10,000 square feet of new construction or 15,000 sf of renovated space that looks at off-site impacts to capital improvements including drainage.
Community Rating System (CRS)		
Does the community participate in CRS?	Community FPA	No, however the Town will continue to explore the benefits of CRS participation as Risk Rating 2.0 goes into effect and as updates to the CRS program are made by FEMA.
What is the community's CRS Class Ranking?	N/A	N/A
What categories and activities provide CRS points and how can the class be improved?	N/A	N/A

NFIP Topic	Source of Information	Comments
Does the plan include CRS planning requirements	Yes	Yes, many of the planning requirements under CRS Activity 510 are included in the plan but will not be evaluated or scored for credit until if/when the Town decides to apply for CRS participation.

Table 62 provides some additional information in response to the updated requirements included in FEMA's 2022 Local Mitigation Planning Policy Guide:[62]

Table 62. Additional NFIP Participation and Compliance Information.

Required Information	Response
Adoption of NFIP minimum floodplain management criteria via local regulation.	Town Zoning Bylaw, Section 3.7. Flood Plain Or Watershed Protection Districts. Last amended at the 2022 Annual Town Meeting (April 25, 2022).
Adoption of the latest effective Flood Insurance Rate Map (FIRM), if applicable.	Town Zoning Bylaw Section 3.7.C.1 District Boundaries and Base Flood Elevation Data establishes the Flood Plain District as shown on the official Flood Insurance Rate Map (FIRM) for the Town of Wellesley dated July 17, 2012.
Implementation and enforcement of local floodplain management regulations to regulate and permit development in SFHAs.	See explanation of the Town's permitting process provided in Table 61.
Appointment of a designee or agency to implement the addressed commitments and requirements of the NFIP.	Per the above Zoning Bylaw, the Town has designated the position of Planning Director to be the official floodplain administrator for the community.
Description of how participants implement the substantial improvement/substantial damage provisions of their floodplain management regulations after an event.	The Town implements the SI/SD provisions of its floodplain management regulations as required per the NFIP (CFR Title 44, Parts 59 thru 65) and Massachusetts State Building Code (780 CMR). The Town will also coordinate with State Flood Hazard Management Program staff to assure that proper practices are followed and that a post-disaster plan will be in place to implement all SI/SD provisions.

[62] Local Mitigation Planning Policy Guide. FEMA. April 2022. P. 26.

Conclusions

The Town of Wellesley is a thriving suburban community with strong municipal capabilities and resources to support the implementation of hazard mitigation actions. This chapter provides documentation on the existing local authorities, policies, programs, and resources to support hazard mitigation.

The Town of Wellesley owes much of its success over the last century to its strong commitment and attention to planning. The Town has long sought a balanced, growth-managed approach to community development that preserves open space and community character while building the economic well-being, sustainability, and in more recent years, the resilience of the community. The Town's innovative "Unified Plan" is one of many recent examples that demonstrate Wellesley's strong capabilities to integrate climate resilience and hazard risk reduction strategies into the community's overall framework for planning and decision-making across a variety of topics and initiatives. The Town also maintains strong administrative and technical capabilities across numerous departments, with many highly motivated, talented, and collaborative staff members who are aided through the active involvement of community members on numerous local boards and commissions. These "people" powered capabilities in combination with the Town's commitment to planning provide Wellesley with the ability to implement projects, programs, and activities in support of numerous community priorities.

The Town also benefits from strong executive leadership and financing capabilities for priority investments in community infrastructure, resilience, and sustainability. For example, in recent years the Town has made substantial investments in upgrading its municipal buildings and completing a lot of drainage infrastructure work as part of a very comprehensive stormwater management program. The Town has also become a recognized leader in climate action and adaptation planning. At a 2020 Special Town Meeting, the Select Board received strong support for its proposal to adopt a resolution to address the serious impact of climate change and to recommend that all boards, committees, and departments take actions in response to the accelerating climate crisis that threatens the community, region, state, nation, and the world. The Town also has its own electric utility (MLP) which provides unique capabilities for the Town in terms of managing its energy infrastructure and associated risks before and after hazard events.

Wellesley is also fortunate to have an abundance of skilled, knowledgeable, and committed residents willing to put meaningful time and effort into furthering Town priorities, especially as it relates to community sustainability and resiliency agendas. The Town has successfully engaged with this active citizenry along with key stakeholders, such as Wellesley College, as part of its public outreach and participation strategy for previous community-based planning efforts, including the Unified Plan, Climate Action Plan, and this Hazard Mitigation Plan.

Although the Town of Wellesley has relatively high capabilities and is well-positioned to mitigate the natural hazard risks faced by the community, it can expand and improve on the capabilities described in this chapter. Some general and specific opportunities to address existing gaps or limitations in local capabilities to reduce risk have been identified for each capability type and are further described below. Each of these opportunities were then considered by the HMPC during the plan update process as potential new mitigation actions to be included in the Mitigation Strategy.

Opportunities to Expand and Improve on Capabilities to Reduce Risk

Planning and Regulatory Capabilities

- Research opportunities for the Town to provide additional incentives for new development that is located outside of protective ecosystems or areas identified as at high risk to natural hazards and projected climate change impacts.
- Conduct a detailed assessment of all relevant regulations and the Town's permit review process to identify improvements to better address natural hazards, climate change, and projected future conditions (i.e., extreme heat, heavy downpour events, etc.). This includes the incorporation of nature-based solutions into existing Town regulations where most appropriate.
- Incorporate hazard mitigation and climate adaptation/resilience building actions into the next update of the Town's Climate Action Plan, which is currently more focused on climate change mitigation (reducing greenhouse gas emissions).
- Increase the integration of hazard mitigation and climate resiliency into the Town's existing CIP planning and project lists. Examples include (1) making resilience a key objective for the Town's strategic, operational, and fiscal policies for municipal infrastructure and asset management; and (2) developing methods to help ensure the Town limit expenditures on projects or infrastructure improvements that would encourage development and/or redevelopment in areas vulnerable to natural hazards.
- Integrate the Town's community resilience planning efforts (HMP, MVP, Climate Action, and other resilience-themed plans/reports) into a consolidated document, website/dashboard, etc. This includes integrating future iterations of its MVP plans and reports (for example, under EEA's rollout of MVP Planning 2.0) into this Hazard Mitigation Plan through amendments or revisions that can occur before the next 5-year plan update.
- Coordinate closely with Wellesley College and Babson College on the alignment and cross-integration of this hazard mitigation plan with their own resiliency planning and project implementation efforts, including but not limited to the pursuit of federal and state grant funding opportunities.

Administrative and Technical Capabilities

- Provide more training and professional development opportunities for Town staff who are engaged in community resilience planning and the implementation of hazard mitigation and/or climate adaptation projects.
- Develop a central tracking system to facilitate improved coordination between departments on pre-disaster mitigation/resiliency-themed projects or routine maintenance activities, as well as improved information sharing and access for Town department heads and staff.

- Increase staff for DPW's Engineering Division to help enforce the MS4 Permit which would include inspectional services for the program.

Financial Capabilities

- Continue to leverage and maximize opportunities through the Town's budgeting and CIP process to help fund priority hazard mitigation and climate adaptation projects, especially when a local cost-share increases the Town's chances for a grant funding award.
- Establish a Stormwater Utility as proposed to create a dedicated, stable revenue source for supporting stormwater management and flood mitigation initiatives across the community.
- Build internal staff capacity to identify and pursue external sources of grant funding for mitigation projects through increased opportunities for training/professional development and the ability to invest more time on grant writing, grants management, and related administrative tasks.
- Consider the designation or hiring of a dedicated resource development director or grants administrator for the Town to provide support across multiple departments that pursue their own external funding opportunities.
- Increase DPW's budget for invasive species management.

Education and Outreach Capabilities

- Increase use of the Town's website, social media platforms, and other readily available outreach mechanisms to support low-cost public education initiatives on building community resilience to hazards as well as individual mitigation actions for homeowners, business owners, etc.
- Explore and expand opportunities for public/private partnerships to support public education and community outreach initiatives related to hazard awareness and risk reduction efforts.
- Identify and seek to address any unmet needs related to targeted outreach and education for the community's more vulnerable populations (i.e., environmental justice communities, residents with special needs, property owners in high risk hazard areas, those who are homebound, etc.).

Possible New Actions Related to NFIP Participation and Compliance

- Promote the availability of flood insurance to owners and renters of property located in flood prone areas, including those that are not located in FEMA-mapped special flood hazard areas.
- Maintain digital FEMA elevation certificates for all construction in the floodplain.
- Evaluate and consider the adoption of "higher standards" that are proven to reduce flood damage (especially freeboard, setbacks, limitations on lower-level enclosure size, and the prohibition on use of fill).

- Maintain supplies of FEMA/NFIP materials to help property owners evaluate measures to reduce potential hazard damage. Make available in public buildings, local library, website, etc. and inform people who they can call to learn more information.

Chapter 6. Mitigation Strategy

The hazard mitigation strategy is the culmination of work presented in the planning area profile, risk assessment and capability assessment. It is also the result of multiple meetings and thorough public outreach. The work of the Hazard Mitigation Planning Committee (HMPC) was essential in developing the mitigation goals and actions included in this chapter. As described in Chapter 3 Planning Process, the HMPC worked in a consistent, coordinated manner to identify and prioritize the goals and mitigation actions for this Plan.

Mitigation Goals

C3. Does the Plan include goals to reduce/avoid long-term vulnerabilities to the identified hazards? (Requirement §201.6(c)(3)(i))

__GOALS__ are broad, long-term policy and vision statements that explain what is to be achieved by implementing the mitigation strategy.

Mitigation goals represent broad statements that are achieved through the implementation of more specific mitigation actions. These actions include both hazard mitigation policies (such as land use regulations) and hazard mitigation projects (such as structure or infrastructure projects). To develop goals for this Town of Wellesley, MA Hazard Mitigation Plan the HMPC reviewed the 2010 draft plan's goal statements, the Municipal Vulnerability Preparedness (MVP) plan goal statements, and the goals of the State's Hazard Mitigation and Climate Adaptation Plan (SHMCAP).

The HMPC developed the goal statements in the figure below to represent their vision and priorities for the Town of Wellesley in terms of hazard mitigation. The first goal statement, Save Lives, is an overarching goal or mission for the Town.

Save Lives
- Reduce risk to people, property, infrastructure, and natural resources from natural hazards and climate change.

Infrastructure
- Mitigate risk to critical facilities and infrastructure from natural hazards and climate change.

Capacity
- Expand the Town's capacity to mitigate risk by adopting a culture of hazard mitigation through regulations, planning, and regional collaboration.

Natural Resources
- Implement actions that minimize risk from climate change and natural hazards to preserve or restore the functions of natural systems.

Education
- Educate all stakeholders about the value of hazard mitigation and how to implement it in their work, businesses, and homes.

Figure 26. Goal Statements.

The mitigation actions from 2010 draft plan were reviewed for their status and relevance to this plan update. Since that plan was never officially adopted or approved by FEMA, and the plan is over ten years old, the status of those actions is not included here.

The Municipal Vulnerability Preparedness (MVP) plan was developed in 2020 and includes eleven recommendations. The MVP is part of a Massachusetts state-wide initiative through the Executive Office of Energy and Environmental Affairs (EEA) to provide support to cities and towns to plan for resiliency and implement climate change adaptation actions. The recommendations identified in Wellesley's MVP were reviewed and considered when developing mitigation actions for this plan update. Below is the list of MVP Recommendations with notes regarding their status and relevance in the Hazard Mitigation Plan. The third column in the table below, Inclusion in this Plan, details if the recommendation is part of this plan's list of mitigation actions.

Table 63. Status of MPV Recommendations.

	MVP Recommendation	2023 Status	Inclusion in this Plan
1	Transit improvements around school and rail stations.	Town has been working with MWRTA since February 2021 on the Catch Connect a micro transit van/bus system. The use has grown exponentially. All Wellesley public schools are part of the Safe Routes to School program, and	Not specifically included.

	MVP Recommendation	2023 Status	Inclusion in this Plan
		the Town has completed a Sustainable Mobility PLan. https://wellesleyma.gov/DocumentCenter/View/28705/Sustainable-Mobility-Plan---Wellesley-MA-April-2022-V01 Town has also been working very closely with MBTA to make all three of Wellesley Commuter Rail stations accessible.	
2	Develop an emergency preparedness campaign that leverages preexisting communication channels, ensures web accessibility, and includes low-tech strategies to maximize reach to all populations.	Through COVID-19 the Town instituted successful messaging and coordination through online presence, social media, and through reverse 911.	Several education actions are included. One specifically name, Reverse 911, one for updating the Town's website, one identifying vulnerable populations, and one regarding the NFIP.
3	Work with various partners to identify, prioritize, and address stormwater management needs, such as the Route 9 culverts.	Currently working on creation of a stormwater enterprise fund. This proposal will go to Town Meeting in March 2023. Under MS4 Permit, Town is working on code assessment for street design and parking lot guidance. The Town has constructed bioretention areas, rain gardens, drainage swales, infiltration systems and pervious pavement. Town has included educational signage around these installations. DPW continues to inspect and screen outfalls and interconnections during wet and dry weather. Town has a separate stormwater webpage at https://wellesleyma.gov/1513/Stormwater-Regulations Town has also increased street sweeping, distributed messaging through social media and Town news channels. Town also has	This is included in several actions, including this one, "Work with various partners to identify, prioritize, and address stormwater management needs, such as the Route 9 culverts."

	MVP Recommendation	2023 Status	Inclusion in this Plan
		drainage review bylaw for disturbance of an acre or more. Currently working on a Phosphorus control plan with a consultant. Provide quarterly digital newsletters on conservation, environmental practices, BMP for lawn care.	
4	Conduct a feasibility assessment for microgrids.	The Town is currently working on the creation of a microgrid at the main Wellesley Free Library location.	Included as written in MVP.
5	Install more solar panels with battery back-up	Solar panels have been installed on Main Library, and we have evaluations on all Town buildings. Two new schools currently approved and one under construction (Hunnewell School) and one in permitting (Hardy School) will be Net Zero ready with solar panel installations. MLP will be installing a battery backup station at their facility.	Included as follows: Accelerate and maximize Installation of solar and battery storage on municipal properties, where appropriate.
6	Identify locations of gas shut off valves and improve maintenance		Not included as an action, this is a capability of the Town.
7	Unified communication strategy that leverages diverse channels and existing organizations	In progress - through COVID-19 various options were explored (online updates, daily news briefing, centralized dashboard) but effective means of distribution and reach needs work, especially communications to senior citizens/vulnerable residents lacking access, technology, or those with language barriers	This action is not included. It is a capability of the Town.
8	Improve commuter and walking connections to schools	In progress - see Sustainable Mobility Plan link above	Not specifically included.

	MVP Recommendation	2023 Status	Inclusion in this Plan
9	Implement a sustainable landscaping program	In progress: https://wellesleyma.gov/454/Grow-Green-Wellesley-Initiative	This action is included as follows: Implement the Grow Green Wellesley sustainable landscaping program.
10	Promote pocket parks/"parklets"/popup parks with built in education (e.g. tree nursery)	Town has been working on parklets for seating in commercial districts for past two years, although not rolling parks in any manner.	Not specifically included.
11	Refine Tree Protection Bylaw to incentivize further protection	Revisions were approved at the 2021 ATM	This action is modified and included as follows: Expand Tree Protection Bylaw to incentivize further protection of public and private trees.

Comprehensive Range of Mitigation Actions

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 §201.6(c)(3)(ii))

***A MITIGATION ACTION** is a measure, project, plan or activity proposed to reduce current and future vulnerabilities described in the risk assessment.*

Identifying a range of mitigation actions was a process that included identifying and analyzing a potential list of natural hazards (described in Chapter 4), then a list of problem statements was developed describing the impacts of each hazard and specific areas of high hazard and specific vulnerable assets. Following, the work done in the Risk Assessment, the HMPC considered possible solutions or actions for each problem identified.

These actions included recommendations from the Capability Assessment (described in Chapter 5), and review of potential actions in each of FEMA's mitigation action categories (plans and regulations, structure and infrastructure, natural resources protection, and education and awareness). This process is illustrated in the figure below. The first column Hazards, indicates four areas of climate change interaction which is how the hazards were reviewed in the Risk Assessment (Chapter 4). The second column, Problems, indicates that the hazards caused problems to Assets in the categories of people, structures, systems, natural, historic, and cultural resources, and activities the community values. The third column, Mitigation Actions, shows the four categories of mitigation action considered to address each problem.

Figure 27. Process of Identifying a Range of Mitigation Actions.

The identified problems were detailed in the Risk Assessment (Chapter 4). The HMPC considered a variety of mitigation actions to address each identified problem. These ranged within the four mitigation action categories defined in Figure 28 below.

Local Plans and Regulations

- Government authorities, policies, or codes that shape how land and buildings are developed and maintained.

Structure and Infrastructure

- Projects modifying existing infrastructure to remove it from a hazard area, or building new structures in ways that reduce the impacts of hazards.

Natural Systems Protection

- Actions that reduce damage and losses, and that preserve or restore the functions of natural systems.

Education and Awareness Programs

- Sustained programs to teach the public and decision makers about hazard risks and community mitigation programs.

Figure 28. Four Types of Mitigation Actions.

Examples of actions in each of the above categories are shown in the table below.

Table 64. Examples of Mitigation Actions.

Mitigation Action Category	Examples of Mitigation Actions
Local Plans and Regulations	• Comprehensive plans • Land use ordinances • Subdivision regulations • Development review • Building codes and enforcement • NFIP Community Rating System • Capital improvement programs • Open space preservation • Stormwater management regulations and master plans
Structure and Infrastructure Projects	• Acquisitions and elevations of structures in flood-prone areas • Utility undergrounding • Structural retrofits • Floodwalls and retaining walls • Detention and retention structures • Culverts
Natural Systems Protection	• Sediment and erosion control • Stream corridor restoration • Forest management • Conservation easements • Wetland restoration and preservation
Education and Awareness Programs	• Radio or television spots • Websites with maps and information • Real estate disclosure • Presentations to school groups or neighborhood organizations • Mailings to residents in hazard-prone areas

Potential mitigation actions for each identified hazard and problem identified in the Risk Assessment are shown Table 65 below. Hazards are listed in order of risk. Some of these mitigation actions are included in the Action Plan some were not included because of cost-benefit-analysis outcomes or inconsistency with Town priorities.

Table 65. Possible Mitigation Actions.

Hazard	Possible Mitigation Actions
Flood	• Replace inadequate culverts. • Develop a Stormwater Enterprise Fund. • Distribute FEMA NFIP information to homes and businesses in the floodplain.
Severe Winter Storms	• Increase internal staff capacity to seek grant funding. • Shore up historic and cultural resources potentially at risk to severe winter storms.
Extreme Temperatures	• Educate residents about the location of heating and cooling centers.
Other Severe Weather Events	• Conduct outreach to vulnerable populations to identify those who may need assistance sheltering or evacuating.
Drought	• Develop water conservancy policies. • Expand the Tree Protection bylaw.
Infectious Disease	• Conduct outreach for participation in the Reverse 911 system. This may be used to alert the population of the presence of disease and vaccination clinics.
Invasive Species	• Create a secondary connection to the outside water supply to create redundancy and mitigate risk from ground wells and potentially contaminated water. • Conduct mechanical harvesting of invasive species.
Hurricanes/Wind	• Collaborate with the regional watershed association to support public private partnerships for community education and outreach.
Earthquakes	• Revise the online permitting system to link builders to educational information regarding unreinforced masonry structures.
Wildfires/Brushfires	• Create defensible space around all buildings and infrastructure.

Hazard	Possible Mitigation Actions
Landslides	• Identify steep slope areas and prohibit building in these areas through zoning regulations.
Tornadoes	• Conduct a feasibility assessment for implementing microgrids for critical facilities and infrastructure.

Mitigation Action Plan

C5. Does the Plan contain an action plan that describes how the actions identified will be prioritized (including cost benefit review), implemented, and administered by each jurisdiction? (Requirement §201.6(c)(3)(iv)); (Requirement §201.6(c)(3)(iii))

The HMPC then had the job to identify cost-effective mitigation actions; projects to address the identified hazards, areas of risk and vulnerable assets. An online Mitigation Action Tracker was developed for the Town to track the implementation of each mitigation action. The Mitigation Action Tracker was an online spreadsheet with separate cells showing each action's essential details. These column labels listed below are included to facilitate the Town's ability to sort through the actions as well as to apply for grant funding.

- Action Title
- Action Description
- Action Lead
- Supporting Organizations
- Potential Funding Source
- Implementation Schedule
- Estimated Cost
- Hazard(s) Addressed
- Critical Facility Protection
- Type of Mitigation Action
- Priority

The HMPC considered each of the types of mitigation actions for each of the identified problems. Mitigation actions supporting underserved communities and environmental justice communities were specifically considered by the HMPC. They also focused on actions to the built environment both buildings and infrastructure as well as future development or redevelopment. The resulting list of mitigation actions includes at a minimum one action for hazard identified. In several instances multiple actions address an identified hazard and problem. For instance, flooding is addressed through multiple actions as shown in the table below.

The priority order was chosen based on weighing costs versus benefits. It was imperative for the Town to determine if the costs associated with an action were reasonable compared to the corresponding benefits. To do this, the HMPC developed a prioritization table that included eight categories of criteria; these are detailed in the table below. Each category was assigned points with priority criteria given the highest points. The most points an action could earn was 17. Actions that scored ten points or higher were given High Priority, actions that scored 9 points were giving Medium Priority, and actions that scored under 8 were given low priority.

Table 66. Priority Ranking System.

	Criteria Category	**Description**	**Detailed Ranking and Associated Points**
1	Hazards Addressed	What level of hazards does the measure provide protection against?	High (Flood, Severe Winter Storms, Extreme Temperatures) = 3 Medium (Wildfires/Brush Fires, Hurricanes/Wind, Thunderstorms, Earthquakes, Drought, Infectious Disease, Invasive Species, Hazardous Materials) = 2 Low (Landslide, Tornadoes) = 1
2	Approximate Cost	How much will the measure cost to implement?	Low (Under $50k) = 3 Medium ($50k - $250k) = 2 High over $250k) = 1
3	Equity Focus	Does the measure provide support to Environmental Justice (EJ) and other Vulnerable Populations?	Direct Support = 3 Indirect Support = 2 No Support = 0
4	Protection of Lives	How effective is the measure in protecting lives and mitigating injuries	Direct Support = 3 Moderate Indirect Support = 2

	Criteria Category	Description	Detailed Ranking and Associated Points
		resulting from the targeted hazard(s)?	Minor Indirect Support = 1 None = 0
5	Protection of Critical Facilities or Infrastructure	Does the measure provide protection of critical facilities and infrastructure?	Yes = 3 No = 0
6	Natural Resource Protection	Does the measure provide protection of natural resources?	Yes = 2 No = 0

All the actions are listed in Table 67 in order of priority with the actions corresponding details. Additional tables are included in Appendix B. The breakdown of priority ranking points for each action is included in Appendix B.

Table 67. Full Mitigation Action List.

1	**Identify and seek to address any unmet needs related to targeted outreach and education for the community's more vulnerable populations (i.e., environmental justice communities, residents with special needs, property owners in high risk hazard areas, those who are homebound, etc.).**	
High	**Action Description**	Ensure that the Town has hazard mitigation materials in multiple languages. Use the direct connections the Town has with the homebound or elderly population for outreach. Utilize COA bulletin that is mailed to people over 60 monthly.
	Action Lead	Director of Public Works
	Supporting Organizations	Select Board
	Cost	Low
	Potential Funding Sources	Staff Time / General Operating Budget
	Hazards	All Hazards
	Implementation Schedule	2023-2028

2	**Work with DCR, EEA and the Commonwealth to assess feasibility of removing the 3 dams on the Charles River in Wellesley.**

High	**Action Description**	Charles River Watershed collaborate. Open Space Plan states " Restoration of damaged natural systems through regenerative design approaches" and "Support watershed efforts to restore fish passage to the Charles River" Lower Falls Dam (A.k.a. Finlay Dam) owned by DCR is a significant hazard potential dam in poor condition based on a 2021 feasibility study; Cordingly Dam is a significant hazard potential dam owned by DCR in Fair Condition according to a 2021 Inspection; Metropolitan Circular Dam in Wellesley and Newton is a significant Hazard potential dam in satisfactory condition from a 2020 inspection report. CRWA has copies of these inspection reports if needed for your records. Also has emergency evacuation plan for the Lower Falls/Finlay Dam.
	Action Lead	Natural Resources Commission Director
	Supporting Organizations	Charles River Watershed Association
	Cost	Low
	Potential Funding Sources	DER Priority Project and Environmental Bond
	Hazards	Flooding, Earthquakes
	Implementation Schedule	2023-2026

3	**Identify and protect open space.**	
High	**Action Description**	The Town of Wellesley has a limited amount of open space. This land must be protected to mitigate risks of flooding and other natural hazards and to prevent increasing hazard risks due to development.
	Action Lead	Natural Resources Commission Director
	Supporting Organizations	Charles River Watershed Association
	Cost	Low
	Potential Funding Sources	MassLANDS Grant, MVP Action Grant and Community Preservation Act
	Hazards	Flood, Drought, Infectious Disease, Invasive Species, Wildfires/Brushfires, Urban Heat Island
	Implementation Schedule	2023-2028

4	**Expand Tree Protection Bylaw to incentivize further protection of public and private trees.**	
High	**Action Description**	Protecting trees from climate change and natural hazards such as drought and extreme heat is a way to reduce heat in the Town.
	Action Lead	Planning Director

	Supporting Organizations	Natural Resources Commission, Charles River Watershed Association
	Cost	Low
	Potential Funding Sources	Staff Time / General Operating Budget
	Hazards	Wildfire, Urban Heat Island, Extreme Temperatures, Drought, Invasive Species
	Implementation Schedule	2023-2027

5	Adopt an ordinance to prevent critical facilities from being built in 500-year floodplain.	
High	Action Description	Floodplain ordinances meet FEMA specifications. The Town may consider expanding these ordinances to mitigate risks of high ground water and flooding.
	Action Lead	Planning Director
	Supporting Organizations	
	Cost	Low
	Potential Funding Sources	Staff Time / General Operating Budget
	Hazards	Flooding
	Implementation Schedule	2024-2027

6	Explore and expand opportunities for public/private partnerships to support public education and community outreach initiatives related to hazard awareness and risk reduction efforts.	
High	Action Description	Collaborate with Charles River Watershed Association to support public education and community outreach initiatives related to hazard awareness and risk reduction efforts.
	Action Lead	Planning Director
	Supporting Organizations	Public Information Officer
	Cost	Low
	Potential Funding Sources	Staff Time / General Operating Budget
	Hazards	All Hazards
	Implementation Schedule	2023-2028

7	Develop a Stormwater Enterprise Fund.	
High	Action Description	Currently working on creation of a stormwater enterprise fund. This proposal will go to Town Meeting in March 2023. Under MS4 Permit, Town is working on code assessment for street design and parking lot guidance. The Town has constructed bioretention areas, rain gardens, drainage swales, infiltration systems and pervious pavement. Town has included educational signage around these installations. DPW continues to inspect and screen outfalls and interconnections during wet and dry weather. Town has a separate stormwater webpage at https://wellesleyma.gov/1513/Stormwater-Regulations Town has also increased street sweeping, distributed messaging through social media and town news channels. Town also has drainage review bylaw for disturbance of an acre or more. Currently working on a Phosphorus control plan with a consultant. Provide quarterly digital newsletters on conservation, environmental practices, BMP for lawn care.
	Action Lead	Director of Public works
	Supporting Organizations	MassDEP/NRC
	Cost	Low
	Potential Funding Sources	Land Owners/Rate Payers
	Hazards	Flood, Severe Winter Storms, Other Severe Weather Events
	Implementation Schedule	2023-2024

8	Educate people about the location and availability of heating and cooling centers.	
High	Action Description	In addition to education about the location and availability of heating and cooling centers, develop a plan to get people to these centers.
	Action Lead	Director of Council on Aging
	Supporting Organizations	
	Cost	Low
	Potential Funding Sources	Council on Aging Budget
	Hazards	Severe Winter Storms, Extreme Temperatures, Other Severe Weather Events
	Implementation Schedule	2023-2028

9	Create secondary MWRA connection (redundancy). This would benefit Needham and Weston.

Medium	**Action Description**	Secondary connection to outside water supply to mitigate ground wells that have been identified as having higher concentrations of pfas. The secondary connection will also benefit the Towns of Weston and Needham. Drought or earthquake could impact the one connection.
	Action Lead	Director of Public Works
	Supporting Organizations	Massachusetts Water Resources Authority
	Cost	High
	Potential Funding Sources	Water Utility - 2025 Budget
	Hazards	Infectious Disease, Invasive Species, Drought, Extreme Temperatures
	Implementation Schedule	2023-2025

10	**Replace bridge at Town Hall to meet H20 loading.**	
Medium	**Action Description**	Bridge goes over a broad floodplain element if the bridge fails or collapses it cannot meet stormwater management needs. This is also the primary access to Town Hall.
	Action Lead	Director of Public Works
	Supporting Organizations	Wetlands Administrator, MA DEP, FEMA
	Cost	High
	Potential Funding Sources	MassDEP Culvert Replacement Program; FEMA BRIC, Town of Wellesley Capital
	Hazards	Flood, Earthquake
	Implementation Schedule	2023-2028

11	**Work with various partners to identify, prioritize, and address stormwater management needs, such as the Route 9 culverts.**	
Medium	**Action Description**	This is an active floodplain area.
	Action Lead	Town Engineer
	Supporting Organizations	MassDOT/Private Landowners/Wetlands Administrator/Traffic Safety Committee/Facilities Management Department
	Cost	High
	Potential Funding Sources	Stormwater Utility/DPW Capital/FEMA/DOT
	Hazards	Flood, Severe Winter Storms, Other Severe Weather Events

	Implementation Schedule	2023-2025

12	**Design and implement a plan to encourage people to sign up for Smart 911 system.**	
Medium	**Action Description**	The Smart 911 system is an integral tool for alerting the public about potential hazards.
	Action Lead	Select Board
	Supporting Organizations	
	Cost	Low
	Potential Funding Sources	Staff Time / General Operating Budget
	Hazards	All Hazards
	Implementation Schedule	2024-2028

13	**Culvert replacement on Route 9**	
Medium	**Action Description**	MAss DOT for design, funding and replacement. Impacts a significant number of properties which floods across 4 lanes of traffic and can be a foot deep of water.
	Action Lead	Director of Public Works
	Supporting Organizations	MassDOT
	Cost	Medium
	Potential Funding Sources	MassDOT
	Hazards	Flood, Severe Winter Storms, Other Severe Weather Events
	Implementation Schedule	2023-2025

14	**Lexington Road, which crosses Boulder Brook just upstream of the Worcester Street crossing near the Natick town line.**	
Medium	**Action Description**	combine with above - problem may be dependent on Route 9 Culvert issue
	Action Lead	Director of Public Works
	Supporting Organizations	Natural Resources Commission
	Cost	Medium
	Potential Funding Sources	Stormwater Utility/DPW Capital

	Hazards	Flood, Severe Winter Storms, Other Severe Weather Events
	Implementation Schedule	2023-2025

15	**Cedar Brook Road, which crosses Boggle Brook at the outlet of Reed Pond near the Natick line.**	
Medium	**Action Description**	This runs closely to residential properties and can become clogged with debris. Add to maintenance schedule.
	Action Lead	Director of Public Works
	Supporting Organizations	Wetlands Administrator
	Cost	Medium
	Potential Funding Sources	Stormwater Utility/Highway Operating
	Hazards	Flood, Severe Winter Storms, Other Severe Weather Events
	Implementation Schedule	2023-2024

16	**River Street, which runs along the Charles River between Washington Street and Walnut Street.**	
Medium	**Action Description**	Habitat is negatively impacted from water runoff from River Street because there is no stormwater infrastructure.
	Action Lead	Director of Public Works
	Supporting Organizations	Wetlands Administrator, Department of Conservation and Recreation
	Cost	Medium
	Potential Funding Sources	Stormwater Utility/Wellesley DPW/Mass DCR
	Hazards	Flood, Severe Winter Storms, Other Severe Weather Events
	Implementation Schedule	2023-2025

17	**#1 Washington Street, bordering the Charles River (opposite River Street).**	
Medium	**Action Description**	Large parking area along Charles River. If there is a dam breach the building would be significantly impacted. There is no stormwater infrastructure in this area which regularly floods the parking lot.
	Action Lead	Director of Public Works
	Supporting Organizations	Private land owner

	Cost	Medium
	Potential Funding Sources	Private Land Owner
	Hazards	Flood, Severe Winter Storms, Other Severe Weather Events
	Implementation Schedule	2023-2026

18	Inverness Road, which is south of Academy Brook, just south of Centennial Reservation.	
Medium	Action Description	Need to reconstruct culvert to reduce flooding.
	Action Lead	Director of Public Works
	Supporting Organizations	
	Cost	Medium
	Potential Funding Sources	MVP Action Grant, MassDOT
	Hazards	Flood, Severe Winter Storms, Other Severe Weather Events
	Implementation Schedule	2023-2026

19	Replacement/upsizing of culvert on MBTA land that flows from bottom of Geraldine Road to the Town's Diane Warren Field.	
Medium	Action Description	Work with MBTA. Overflow at significant speeds that is damaging private property. It is an undersized culvert that floods property and fields. It is under railroad.
	Action Lead	Director of Public works
	Supporting Organizations	MBTA
	Cost	Medium
	Potential Funding Sources	MBTA/MassDOT
	Hazards	Flood, Severe Winter Storms, Other Severe Weather Events
	Implementation Schedule	2023-2028

20	Replace culvert with a larger one on unaccepted portion of Rice Street to prevent flooding.	
Medium	Action Description	This is a walking route to the High School.
	Action Lead	Town Engineer

	Supporting Organizations	WPD/NRC
	Cost	Medium
	Potential Funding Sources	Stormwater Utility/DPW Capital/Culvert Replacement Program
	Hazards	Flood, Severe Winter Storms, Other Severe Weather Events
	Implementation Schedule	2024-2027

21	**Accelerate and maximize Installation of solar and battery storage on municipal properties, where appropriate**	
Medium	**Action Description**	Solar power and battery storage are essential resources for building Wellesley's resilience to grid failure. Solar plus battery storage also reduces electricity costs and greenhouse gas emissions for the Wellesley Municipal Light Plant (WMLP) and its customers and defers WMLP capital expenditures on distribution system upgrades.
	Action Lead	Director Municipal Light Plant
	Supporting Organizations	FEMA BRIC, EEA
	Cost	Medium
	Potential Funding Sources	FEMA BRIC, MVP
	Hazards	Severe Winter Storms, Extreme Temperatures, Other Severe Weather Events, Hurricanes/Wind, Tornadoes
	Implementation Schedule	2024-2028

22	**Increase Public Works funding for invasive species management.**	
Medium	**Action Description**	Public Works needs additional funding to manage invasive species.
	Action Lead	Natural Resources Commission Director
	Supporting Organizations	DPW Park and Tree Division
	Cost	Low
	Potential Funding Sources	DPW Budget/Grant Funding
	Hazards	Invasive Species
	Implementation Schedule	2024-2025

23	Develop a program to monitor and protect water quality.	
Medium	Action Description	Early detection of a water quality issue is essential to mitigate the risk of invasive species growing.
	Action Lead	Natural Resources Commission Director
	Supporting Organizations	Charles River Watershed Association
	Cost	Low
	Potential Funding Sources	Staff Time / General Operating Budget
	Hazards	Invasive Species, Infectious Disease, Drought, Extreme Temperatures
	Implementation Schedule	2026-2028

24	Conduct mechanical harvesting of aquatic invasive species	
Medium	Action Description	Harvesting invasive aquatic species mitigates the risk of invasive species which put water quality at risk.
	Action Lead	Assistant Superintendent Park and Tree Division of Department of Public Works
	Supporting Organizations	Natural Resources Commission
	Cost	Medium
	Potential Funding Sources	Staff Time / General Operating Budget
	Hazards	Invasive Species, Infectious Disease, Drought, Extreme Temperatures
	Implementation Schedule	2023-2028

25	Implement the Grow Green Wellesley sustainable landscaping program.	
Medium	Action Description	The Grow Green Wellesley Initiative is intended to inspire our community to use eco-friendly landscaping methods to protect our health and environment. The Town of Wellesley currently maintains all public land - including schools and playing fields - without harmful chemicals and emphasizes native plants to create biodiversity in town. https://wellesleyma.gov/454/Grow-Green-Wellesley-Initiative
	Action Lead	Natural Resources Commission Director
	Supporting Organizations	Sustainable Wellesley
	Cost	Low
	Potential Funding Sources	Staff Time / General Operating Budget

	Hazards	Invasive Species, Infectious Disease, Drought, Extreme Temperatures
	Implementation Schedule	2023-2024

26	**Mitigate the pumping stations and ejectors, and government buildings that are located in the base flood zone.**	
Low	**Action Description**	Identify and procure emergency flood projection equipment and supplies (e.g., pumps, sand bags, generators, road blocking).
	Action Lead	Director of Public Works
	Supporting Organizations	Facilities Director, Massachusetts Water Resources Authority, Wellesley Fire Department, FEMA, Municipal Aid Communities
	Cost	High
	Potential Funding Sources	Building Owners
	Hazards	Flood
	Implementation Schedule	2023-2025

27	**Develop a policy to limit the amount of impervious surface allowed during development or redevelopment.**	
Low	**Action Description**	Impervious surface increases the risk of flooding and allows for greater groundwater infiltration.
	Action Lead	Planning Director
	Supporting Organizations	Department of Public Works
	Cost	Low
	Potential Funding Sources	Staff Time / General Operating Budget
	Hazards	Flood, Severe Winter Storms, Other Severe Weather Events
	Implementation Schedule	2024-2027

28	**Accelerate and maximize the installation of solar and battery storage on residential, institutional, and commercial properties town-wide through advocacy for state incentives and through community outreach programs.**	
Low	**Action Description**	Solar power and battery storage are essential resources for building Wellesley's resilience to grid failure. Solar plus battery storage also reduces electricity costs and greenhouse gas emissions for the Wellesley Municipal Light Plant (WMLP) and its customers and defers WMLP capital expenditures on distribution system upgrades.

	Action Lead	Director Municipal Light Plant
	Supporting Organizations	Climate Action Committee
	Cost	Medium
	Potential Funding Sources	FEMA BRIC, MVP
	Hazards	Severe winter storms; Extreme Temperatures, Other Severe Weather Events, Hurricanes/Wind, Tornadoes
	Implementation Schedule	2024-2028

29	**Expand water conservation programs/policies.**	
Low	**Action Description**	Mitigating risk of extreme temperatures and droughts is necessary through the implementation of policies and education.
	Action Lead	Natural Resources Commission Director
	Supporting Organizations	Charles River Watershed Association
	Cost	Low
	Potential Funding Sources	Staff Time / General Operating Budget
	Hazards	Drought
	Implementation Schedule	2027-2028

30	**Conduct a feasibility assessment for microgrids.**	
Low	**Action Description**	Utilizing microgrids is a way for the Town to mitigate the risk of power outages caused by multiple natural hazards. The Town is currently working on the creation of a microgrid at the main Wellesley Free Library location.
	Action Lead	Natural Resources Commission Director
	Supporting Organizations	Sustainable Wellesley
	Cost	Medium
	Potential Funding Sources	Staff Time / General Operating Budget
	Hazards	Severe Winter Storms, Extreme Temperatures, Other Severe Weather Events, Hurricanes/Wind, Urban Heat Island, Tornadoes
	Implementation Schedule	2025-2028

31	Identify steep slope areas and prevent building on the area through land use and zoning.	
Low	Action Description	Utilize robust GIS program and fly-over data to identify steep slopes. Planning Board will identify zoning modifications or revisions to address this issue.
	Action Lead	Planning Director
	Supporting Organizations	GIS Manager
	Cost	Low
	Potential Funding Sources	Staff Time / General Operating Budget
	Hazards	Landslide
	Implementation Schedule	2023-2026

32	Promote the availability of flood insurance to owners and renters of property located in flood prone areas, including those that are not located in FEMA-mapped special flood hazard areas. Maintain supplies of FEMA/NFIP materials to help property owners evaluate measures to reduce potential hazard damage. Make available in public buildings, local library, website, etc. and inform people who they can call to learn more information.	
Low	Action Description	Utilize Town Website, point residents to the interactive mapping that identifies flood zones. Planning Department assists residents in access this information and modifying designations in the floodplain. The Planning Department and the Wetlands Department provide NFIP information to property owners.
	Action Lead	Planning Director
	Supporting Organizations	Inspector of Buildings, Public Info. Officer
	Cost	Low
	Potential Funding Sources	Staff Time / General Operating Budget
	Hazards	Flood
	Implementation Schedule	2023-2026

33	Improve vegetation management at Longfellow Dam.	
Low	Action Description	Managing vegetation at the Longfellow Dam, an earthen dam, is a way to maintain the structural integrity of the dam and a way to prevent a dam breach.
	Action Lead	Director of Public works
	Supporting Organizations	Natural Resources Commission, Charles River Watershed Association, Charles River Climate Compact's Flood Model

	Cost	High
	Potential Funding Sources	MVP action grant
	Hazards	Flood, Invasive Species
	Implementation Schedule	2024-2028

34	**Build internal staff capacity to identify and pursue external sources of grant funding for mitigation projects through increased opportunities for training/professional development and the ability to invest more time on grant writing, grants management, and related administrative tasks.**	
Low	**Action Description**	In monthly department head meetings identify potential grant sources and determine which department will apply for relevant grants.
	Action Lead	Director of Public Works
	Supporting Organizations	Select Board
	Cost	Low
	Potential Funding Sources	Staff Time / General Operating Budget
	Hazards	All Hazards
	Implementation Schedule	2023-2028

35	**Explore the potential use of vehicle batteries for backup power supply.**	
Low	**Action Description**	Back-up batteries enhance resilience to grid disruptions.
	Action Lead	Director Municipal Light Plant
	Supporting Organizations	Climate Action Committee
	Cost	Low
	Potential Funding Sources	State and federal incentives
	Hazards	Severe Winter Storms; Extreme Temperatures, Other Severe Weather Events, Hurricanes/Wind, Tornadoes
	Implementation Schedule	2024-2028

36	**Explore opportunities for local geothermal and wind energy projects.**	
Low	**Action Description**	Diverse forms of renewable energy coupled with battery storage enhance resilience to grid disruptions.

	Action Lead	Director Municipal Light Plant
	Supporting Organizations	Climate Action Committee
	Cost	Low
	Potential Funding Sources	Grants, state and federal incentives, Town
	Hazards	Severe Winter Storms; Extreme Temperatures, Other Severe Weather Events, Hurricanes/Wind, Tornadoes
	Implementation Schedule	2024-2028

37	**Revise the online permitting system to automatically link building owners to educational materials regarding unreinforced masonry structures and the earthquake risk.**	
Low	**Action Description**	On the viewpoint cloud web portal have links triggered by specific types of permits.
	Action Lead	Inspector of Buildings
	Supporting Organizations	
	Cost	Low
	Potential Funding Sources	Staff Time / General Operating Budget
	Hazards	Earthquake
	Implementation Schedule	2024-2025

Table 68 shows the mitigation actions that specifically target vulnerable populations and Table 69 shows the mitigation actions that specifically target buildings and infrastructure. Each table lists the actions in order of priority.

Table 68. Mitigation actions for vulnerable populations.

Priority	Action #	Action Title
High	1	Identify and seek to address any unmet needs related to targeted outreach and education for the community’s more vulnerable populations (i.e., environmental justice communities, residents with special needs, property owners in high risk hazard areas, thos

Priority	Action #	Action Title
	6	Explore and expand opportunities for public/private partnerships to support public education and community outreach initiatives related to hazard awareness and risk reduction efforts.
	8	Educate people about the location and availability of heating and cooling centers.
Medium	9	Create secondary MWRA connection (redundancy). This would benefit Needham and Weston.
	12	Design and implement a plan to encourage people to sign up for Smart 911 system.
	15	Cedar Brook Road, which crosses Boggle Brook at the outlet of Reed Pond near the Natick line.
	17	#1 Washington Street, bordering the Charles River (opposite River Street).
	23	Develop a program to monitor and protect water quality.
Low	32	Promote the availability of flood insurance to owners and renters of property located in flood prone areas, including those that are not located in FEMA-mapped special flood hazard areas. Maintain supplies of FEMA/NFIP materials to help property owners evaluate measures to reduce potential hazard damage. Make available in public buildings, local library, website, etc. and inform people who they can call to learn more information.

Table 69. Mitigation actions for buildings and infrastructure.

Priority	Action #	Action Title
High	5	Adopt an ordinance to prevent critical facilities from being built in 500-year floodplain.
	7	Develop a Stormwater Enterprise Fund.
Medium	9	Create secondary MWRA connection (redundancy). This would benefit Needham and Weston.
	10	Replace bridge at Town Hall to meet H20 loading.
	11	Work with various partners to identify, prioritize, and address stormwater management needs, such as the Route 9 culverts.
	13	Culvert replacement on Route 9

Priority	Action #	Action Title
	14	Lexington Road, which crosses Boulder Brook just upstream of the Worcester Street crossing near the Natick town line.
	15	Cedar Brook Road, which crosses Boggle Brook at the outlet of Reed Pond near the Natick line.
	16	River Street, which runs along the Charles River between Washington Street and Walnut Street.
	17	#1 Washington Street, bordering the Charles River (opposite River Street).
	18	Inverness Road, which is south of Academy Brook, just south of Centennial Reservation.
	19	Replacement/upsizing of culvert on MBTA land that flows from bottom of Geraldine Road to the Town's Diane Warren Field.
	20	Replace culvert with a larger one on unaccepted portion of Rice Street to prevent flooding.
Low	26	Mitigate the pumping stations and ejectors, and government buildings that are located in the base flood zone.
	27	Develop a policy to limit the amount of impervious surface allowed during development or redevelopment.
	31	Identify steep slope areas and prevent building on the area through land use and zoning.
	32	Promote the availability of flood insurance to owners and renters of property located in flood prone areas, including those that are not located in FEMA-mapped special flood hazard areas. Maintain supplies of FEMA/NFIP materials to help property owners evaluate measures to reduce potential hazard damage. Make available in public buildings, local library, website, etc. and inform people who they can call to learn more information.
	37	Revise the online permitting system to automatically link building owners to educational materials regarding unreinforced masonry structures and the earthquake risk.

The HMPC requested three additional tables of actions, these are included in Appendix B:

1. Actions Sorted by Hazard
2. Actions Sorted by Lead
3. Actions Sorted by Implementation Schedule

Possible Funding Sources

All the mitigation actions included in this plan have identified one or more potential funding sources. The HMWG focused on projects eligible for MVP Grant funding and FEMA BRIC funding. Below is a list of some of the federal and state funding mechanisms that may assist in implementing mitigation actions.

Federal Emergency Management Agency (FEMA) Mitigation Grants

The Federal Emergency Management Agency (FEMA) makes grant funding available for a range of mitigation activities via several Hazard Mitigation Assistance (HMA) programs. These grant programs provide funding for eligible mitigation activities that reduce disaster losses and protect life and property from future disaster damages. They are not intended to fund repair, replacement, or deferred maintenance activities but are rather designed to assist in developing long-term, cost-effective improvements that will reduce risk to natural hazards.

- **Building Resilient Infrastructure and Communities (BRIC)**
  BRIC is a new FEMA hazard mitigation program designed to replace the agency's former HMA Pre-Disaster Mitigation (PDM) grant program, aiming to categorically shift the federal focus away from reactive disaster spending and toward research-supported, proactive investment in community resilience. It is a result of recent amendments made to Section 203 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act) by Section 1234 of the Disaster Recovery Reform Act of 2018 (DRRA). BRIC will support states, local communities, tribes, and territories as they undertake hazard mitigation projects reducing the risks they face from natural hazards. The BRIC program's guiding principles are supporting communities through capability- and capacity-building; encouraging and enabling innovation; promoting partnerships; enabling large projects; maintaining flexibility; and providing consistency.

- **Hazard Mitigation Grant Program (HMGP)**
  The HMGP is authorized under Section 404 of the Stafford Act. The HMGP provides grants to states, tribes, and local governments to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the HMGP is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster. A key purpose of the HMGP is to ensure that any opportunities to take critical mitigation measures to protect life and property from future disasters are not lost during the recovery and reconstruction process following a disaster. HMGP is typically available only in the months after a federal disaster declaration, as funding amounts are determined based on a percentage of the funds spent on FEMA's Public and Individual Assistance programs.

- **Flood Mitigation Assistance (FMA) Program**
  The FMA program was created as part of the National Flood Insurance Reform Act (NFIRA) of 1994 (42 U.S.C. 4101) with the goal of reducing or eliminating claims under the NFIP. FEMA provides FMA funds to assist states and communities with implementing measures that reduce

or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insurable under the NFIP. The long-term goal of FMA is to reduce or eliminate claims under the NFIP through mitigation activities. One limitation of the FMA program is that it is generally used to provide mitigation for structures that are insured or located in Special Flood Hazard Areas (SFHAs) as mapped by FEMA. Federal funding for this nationally competitive grant program is generally an annual allocation (subject to Congressional appropriation) and eligibility is linked to a community's good standing in the NFIP.

Municipal Vulnerability Preparedness Action Grants[63]

The MVP Action Grant offers financial resources to municipalities seeking to advance priority climate adaptation actions to address climate change impacts resulting from extreme weather, sea level rise, inland and coastal flooding, severe heat, and other climate impacts.

Responses to the RFR may be submitted by municipalities who have received designation from the Executive Office of Energy and Environmental Affairs (EEA) as a Climate Change Municipal Vulnerability Preparedness (MVP) Community, or "MVP Community." All projects are required to provide monthly updates, project deliverables, a final project report, and a brief project summary communicating lessons learned. The municipality is also required to match 25% of total project cost using cash or in-kind contributions. All proposals must include the following:

- Completed application template
- Project budget and deliverables
- MVP yearly progress report describing any relevant work toward advancing community priorities since earning MVP designation
- Statement of match
- Letters of support from landowner (if applicable), partners, and the public

Project types include:

- ***Detailed Vulnerability and Risk Assessment*** – In-depth vulnerability or risk assessment of a particular sector, location, or other aspect of the municipality.
- ***Public Education and Communication*** – Projects that increase public understanding of climate change impacts within and beyond the community and foster effective partnerships to develop support.
- ***Local Bylaws, Ordinances, Plans, and other Management Measures*** – Projects to develop, amend, and implement local ordinances, bylaws, standards, plans, and other management

[63] State of Massachusetts. *MVP Action Grant.* https://www.mass.gov/service-details/mvp-action-grant.

measures to reduce risk and damages from extreme weather, heat, flooding, and other climate change impacts.

- ***Redesigns and Retrofits*** – Engineering and construction projects to redesign, plan, or retrofit vulnerable community facilities and infrastructure (e.g., wastewater treatment plants, culverts, and critical municipal roadways/evacuation routes) to function over the life of the infrastructure given projected climate change impacts.

- ***Energy Resilience Strategies*** — Projects that incorporate clean energy generation and that are paired with resilience enabling technology to maintain electrical and/or heating and cooling services at critical facilities.

- ***Chemical Safety and Climate Vulnerabilities*** — Projects that seek to engage the business and manufacturing community through assistance or training on identifying vulnerabilities to chemical releases due to severe weather events, reducing use of toxic or hazardous chemicals, outreach to improve operations and maintenance procedures to prevent chemical releases and accidents, outreach to improve emergency and contingency planning, and/or identifying existing contaminated sites that pose chemical dispersion risks during flood events.

- ***Nature-Based Storm-Damage Protection, Drought Mitigation, Water Quality, and Water Infiltration Techniques*** – Projects that utilize natural resources and pervious surfaces to manage coastal and inland flooding, erosion, and other storm damage, such as stormwater wetlands and bio-retention systems, and other Smart Growth and Low Impact Development techniques.

- ***Nature-Based, Infrastructure and Technology Solutions to Reduce Vulnerability to Extreme Heat and Poor Air Quality*** – Projects that utilize natural resources, vegetation, and increasing pervious surface to reduce ambient temperatures, provide shade, increase evapotranspiration, improve local air quality, and otherwise provide cooling services within the municipality.

- ***Nature-Based Solutions to Reduce Vulnerability to other Climate Change Impacts*** – Nature-based projects that address other impacts of climate change such as extreme weather, damaging wind and power outages, and increased incidence of pests and vector-borne illnesses and other public health issues.

- ***Acquisition of Land to Achieve a Resiliency Objective*** — Land purchases are eligible for grant funding if the parcel has been identified through a climate vulnerability assessment as an appropriate location for a specific eligible adaptation activity to occur, such as accommodating an infrastructure or facility redesign or retrofit project, providing natural flood storage to reduce downstream flooding, or removal of pavement and planting of trees to reduce flooding and heat island effects.

- ***Ecological Restoration and Habitat Management to Increase Resiliency*** — Projects that repair or improve natural systems for community and ecosystem adaptation, such as right-sizing culverts with natural bottoms for fish and wildlife passage, dam removal, restoration of coastal wetlands, etc.

- ***Subsidized Low Income Housing Resilience Strategies*** — Investments in resiliency measures for affordable housing to protect vulnerable populations that may not have the resources to recover from an extreme climate event.

- ***Mosquito Control Districts*** — Projects to reduce the risk to public health from mosquito-borne illness and to increase mosquito surveillance and control capacity by incentivizing municipalities not in an organized mosquito control project or district to form a new mosquito control district or join an existing mosquito control district. Also funding for municipalities currently in a mosquito control district for new or proactive mosquito control measures.

Chapter 7. Plan Integration and Maintenance

The Hazard Mitigation Planning Committee (HMPC) will implement the mitigation strategy and specific mitigation actions outlined in this plan, and update and maintain the plan according to the guidelines below. The HMPC includes key stakeholders in the Town, who will use the plan's goals, as well as continued analysis of hazard risks and capabilities, to weigh the available resources against the costs and benefits for each mitigation action. The Town understands the value of this plan and its positive mitigation impact and intend to continue updating this plan and implementing the plan's strategies. The Town Administrator will lead the efforts to maintain, implement, update the Hazard Mitigation Plan.

Continued Public Participation

D1. Is there discussion of how the community(ies) will continue public participation in the plan maintenance process? (Requirement §201.6(c)(4)(iii))

Public participation is an integral component of the mitigation planning process and will continue to be essential as this plan is implemented and updated over time. Based on the high level of interest in the mitigation planning process and in the Municipal Vulnerability Preparedness project, Town residents and stakeholders are interested in mitigation. The HMPC included several education and outreach mitigation actions designed to engage the public. The Town intends to involve the public throughout the five-year implementation of this plan, as well as in the reviewing and updating processes. The Executive Director will take the lead in soliciting participation from the public. This participation will take multiple forms, including all of those outlined in the Chapter 3: Planning Process of this plan. Efforts to involve the public include:

- Advertising on the Town's website and posting news and announcements on the Town's Twitter and Facebook pages.
- The Town will record with closed captioning all meetings to air on the public television station.
- Representatives from the three local schools, Wellesley College, Babson College, and MassBay Community College will join Town officials in implementing mitigation actions and participating in plan update meetings.
- Copies of this plan will remain on the Town's website; and a hard copy will be kept in the Selectboard Office and the Planning Office for public review. Updates to the plan will also be posted on the Town's website.
- The Town of Wellesley will continue to work with private industry, regional agencies, and adjacent communities as this plan is implemented.

Method and Schedule for Keeping the Plan Current

D2. Is there a description of the method and schedule for keeping the plan current (monitoring, evaluating and updating the mitigation plan within a 5-year cycle)? (Requirement §201.6(c)(4)(i))

The HMPC and the Town of Wellesley recognize the importance of keeping the mitigation plan up to date. Keeping the plan current includes monitoring, evaluating, and updating the plan over a five-year period. The overall responsibility for monitoring the implementation of the plan rests with the HMPC members, led by the Executive Director.

Process to Track Actions

***MONITORING** means tracking the implementation of the plan over time.*

Together the Executive Director and the HMPC will maintain the Mitigation Action Tracker (a tool to record the status of each mitigation action). They will send a reminder email with a link to the web-based Mitigation Action Tracker on a semi-annual basis (January and July) to all Department Heads responsible for a mitigation action and to relevant Town committees. They may also distribute the Mitigation Action Progress Worksheet (shown in Appendix C) for Department Heads who prefer a form over a digital spreadsheet.

If the Town experiences a large-scale disaster, the Executive Director will assemble a HMPC meeting to update the list of mitigation actions and review their order based on current priorities.

Process to Evaluate Effectiveness of the Plan

***EVALUATING** means assessing the effectiveness of the plan at achieving its stated purpose and goals.*

The HMPC has agreed to meet on a semi-annual basis to review the implementation of the mitigation plan. The first meeting will take place in June; the second, in January.

At the first meeting (June 2023), the HMPC will review the effectiveness of the planning process, public and stakeholder engagement, risk analysis, and the mitigation strategy, including its implementation. It is recommended that the HMPC use the worksheet provided in Appendix C. Beyond considering the planning process, the HMPC will seek to answer the following questions to determine if the plan is effective at mitigating risk to Town residents, the built environment, and the natural environment.

- Can the HMPC identify success stories of losses avoided because of hazard mitigation measures implemented? Can the HMPC identify political, social, and economic successes?
- Have the mitigation actions implemented achieved benefits beyond the cost of mitigation?
- Have the implemented mitigation actions saved lives or protected property?

- Does the list of mitigation actions coincide with the Town's priorities? Do additional actions need to be added?

Process to Update the Plan

***UPDATING** means reviewing and revising the plan at least once every five years.*

At each semi-annual meeting, the HMPC will review the plan's goal statements and mitigation action status. If necessary, the goal statements and mitigation actions may be revised to reflect current Town priorities. In addition, the HMPC will discuss methods for continuing to integrate the mitigation plan with other plans, processes, and projects in the Town.

They will prepare a one-page brief regarding each semi-annual HMPC meeting to share with the Select Board and to post on the Town website. The HMPC recognizes the value in keeping the public and key stakeholders informed about the implementation and status of the mitigation plan.

HMPC members will continue to participate in regional and state-based meetings to stay current with best risk-mitigation practices. Such meetings may include the Massachusetts Emergency Management Agency (MEMA), the Metropolitan Area Planning Council (MAPC), and Charles River Watershed Association. The HMPC will also participate in land use planning and mitigation planning meetings with their neighbors, Needham, Newton, Weston, Dover, and Natick. They will collaborate with the City of Boston on issues related to the Charles River Watershed, transportation, and emergency management.

The Town of Wellesley agrees to update and adopt this mitigation plan on a five-year basis. The update will include a comprehensive review and planning process like the one used to develop this mitigation plan update. It will update the mitigation action list, current land use practices, collect and review best available data, review the capability assessment, and engage the public and stakeholders. This process will occur according to FEMA guidelines. The HMPC will seek funding for the development of the plan update **two years** before the plan expires. The plan update process gives the Town the chance to add and/or re-prioritize mitigation actions based on current risk, capabilities, and public/stakeholder suggestions. The Executive Director will serve as the Project Manager for the update process. The figure below illustrates the update timeline.

Year 1	Year 2	Year 3	Year 4	Year 5
• Seek grant funding for mitigation actions • Gather the HMPC in January and June	• Seek grant funding for mitigation actions • Gather the HMPC in January and June	• Seek FEMA BRIC funding for plan update • Seek grant funding for mitigation actions • Gather the HMPC in January and June	• Begin the plan update process • Seek grant funding for mitigation actions • Gather the HMPC in January and June	• Complete the plan update process - adopt the new plan • Seek grant funding for mitigation actions • Gather the HMPC in January and June

Figure 29. Plan Update and Implementation Schedule.

Responsible Parties for Plan Implementation and Maintenance

Wellesley, MA

Meghan Jop, Executive Director

525 Washington Street

Wellesley, MA 02482

Phone: 781-431-1019

For State resources:

Massachusetts Emergency Management Agency:

Address: 400 Worcester Road, Framingham, MA 01702-5399

Phone: 508-820-2000 (MEMA Headquarters and Communications Center)

or 978-328-1500 (MEMA Region 1 Office)

Website: https://www.mass.gov/orgs/massachusetts-emergency-management-agency

For Federal resources:

Federal Emergency Management Agency:

Address: 220 Binney Street, Cambridge, MA 02142

Phone: 877-336-2734

Email: fema-r1-info@fema.dhs.gov

Website: https://www.fema.gov/region-i-ct-me-ma-nh-ri-vt

System to Integrate this Plan with Existing Planning Mechanisms

D3. Does the Plan describe a process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate? (Requirement §201.6(c)(4)(ii))

***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.*

For the Town of Wellesley to succeed in reducing hazard risks over the long term, the information, conclusions, and recommendations of this hazard mitigation plan should be integrated throughout government operations. Many other local plans and processes will present opportunities to address hazard mitigation in a way that can support multiple community objectives, so an important part of maintaining and implementing this hazard mitigation plan will be to identify and capitalize on these opportunities to leverage activities that have co-benefits (including but not limited to risk reduction). The Town's most recent adoption of its Unified Plan effectively demonstrates this type of integration by stressing the importance of community sustainability and climate resilience strategies across various elements of this separate planning document.

The HMPC will remain tasked with helping to ensure that all new or updated local plan documents are informed by and consistent with the goals and actions of this hazard mitigation plan and will not contribute to increased hazard vulnerability in Wellesley. Specifically, this includes but is not limited to the implementation or future updates to the following local plans as identified and further described in Chapter 5 (Capability Assessment):

- Municipal Vulnerability Preparedness / Community Resilience Building Summary of Findings Report (2020)
- Climate Action Plan (2022)
- Open Space and Recreation Plan (2022)
- The Wellesley Unified Plan (2019)
- Housing Production Plan (2018)
- Town Forest Management Plan (2018)

Additional opportunities to integrate the requirements of this plan into other local planning mechanisms shall continue to be identified through future meetings of the HMPC and through the five-year review process described in this chapter. Other planning mechanisms include local regulations and existing code enforcement procedures (i.e., zoning bylaws, site plan review, etc.), internal municipal policies, special projects or initiatives, and other routine government or community decision-making activities such as capital improvement planning and the Town's annual budget process. Emphasis for identifying these integration opportunities will be placed on those governance structures used to manage local land use and community development in both the pre-disaster and post-disaster environment. Also, as it relates to implementing specific mitigation actions identified in this plan, it will be the responsibility of each assigned lead department to determine additional measures that can support action completion or enhancement. This includes integrating mitigation actions from this plan into other local planning documents, processes, or mechanisms as deemed appropriate and most effective.

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.*

While it is recognized that there are many possible benefits to integrating components of this plan into other local planning mechanisms, the routine maintenance of this stand-alone plan is considered by the Town to be the most effective and appropriate method to identify, prioritize, and implement local hazard mitigation actions. In moving forward however the Town will consider the incorporation of some other plan documents into the hazard mitigation plan, such as any future iterations of the Town's MVP Plan, Climate Action Plan, or related climate adaptation planning efforts.

Appendix A. Planning Process Supporting Materials

Hazard Mitigation Planning Committee Meetings

HMPC Meeting Participants

Figure 30. HMPC Meeting Participation.

First Name	Last Name	Title	Affiliation	Phone	Email	#1 9/27/2022	#2 11/3/2022	#3 1/10/2023	#4 2/23/2023
Eric	Arbeene	Planning Director	Town of Wellesley	781-431-1019 x2237	earbeene@wellesleyma.gov	☑	☑	☑	☑
Jeffrey	Azano-Brow	Department of Public Work	Town of Wellesley	781-431-1019 x3360	jazanobrown@wellesleyma.gov	☑	☐	☐	☐
Nathaniel	Brady	Interim Fire Chief	Town of Wellesley	781-235-1300	nbrady@wellesleyma.gov	☑	☑	☐	☐
Kate	Deeb	Director of Campus and Cor	Babson College		kdeeb@babson.edu	☐	☐	☐	☑
Brian	Drainville	Maintenance Supervisor	Wellesley Housing Authority	781-235-0223	bdrainville@wellesleyhousing.org	☐	☑	☐	☐
Brian	Dupont	IT Director	Town of Wellesley	781-431-1019 x2280	bdupont@wellesleyma.gov	☑	☐	☐	☐
Amy	Frigulietti	Assistant Executive Director	Town of Wellesley	781-431-1019 x2205	afrigulietti@wellesleyma.gov	☑	☑	☐	☐
Stephanie	Hawkinson	Public Information Officer	Town of Wellesley	781-431-1019 x2207	shawkinson@wellesleyma.gov	☑	☑	☑	☑
David	Hickey	Town Engineer	Town of Wellesley	781-431-1019 x3310	dhickey@wellesleyma.gov	☐	☑	☐	☐
Suzanne	Howard	EHS Director	Wellesley College	781-283-3882	showard@wellesley.edu	☐	☑	☑	☐
Leonardo	Izzo	Director of Public Health	Town of Wellesley	781-431-1019 x4110	lizzo@wellesleyma.gov	☑	☐	☐	☑
Dira	Johanif	Urban Resilience Advocate	Charles River Watershed Association	617-540-5650	djohanif@crwa.org		☑	☑	☑
Meghan	Jop	Executive Director	Town of Wellesley	781-431-1019 x2200	mjop@wellesleyma.gov	☑	☑	☑	☑
Marybeth	Martello	Sustainability Director	Town of Wellesley	781-431-1019	mmartello@wellesleyma.gov	☑	☑	☑	☐
Joseph	Murray	Facilities Project Manager	Town of Wellesley	781-431-1019 x2402	jmurray@wellesleyma.gov	☑	☑	☐	☐
Jeff	Peterson	Assistant Fire Chief (retired	Town of Wellesley	781-431-1019 x6213	jpeterson@wellesleyma.gov	☐	☑	☑	☑
Jack	Pilecki	Chief of Police	Town of Wellesley	781-431-1019 x7123	jpilecki@wellesleyma.gov	☐	☐	☑	☑
George	Sarceno	Assistant Town Engineer	Town of Wellesley	781-431-1019 x3319	gsaraceno@wellesleyma.gov	☑	☑	☐	☐
Brandon	Schmitt	Natural Resource Commissi	Town of Wellesley	781-431-1019 x2298	bschmitt@wellesleyma.gov	☐	☑	☑	☑
Jackie	Sullivan	Executive Director	Wellesley Housing Authority	781-235-0223 x 12	jsullivan@wellesleyhousing.org	☐	☑	☑	☐
Mike	Thompson	GIS Manager	Town of Wellesley	781-431-1019 x2289	mthompson@wellesleyma.gov	☑	☑	☑	☐
Lisa	Wolf	Sustainability Coordinator	Wellesley Municipal Light Plant	781-431-1019 x3400	lwolf@wellesleyma.gov	☑	☐	☐	☐
Jeffrey	Zukowski	Hazard Mitigation Planner	MA Emergency Management Agency	508-820-1422	jeffrey.zukowski@state.mas.us	☐	☑	☐	☐

Public Outreach

Public Meeting November 14, 2022

News & Announcements

Posted on: November 9, 2022

Hazard Mitigation Public Meeting on November 16

Wellesley is developing a Hazard Mitigation Plan to better prepare for natural hazards and climate change impacts.

Public participation is essential to developing this plan.

All residents are invited to attend a virtual public meeting on **Wednesday, November 16 from 6:30 p.m. to 7:30 p.m.** to ask questions and give input as the Town develops this plan.

The meeting will take place via Zoom. Please register in advance to attend.

Meeting participants will have an opportunity to contribute ideas for making the Town more resilient to natural hazards like flooding, snowstorms, high winds and extreme temperatures.

The plan is being developed by a Hazard Mitigation Planning Committee comprised of Town leaders and local stakeholders, along with consultants from the Massachusetts Emergency Management Agency (MEMA).

Approval and adoption of this plan will allow the Town to apply for pre- and post-disaster hazard mitigation grant funds.

Figure 31. Public Meeting Announcement Example.

Appendix B. Mitigation Actions.

Priority Ranking Points

Action #	Action Title	Hazards Addressed	Approximate Cost	Equity Focus	Protection of Lives	Protection of Critical Facilities or Infrastructure	Protection of Natural Resources	Total
1	Identify and seek to address any unmet needs related to targeted outreach and education for the community's more vulnerable populations (i.e., environmental justice communities, residents with special needs, property owners in high risk hazard areas, those who are homebound, etc.).	3	3	3	3	0	0	12
2	Work with DCR, EEA and the Commonwealth to assess feasibility of removing the 3 dams on the Charles River in Wellesley.	3	3	0	1	3	2	12
3	Identify and protect open space.	2	3	3	2	0	2	12
4	Expand Tree Protection Bylaw to incentivize further protection of public and private trees.	2	3	3	2	0	2	12

Action #	Action Title	Hazards Addressed	Approximate Cost	Equity Focus	Protection of Lives	Protection of Critical Facilities or Infrastructure	Protection of Natural Resources	Total
5	Adopt an ordinance to prevent critical facilities from being built in 500-year floodplain.	3	3	0	2	3	0	11
6	Explore and expand opportunities for public/private partnerships to support public education and community outreach initiatives related to hazard awareness and risk reduction efforts.	3	3	2	2	0	0	10
7	Develop a Stormwater Enterprise Fund.	3	3	0	1	3	0	10
8	Educate people about the location and availability of heating and cooling centers.	3	3	3	1	0	0	10
9	Create secondary MWRA connection (redundancy). This would benefit Needham and Weston.	3	1	0	2	3	0	9
10	Replace bridge at Town Hall to meet H20 loading.	3	1	0	2	3	0	9

Action #	Action Title	Hazards Addressed	Approximate Cost	Equity Focus	Protection of Lives	Protection of Critical Facilities or Infrastructure	Protection of Natural Resources	Total
11	Work with various partners to identify, prioritize, and address stormwater management needs, such as the Route 9 culverts.	3	1	0	2	3	0	9
12	Design and implement a plan to encourage people to sign up for Smart 911 system.	3	3	0	3	0	0	9
13	Culvert replacement on Route 9.	3	2	0	1	3	0	9
14	Lexington Road, which crosses Boulder Brook just upstream of the Worcester Street crossing near the Natick town line.	3	2	0	1	3	0	9
15	Cedar Brook Road, which crosses Boggle Brook at the outlet of Reed Pond near the Natick line.	3	2	0	1	3	0	9
16	River Street, which runs along the Charles River between Washington Street and Walnut Street.	3	2	0	1	3	0	9

Action #	Action Title	Hazards Addressed	Approximate Cost	Equity Focus	Protection of Lives	Protection of Critical Facilities or Infrastructure	Protection of Natural Resources	Total
17	#1 Washington Street, bordering the Charles River (opposite River Street).	3	2	0	1	3	0	9
18	Inverness Road, which is south of Academy Brook, just south of Centennial Reservation.	3	2	0	1	3	0	9
19	Replacement/upsizing of culvert on MBTA land that flows from bottom of Geraldine Road to the Town's Diane Warren Field.	3	2	0	1	3	0	9
20	Replace culvert with a larger one on unaccepted portion of Rice Street to prevent flooding.	3	2	0	1	3	0	9
21	Accelerate and maximize Installation of solar and battery storage on municipal properties, where appropriate	3	2	0	1	3	0	9
22	Increase Public Works funding for invasive species management.	2	3	0	2	0	2	9
23	Develop a program to monitor and protect water quality.	2	3	0	2	0	2	9

Action #	Action Title	Hazards Addressed	Approximate Cost	Equity Focus	Protection of Lives	Protection of Critical Facilities or Infrastructure	Protection of Natural Resources	Total
24	Conduct mechanical harvesting of aquatic invasive species	2	2	2	1	0	2	9
25	Implement the Grow Green Wellesley sustainable landscaping program.	2	1	3	1	0	2	9
26	Mitigate the pumping stations and ejectors, and government buildings that are located in the base flood zone.	3	1	0	1	3	0	8
27	Develop a policy to limit the amount of impervious surface allowed during development or redevelopment.	3	3	0	0	0	2	8
28	Accelerate and maximize the installation of solar and battery storage on residential, institutional, and commercial properties town-wide through advocacy for state incentives and through community outreach programs.	3	2	2	1	0	0	8

Action #	Action Title	Hazards Addressed	Approximate Cost	Equity Focus	Protection of Lives	Protection of Critical Facilities or Infrastructure	Protection of Natural Resources	Total
29	Expand water conservation programs/policies.	2	3	0	1	0	2	8
30	Conduct a feasibility assessment for microgrids.	3	2	0	0	3	0	8
31	Identify steep slope areas and prevent building on the area through land use and zoning.	1	3	0	1	0	2	7
32	Promote the availability of flood insurance to owners and renters of property located in flood prone areas, including those that are not located in FEMA-mapped special flood hazard areas. Maintain supplies of FEMA/NFIP materials to help property owners evaluate measures to reduce potential hazard damage. Make available in public buildings, local library, website, etc. and inform people who they can call to learn more information.	3	3	0	1	0	0	7

Action #	Action Title	Hazards Addressed	Approximate Cost	Equity Focus	Protection of Lives	Protection of Critical Facilities or Infrastructure	Protection of Natural Resources	Total
33	Improve vegetation management at Longfellow Dam.	2	1	0	2	0	2	7
34	Build internal staff capacity to identify and pursue external sources of grant funding for mitigation projects through increased opportunities for training/professional development and the ability to invest more time on grant writing, grants management, and related administrative tasks.	3	3	0	0	0	0	6
35	Explore the potential use of vehicle batteries for back-up power supply.	3	3	0	0	0	0	6
36	Explore opportunities for local geothermal and wind energy projects.	3	3	0	0	0	0	6
37	Revise the online permitting system to automatically link building owners to educational materials regarding unreinforced	2	3	0	0	0	0	5

Action #	Action Title	Hazards Addressed	Approximate Cost	Equity Focus	Protection of Lives	Protection of Critical Facilities or Infrastructure	Protection of Natural Resources	Total
	masonry structures and the earthquake risk.							

Actions Sorted by Goal Statement

Goal	Action #	Action Title
Capacity	5	Adopt an ordinance to prevent critical facilities from being built in 500-year floodplain.
	6	Explore and expand opportunities for public/private partnerships to support public education and community outreach initiatives related to hazard awareness and risk reduction efforts.
	7	Develop a Stormwater Enterprise Fund.
	31	Identify steep slope areas and prevent building on the area through land use and zoning.
	34	Build internal staff capacity to identify and pursue external sources of grant funding for mitigation projects through increased opportunities for training/professional development and the ability to invest more time on grant writing, grants management, and related administrative tasks.
Education	1	Identify and seek to address any unmet needs related to targeted outreach and education for the community's more vulnerable populations (i.e., environmental justice communities, residents with special needs, property owners in high risk hazard areas, those who are homebound, etc.).
	8	Educate people about the location and availability of heating and cooling centers.
	12	Design and implement a plan to encourage people to sign up for Smart 911 system.
	28	Accelerate and maximize the installation of solar and battery storage on residential, institutional, and commercial properties town-wide through advocacy for state incentives and through community outreach programs.
	32	Promote the availability of flood insurance to owners and renters of property located in flood prone areas, including those that are not located in FEMA-mapped special flood hazard areas. Maintain supplies of FEMA/NFIP materials to help property owners evaluate measures to reduce potential hazard damage. Make available in public buildings, local library, website, etc. and inform people who they can call to learn more information.

Goal	Action #	Action Title
	37	Revise the online permitting system to automatically link building owners to educational materials regarding unreinforced masonry structures and the earthquake risk.
Infrastructure	2	Work with DCR, EEA and the Commonwealth to assess feasibility of removing the 3 dams on the Charles River in Wellesley.
	9	Create secondary MWRA connection (redundancy). This would benefit Needham and Weston.
	10	Replace bridge at Town Hall to meet H20 loading.
	11	Work with various partners to identify, prioritize, and address stormwater management needs, such as the Route 9 culverts.
	13	Culvert replacement on Route 9
	14	Lexington Road, which crosses Boulder Brook just upstream of the Worcester Street crossing near the Natick town line.
	15	Cedar Brook Road, which crosses Boggle Brook at the outlet of Reed Pond near the Natick line.
	16	River Street, which runs along the Charles River between Washington Street and Walnut Street.
	17	#1 Washington Street, bordering the Charles River (opposite River Street).
	18	Inverness Road, which is south of Academy Brook, just south of Centennial Reservation.
	19	Replacement/upsizing of culvert on MBTA land that flows from bottom of Geraldine Road to the Town's Diane Warren Field.
	20	Replace culvert with a larger one on unaccepted portion of Rice Street to prevent flooding.
	21	Accelerate and maximize Installation of solar and battery storage on municipal properties, where appropriate
	26	Mitigate the pumping stations and ejectors, and government buildings that are located in the base flood zone.
	27	Develop a policy to limit the amount of impervious surface allowed during development or redevelopment.
	30	Conduct a feasibility assessment for microgrids.

Goal	Action #	Action Title
	35	Explore the potential use of vehicle batteries for back-up power supply.
	36	Explore opportunities for local geothermal and wind energy projects.
Natural Resources	3	Identify and protect open space.
	4	Expand Tree Protection Bylaw to incentivize further protection of public and private trees.
	22	Increase Public Works funding for invasive species management.
	23	Develop a program to monitor and protect water quality.
	24	Conduct mechanical harvesting of aquatic invasive species
	25	Implement the Grow Green Wellesley sustainable landscaping program.
	29	Expand water conservation programs/policies.
	33	Improve vegetation management at Longfellow Dam.

Actions Sorted by Hazard

Table 70. Actions Sorted by Hazard.

Specific Hazards Addressed	Priority	Action #	Action Title
All Hazards	High	1	Identify and seek to address any unmet needs related to targeted outreach and education for the community's more vulnerable populations (i.e., environmental justice communities, residents with special needs, property owners in high risk hazard areas, those who are homebound, etc.).
		6	Explore and expand opportunities for public/private partnerships to support public education and community outreach initiatives related to hazard awareness and risk reduction efforts.
	Medium	12	Design and implement a plan to encourage people to sign up for Smart 911 system.
	Low	34	Build internal staff capacity to identify and pursue external sources of grant funding for mitigation projects through increased opportunities for training/professional development and the ability to invest more time on grant writing, grants management, a
Drought	Low	29	Expand water conservation programs/policies.
Earthquake	Low	37	Revise the online permitting system to automatically link building owners to educational materials regarding unreinforced masonry structures and the earthquake risk.
Flood	Low	26	Mitigate the pumping stations and ejectors, and government buildings that are located in the base flood zone.
		32	Promote the availability of flood insurance to owners and renters of property located in flood prone areas, including those that are not located in FEMA-mapped special flood hazard areas. Maintain supplies of FEMA/NFIP materials to help property owners evaluate measures to reduce potential hazard damage. Make available in public buildings, local

Specific Hazards Addressed	Priority	Action #	Action Title
			library, website, etc. and inform people who they can call to learn more information.
Flood, Drought, Infectious Disease, Invasive Species, Wildfires/Brushfires, Urban Heat Island	High	3	Identify and protect open space.
Flood, Earthquake	Medium	10	Replace bridge at Town Hall to meet H20 loading.
Flood, Invasive Species	Low	33	Improve vegetation management at Longfellow Dam.
Flood, Severe Winter Storms, Other Severe Weather Events	High	7	Develop a Stormwater Enterprise Fund.
	Medium	11	Work with various partners to identify, prioritize, and address stormwater management needs, such as the Route 9 culverts.
		13	Culvert replacement on Route 9
		14	Lexington Road, which crosses Boulder Brook just upstream of the Worcester Street crossing near the Natick town line.
		15	Cedar Brook Road, which crosses Boggle Brook at the outlet of Reed Pond near the Natick line.
		16	River Street, which runs along the Charles River between Washington Street and Walnut Street.
		17	#1 Washington Street, bordering the Charles River (opposite River Street).
		18	Inverness Road, which is south of Academy Brook, just south of Centennial Reservation.
		19	Replacement/upsizing of culvert on MBTA land that flows from bottom of Geraldine Road to the Town's Diane Warren Field.
		20	Replace culvert with a larger one on unaccepted portion of Rice Street to prevent flooding.

Specific Hazards Addressed	Priority	Action #	Action Title
	Low	27	Develop a policy to limit the amount of impervious surface allowed during development or redevelopment.
Flooding	High	5	Adopt an ordinance to prevent critical facilities from being built in 500-year floodplain.
Flooding, Earthquakes	High	2	Work with DCR, EEA and the Commonwealth to assess feasibility of removing the 3 dams on the Charles River in Wellesley.
Infectious Disease, Invasive Species, Drought, Extreme Temperatures	Medium	9	Create secondary MWRA connection (redundancy). This would benefit Needham and Weston.
Invasive Species	Medium	22	Increase Public Works funding for invasive species management.
Invasive Species, Infectious Disease, Drought, Extreme Temperatures	Medium	23	Develop a program to monitor and protect water quality.
		24	Conduct mechanical harvesting of aquatic invasive species
		25	Implement the Grow Green Wellesley sustainable landscaping program.
Landslide	Low	31	Identify steep slope areas and prevent building on the area through land use and zoning.
Severe Winter Storms, Extreme Temperatures, Other Severe Weather Events	High	8	Educate people about the location and availability of heating and cooling centers.
Severe Winter Storms, Extreme Temperatures, Other Severe Weather Events, Hurricanes/Wind, Tornadoes	Medium	21	Accelerate and maximize Installation of solar and battery storage on municipal properties, where appropriate

Specific Hazards Addressed	Priority	Action #	Action Title
Severe Winter Storms, Extreme Temperatures, Other Severe Weather Events, Hurricanes/Wind, Urban Heat Island, Tornadoes	Low	30	Conduct a feasibility assessment for microgrids.
Severe winter storms; Extreme Temperatures, Other Severe Weather Events, Hurricanes/Wind, Tornadoes	Low	28	Accelerate and maximize the installation of solar and battery storage on residential, institutional, and commercial properties town-wide through advocacy for state incentives and through community outreach programs.
		35	Explore the potential use of vehicle batteries for backup power supply.
		36	Explore opportunities for local geothermal and wind energy projects.
Wildfire, Urban Heat Island, Extreme Temperatures, Drought, Invasive Species	High	4	Expand Tree Protection Bylaw to incentivize further protection of public and private trees.

Actions Sorted by Lead Position

Table 71. Actions Sorted by Lead Position.

Action Lead Position	Priority	Action #	Action Title
Assistant Superintendent Park and Tree Division of Department of Public Works	Medium	24	Conduct mechanical harvesting of aquatic invasive species
Director Municipal Light Plant	Medium	21	Accelerate and maximize Installation of solar and battery storage on municipal properties, where appropriate
	Low	28	Accelerate and maximize the installation of solar and battery storage on residential, institutional, and commercial properties town-wide through advocacy for state incentives and through community outreach programs.
		35	Explore the potential use of vehicle batteries for backup power supply.
		36	Explore opportunities for local geothermal and wind energy projects.
Director of Council on Aging	High	8	Educate people about the location and availability of heating and cooling centers.
Director of Public Works	High	1	Identify and seek to address any unmet needs related to targeted outreach and education for the community's more vulnerable populations (i.e., environmental justice communities, residents with special needs, property owners in high risk hazard areas, those who are homebound, etc.).
		7	Develop a Stormwater Enterprise Fund.
	Medium	9	Create secondary MWRA connection (redundancy). This would benefit Needham and Weston.
		10	Replace bridge at Town Hall to meet H20 loading.

Action Lead Position	Priority	Action #	Action Title
		13	Culvert replacement on Route 9
		14	Lexington Road, which crosses Boulder Brook just upstream of the Worcester Street crossing near the Natick town line.
		15	Cedar Brook Road, which crosses Boggle Brook at the outlet of Reed Pond near the Natick line.
		16	River Street, which runs along the Charles River between Washington Street and Walnut Street.
		17	#1 Washington Street, bordering the Charles River (opposite River Street).
		18	Inverness Road, which is south of Academy Brook, just south of Centennial Reservation.
		19	Replacement/upsizing of culvert on MBTA land that flows from bottom of Geraldine Road to the Town's Diane Warren Field.
	Low	26	Mitigate the pumping stations and ejectors, and government buildings that are located in the base flood zone.
		33	Improve vegetation management at Longfellow Dam.
		34	Build internal staff capacity to identify and pursue external sources of grant funding for mitigation projects through increased opportunities for training/professional development and the ability to invest more time on grant writing, grants management, a
Inspector of Buildings	Low	37	Revise the online permitting system to automatically link building owners to educational materials regarding unreinforced masonry structures and the earthquake risk.

Action Lead Position	Priority	Action #	Action Title
Natural Resources Commission Director	High	2	Work with DCR, EEA and the Commonwealth to assess feasibility of removing the 3 dams on the Charles River in Wellesley.
		3	Identify and protect open space.
	Medium	22	Increase Public Works funding for invasive species management.
		23	Develop a program to monitor and protect water quality.
		25	Implement the Grow Green Wellesley sustainable landscaping program.
	Low	29	Expand water conservation programs/policies.
		30	Conduct a feasibility assessment for microgrids.
Planning Director	High	4	Expand Tree Protection Bylaw to incentivize further protection of public and private trees.
		5	Adopt an ordinance to prevent critical facilities from being built in 500-year floodplain.
		6	Explore and expand opportunities for public/private partnerships to support public education and community outreach initiatives related to hazard awareness and risk reduction efforts.
	Low	27	Develop a policy to limit the amount of impervious surface allowed during development or redevelopment.
		31	Identify steep slope areas and prevent building on the area through land use and zoning.
		32	Promote the availability of flood insurance to owners and renters of property located in flood prone areas, including those that are not located in FEMA-mapped special flood hazard areas. Maintain supplies of FEMA/NFIP materials to help property

Action Lead Position	Priority	Action #	Action Title
			owners evaluate measures to reduce potential hazard damage. Make available in public buildings, local library, website, etc. and inform people who they can call to learn more information.
Select Board	Medium	12	Design and implement a plan to encourage people to sign up for Smart 911 system.
Town Engineer	Medium	11	Work with various partners to identify, prioritize, and address stormwater management needs, such as the Route 9 culverts.
		20	Replace culvert with a larger one on unaccepted portion of Rice Street to prevent flooding.

Actions Sorted by Implementation Schedule

Table 72. Actions Sorted by Implementation Schedule.

Implementation Schedule	Priority	Action #	Action Title
2023-2024	High	7	Develop a Stormwater Enterprise Fund.
	Medium	15	Cedar Brook Road, which crosses Boggle Brook at the outlet of Reed Pond near the Natick line.
		25	Implement the Grow Green Wellesley sustainable landscaping program.
2023-2025	Medium	9	Create secondary MWRA connection (redundancy). This would benefit Needham and Weston.
		11	Work with various partners to identify, prioritize, and address stormwater management needs, such as the Route 9 culverts.
		13	Culvert replacement on Route 9
		14	Lexington Road, which crosses Boulder Brook just upstream of the Worcester Street crossing near the Natick town line.
		16	River Street, which runs along the Charles River between Washington Street and Walnut Street.
	Low	26	Mitigate the pumping stations and ejectors, and government buildings that are located in the base flood zone.
2023-2026	High	2	Work with DCR, EEA and the Commonwealth to assess feasibility of removing the 3 dams on the Charles River in Wellesley.
	Medium	17	#1 Washington Street, bordering the Charles River (opposite River Street).
		18	Inverness Road, which is south of Academy Brook, just south of Centennial Reservation.

Implementation Schedule	Priority	Action #	Action Title
	Low	31	Identify steep slope areas and prevent building on the area through land use and zoning.
		32	Promote the availability of flood insurance to owners and renters of property located in flood prone areas, including those that are not located in FEMA-mapped special flood hazard areas. Maintain supplies of FEMA/NFIP materials to help property owners evaluate measures to reduce potential hazard damage. Make available in public buildings, local library, website, etc. and inform people who they can call to learn more information.
2023-2027	High	4	Expand Tree Protection Bylaw to incentivize further protection of public and private trees.
2023-2028	High	1	Identify and seek to address any unmet needs related to targeted outreach and education for the community's more vulnerable populations (i.e., environmental justice communities, residents with special needs, property owners in high risk hazard areas, those who are homebound, etc.).
		3	Identify and protect open space.
		6	Explore and expand opportunities for public/private partnerships to support public education and community outreach initiatives related to hazard awareness and risk reduction efforts.
		8	Educate people about the location and availability of heating and cooling centers.
	Medium	10	Replace bridge at Town Hall to meet H20 loading.
		19	Replacement/upsizing of culvert on MBTA land that flows from bottom of Geraldine Road to the Town's Diane Warren Field.
		24	Conduct mechanical harvesting of aquatic invasive species

Implementation Schedule	Priority	Action #	Action Title
	Low	34	Build internal staff capacity to identify and pursue external sources of grant funding for mitigation projects through increased opportunities for training/professional development and the ability to invest more time on grant writing, grants management, and related administrative tasks.
2024-2025	Medium	22	Increase Public Works funding for invasive species management.
	Low	37	Revise the online permitting system to automatically link building owners to educational materials regarding unreinforced masonry structures and the earthquake risk.
2024-2027	High	5	Adopt an ordinance to prevent critical facilities from being built in 500-year floodplain.
	Medium	20	Replace culvert with a larger one on unaccepted portion of Rice Street to prevent flooding.
	Low	27	Develop a policy to limit the amount of impervious surface allowed during development or redevelopment.
2024-2028	Medium	12	Design and implement a plan to encourage people to sign up for Smart 911 system.
		21	Accelerate and maximize Installation of solar and battery storage on municipal properties, where appropriate
	Low	28	Accelerate and maximize the installation of solar and battery storage on residential, institutional, and commercial properties town-wide through advocacy for state incentives and through community outreach programs.
		33	Improve vegetation management at Longfellow Dam.

Implementation Schedule	Priority	Action #	Action Title
		35	Explore the potential use of vehicle batteries for back-up power supply.
		36	Explore opportunities for local geothermal and wind energy projects.
2025-2028	Low	30	Conduct a feasibility assessment for microgrids.
2026-2028	Medium	23	Develop a program to monitor and protect water quality.
2027-2028	Low	29	Expand water conservation programs/policies.

Actions with Associated Mitigation Category

Table 73. Actions Sorted by Mitigation Category.

Mitigation Category	Action #	Action Title
Education & Awareness Programs	1	Identify and seek to address any unmet needs related to targeted outreach and education for the community's more vulnerable populations (i.e., environmental justice communities, residents with special needs, property owners in high risk hazard areas, those who are homebound, etc.).
	6	Explore and expand opportunities for public/private partnerships to support public education and community outreach initiatives related to hazard awareness and risk reduction efforts.
	8	Educate people about the location and availability of heating and cooling centers.
	12	Design and implement a plan to encourage people to sign up for Smart 911 system.
	25	Implement the Grow Green Wellesley sustainable landscaping program.
	28	Accelerate and maximize the installation of solar and battery storage on residential, institutional, and commercial properties town-wide through advocacy for state incentives and through community outreach programs.
	32	Promote the availability of flood insurance to owners and renters of property located in flood prone areas, including those that are not located in FEMA-mapped special flood hazard areas. Maintain supplies of FEMA/NFIP materials to help property owners evaluate measures to reduce potential hazard damage. Make available in public buildings, local library, website, etc. and inform people who they can call to learn more information.
	34	Build internal staff capacity to identify and pursue external sources of grant funding for mitigation projects through increased opportunities for training/professional development and the ability to invest more time on grant writing, grants management, and related administrative tasks.

	37	Revise the online permitting system to automatically link building owners to educational materials regarding unreinforced masonry structures and the earthquake risk.
Local Plans & Regulations	3	Identify and protect open space.
	4	Expand Tree Protection Bylaw to incentivize further protection of public and private trees.
	5	Adopt an ordinance to prevent critical facilities from being built in 500-year floodplain.
	7	Develop a Stormwater Enterprise Fund.
	27	Develop a policy to limit the amount of impervious surface allowed during development or redevelopment.
	29	Expand water conservation programs/policies.
	31	Identify steep slope areas and prevent building on the area through land use and zoning.
Natural Systems Protection	22	Increase Public Works funding for invasive species management.
	23	Develop a program to monitor and protect water quality.
	24	Conduct mechanical harvesting of aquatic invasive species
Structure & Infrastructure Projects	2	Work with DCR, EEA and the Commonwealth to assess feasibility of removing the 3 dams on the Charles River in Wellesley.
	9	Create secondary MWRA connection (redundancy). This would benefit Needham and Weston.
	10	Replace bridge at Town Hall to meet H20 loading.
	11	Work with various partners to identify, prioritize, and address stormwater management needs, such as the Route 9 culverts.
	13	Culvert replacement on Route 9
	14	Lexington Road, which crosses Boulder Brook just upstream of the Worcester Street crossing near the Natick town line.
	15	Cedar Brook Road, which crosses Boggle Brook at the outlet of Reed Pond near the Natick line.

	16	River Street, which runs along the Charles River between Washington Street and Walnut Street.
	17	#1 Washington Street, bordering the Charles River (opposite River Street).
	18	Inverness Road, which is south of Academy Brook, just south of Centennial Reservation.
	19	Replacement/upsizing of culvert on MBTA land that flows from bottom of Geraldine Road to the Town's Diane Warren Field.
	20	Replace culvert with a larger one on unaccepted portion of Rice Street to prevent flooding.
	21	Accelerate and maximize Installation of solar and battery storage on municipal properties, where appropriate
	26	Mitigate the pumping stations and ejectors, and government buildings that are located in the base flood zone.
	30	Conduct a feasibility assessment for microgrids.
	33	Improve vegetation management at Longfellow Dam.
	35	Explore the potential use of vehicle batteries for backup power supply.
	36	Explore opportunities for local geothermal and wind energy projects.

Appendix C. Plan Implementation and Review Supporting Materials.

Plan Update Evaluation Worksheet

Table 74. Plan Update Evaluation Worksheet.

Plan Section	Considerations	Explanation
Planning Process	Should the town invite any additional stakeholders to participate in the planning process? What public outreach activities have occurred? How can public involvement be improved?	
Risk Assessment	What disasters has the town, or the region experienced? Should the list of hazards be modified? Are new data sources, maps or studies available? If so, what have they revealed, and should the information be incorporated into the plan update? Has development in the region occurred and could it create or reduce risk?	
Capability Assessment	Has the town adopted new policies, plans, regulations, or reports that could be incorporated into this plan? Are there different or additional administrative, human, technical, and financial resources available for mitigation planning? Are there different or new education and outreach programs and resources available for mitigation activities?	
Mitigation Strategy	Is the mitigation strategy being implemented as anticipated? Were the cost and timeline estimate accurate? Should new mitigation actions be added to the Action Plan? Should existing mitigation actions be revised or removed from the plan? Are there new obstacles that were not anticipated in the plan that will need to be considered in the next plan update? Are there new funding sources to consider? Have elements of the plan been incorporated into other planning mechanisms?	
Implementation Plan	Was the plan monitored and evaluated as anticipated? What are needed improvements to the plan implementation procedures?	

Mitigation Action Progress Worksheet

Table 75. Mitigation Action Progress Worksheet.

<table>
<tr><th colspan="5">Mitigation Action Progress Worksheet</th></tr>
<tr><td>Progress Report Period</td><td colspan="2">From Date</td><td colspan="2">To Date</td></tr>
<tr><td>Action/Project Title</td><td colspan="4"></td></tr>
<tr><td>Responsible Department</td><td colspan="4"></td></tr>
<tr><td>Contact Name</td><td colspan="4"></td></tr>
<tr><td>Contact Phone/Email</td><td colspan="4"></td></tr>
<tr><td>Project Description</td><td colspan="4"></td></tr>
<tr><td>Project Goal</td><td colspan="4"></td></tr>
<tr><td>Project Objective</td><td colspan="4"></td></tr>
<tr><td>Project Cost</td><td colspan="4"></td></tr>
<tr><td colspan="5">Project Status</td></tr>
<tr><td>Date of Project Approval</td><td>Date of Project Start</td><td>Anticipated Date of Completion</td><td>Project Canceled</td><td>Project Delayed</td></tr>
<tr><td colspan="5">Explanation of Delay or Cost Overruns</td></tr>
<tr><td colspan="5">Project Report Summary</td></tr>
<tr><td colspan="5">What was accomplished for this project during this reporting period?</td></tr>
<tr><td colspan="5">What obstacles, problems, or delays did the project encounter?</td></tr>
<tr><td colspan="5">Plans for next reporting period.</td></tr>
</table>

Appendix D. Hazus Reports

Hazus: Flood Global Risk Report

Region Name: WellesleyFL

Flood Scenario: 100year

Print Date: Wednesday, November 23, 2022

Disclaimer:
This version of Hazus utilizes 2010 Census Data.
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Flood. These results can be improved by using enhanced inventory data and flood hazard information.

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Table of Contents

FEMA

RiskMAP
Increasing Resilience Together

General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences (NIBS). The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The flood loss estimates provided in this report were based on a region that included 1 county(ies) from the following state(s):

- Massachusetts

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is approximately 11 square miles and contains 631 census blocks. The region contains over 9 thousand households and has a total population of 27,982 people (2010 Census Bureau data). The distribution of population by State and County for the study region is provided in Appendix B.

There are an estimated 9,013 buildings in the region with a total building replacement value (excluding contents) of 5,725 million dollars. Approximately 87.98% of the buildings (and 74.38% of the building value) are associated with residential housing.

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Building Inventory

General Building Stock

Hazus estimates that there are 9,013 buildings in the region which have an aggregate total replacement value of 5,725 million dollars. Table 1 and Table 2 present the relative distribution of the value with respect to the general occupancies by Study Region and Scenario respectively. Appendix B provides a general distribution of the building value by State and County.

Table 1
Building Exposure by Occupancy Type for the Study Region

Occupancy	Exposure ($1000)	Percent of Total
Residential	4,258,449	74.4%
Commercial	1,168,926	20.4%
Industrial	119,475	2.1%
Agricultural	6,674	0.1%
Religion	59,798	1.0%
Government	22,214	0.4%
Education	89,520	1.6%
Total	**5,725,056**	**100%**

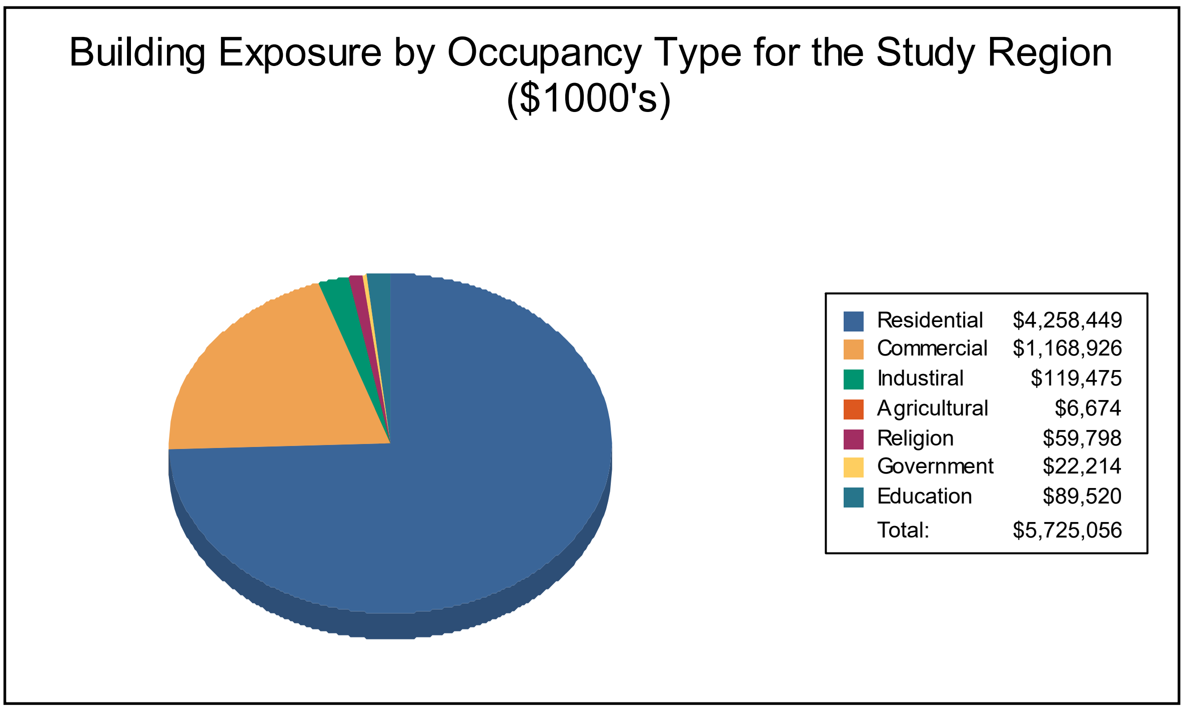
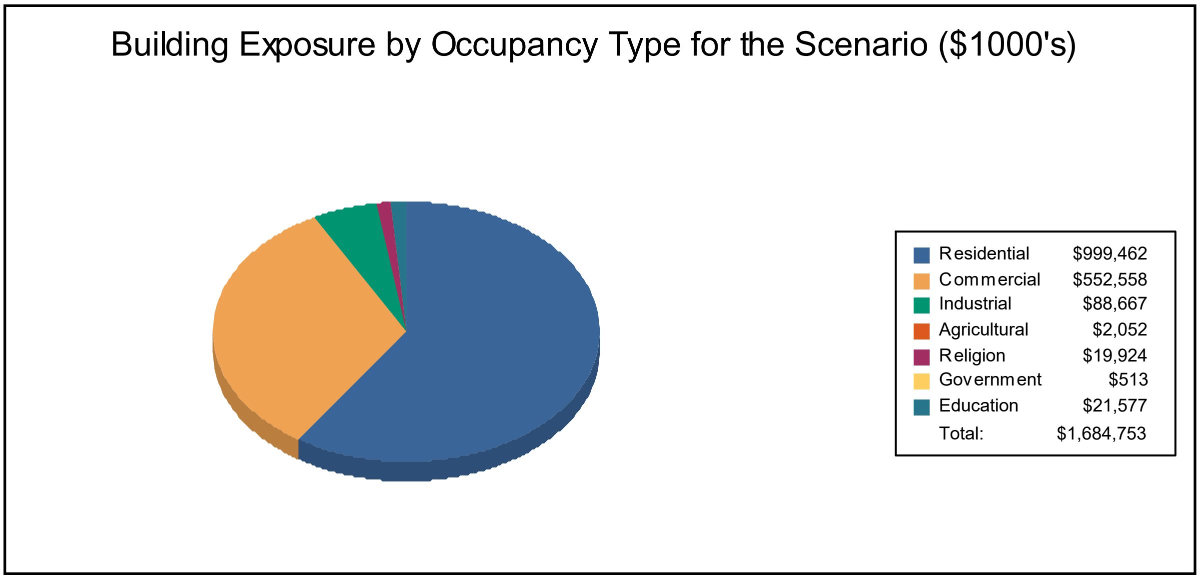


Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	999,462	59.3%
Commercial	552,558	32.8%
Industrial	88,667	5.3%
Agricultural	2,052	0.1%
Religion	19,924	1.2%
Government	513	0.0%
Education	21,577	1.3%
Total	**1,684,753**	**100%**



Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 17 schools, 2 fire stations, 4 police stations and 2 emergency operation centers.

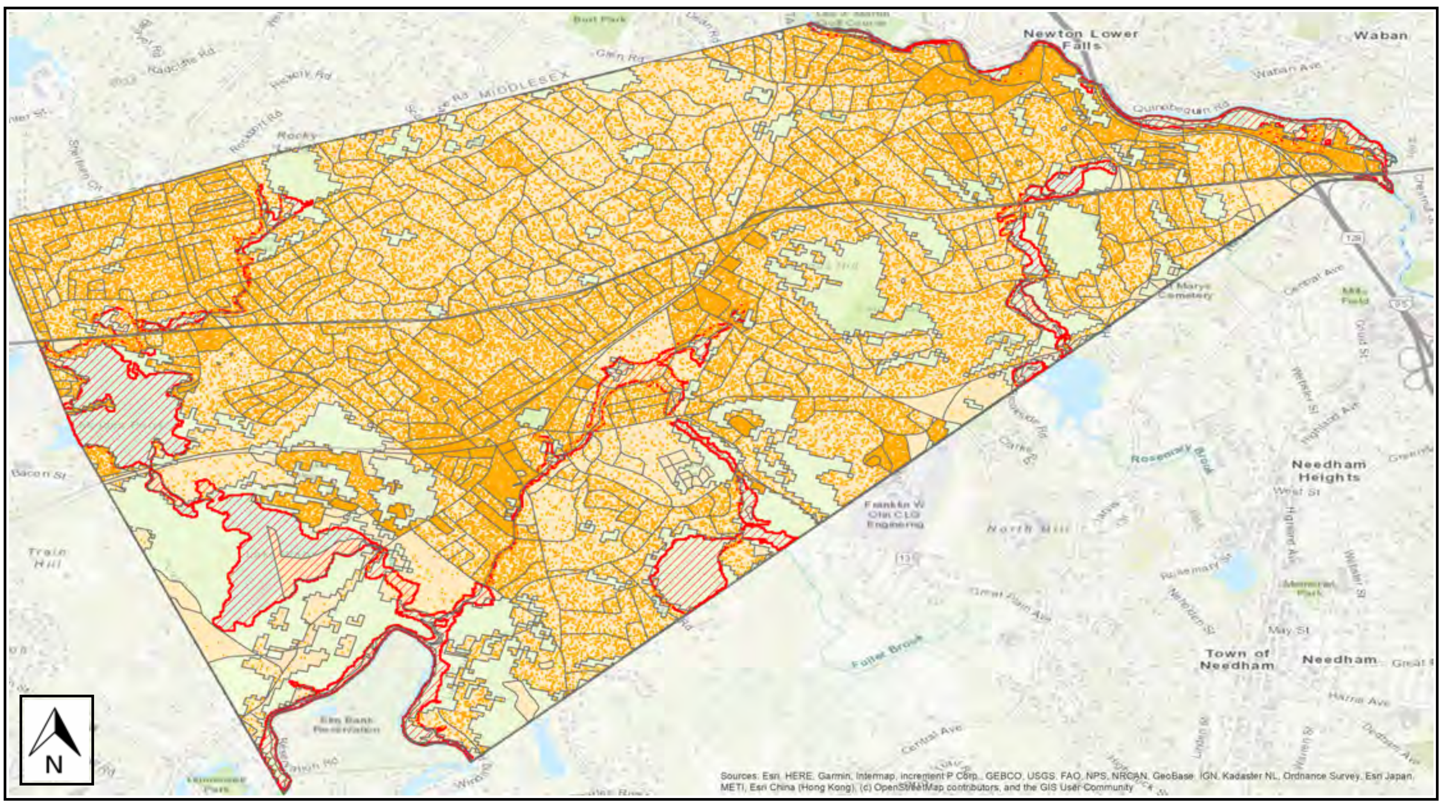
Flood Scenario Parameters

Hazus used the following set of information to define the flood parameters for the flood loss estimate provided in this report.

Study Region Name:	WellesleyFL
Scenario Name:	100year
Return Period Analyzed:	100
Analysis Options Analyzed:	No What-Ifs

Study Region Overview Map

Illustrating scenario flood extent, as well as exposed essential facilities and total exposure



General Building Stock Damage

Hazus estimates that about 0 buildings will be at least moderately damaged. This is over 73% of the total number of buildings in the scenario. There are an estimated 0 buildings that will be completely destroyed. The definition of the ‘damage states’ is provided in the Hazus Flood Technical Manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 summarizes the expected damage by general building type.

Total Economic Loss (1 dot = $300K) Overview Map

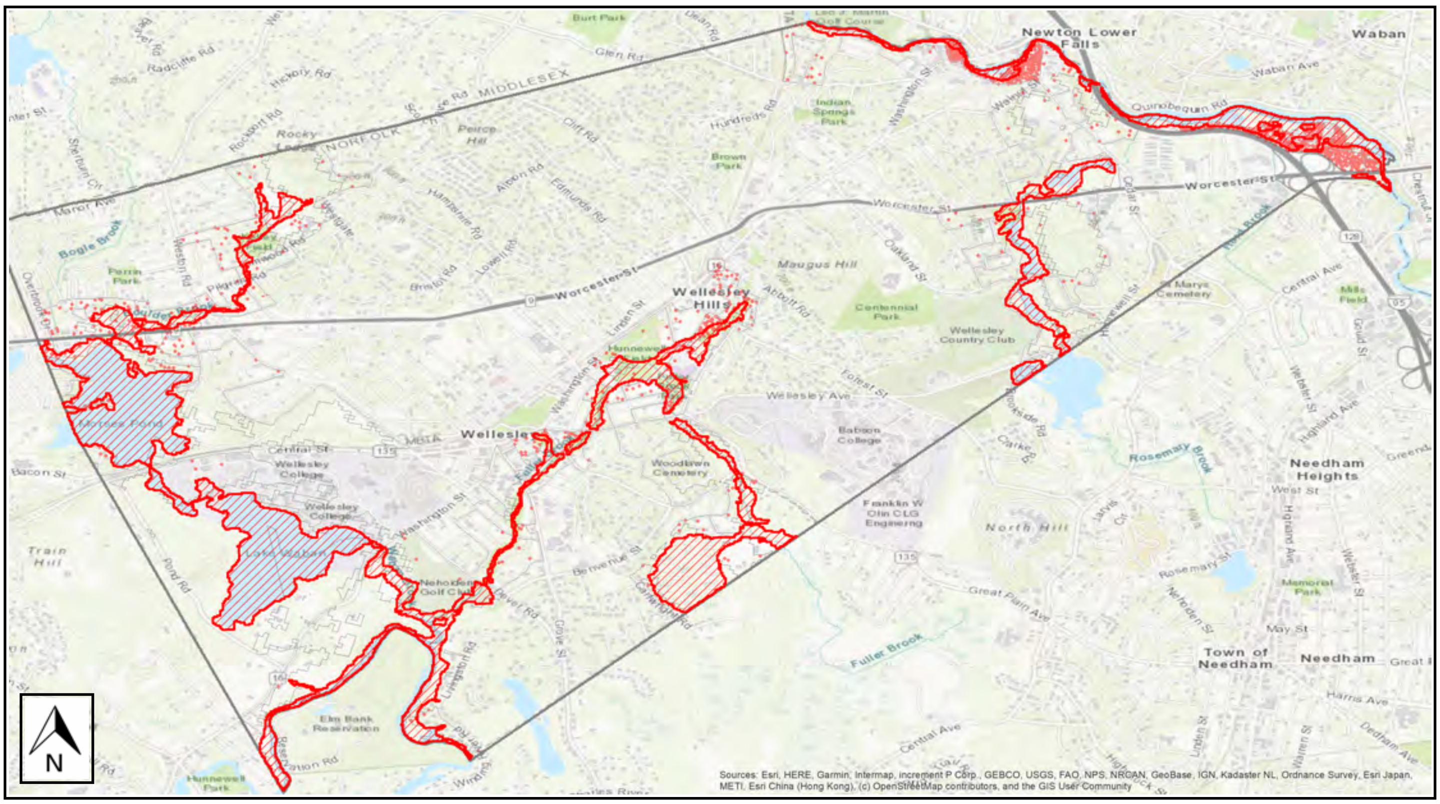


Table 3: Expected Building Damage by Occupancy

	1-10		11-20		21-30		31-40		41-50		>50	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0
Commercial	0	0	0	0	0	0	0	0	0	0	0	0
Education	0	0	0	0	0	0	0	0	0	0	0	0
Government	0	0	0	0	0	0	0	0	0	0	0	0
Industrial	0	0	0	0	0	0	0	0	0	0	0	0
Religion	0	0	0	0	0	0	0	0	0	0	0	0
Residential	30	100	0	0	0	0	0	0	0	0	0	0
Total	**30**		**0**		**0**		**0**		**0**		**0**	

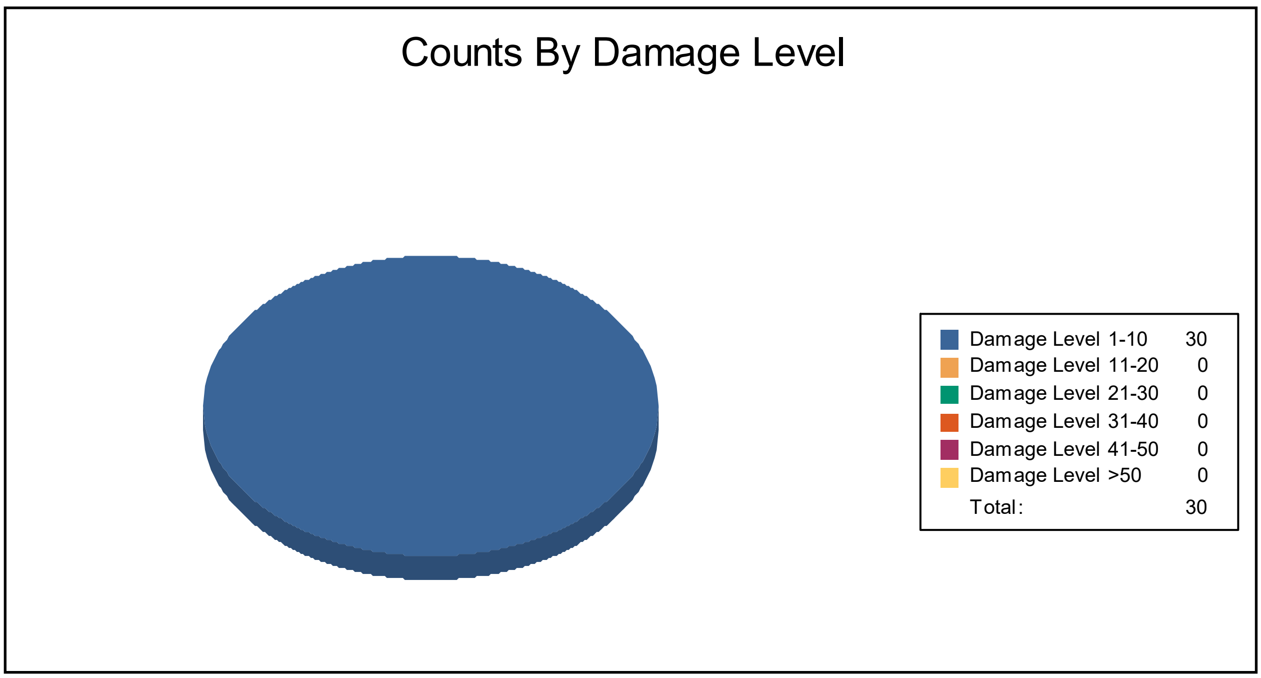


Table 4: Expected Building Damage by Building Type

Building Type	1-10		11-20		21-30		31-40		41-50		>50	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	0	0	0	0	0	0	0	0	0	0	0	0
ManufHousing	0	0	0	0	0	0	0	0	0	0	0	0
Masonry	0	0	0	0	0	0	0	0	0	0	0	0
Steel	0	0	0	0	0	0	0	0	0	0	0	0
Wood	30	100	0	0	0	0	0	0	0	0	0	0

Essential Facility Damage

Before the flood analyzed in this scenario, the region had 0 hospital beds available for use. On the day of the scenario flood event, the model estimates that 0 hospital beds are available in the region.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	Total	At Least Moderate	At Least Substantial	Loss of Use
Emergency Operation Centers	2	0	0	0
Fire Stations	2	0	0	0
Hospitals	0	0	0	0
Police Stations	4	0	0	0
Schools	17	0	0	0

If this report displays all zeros or is blank, two possibilities can explain this.

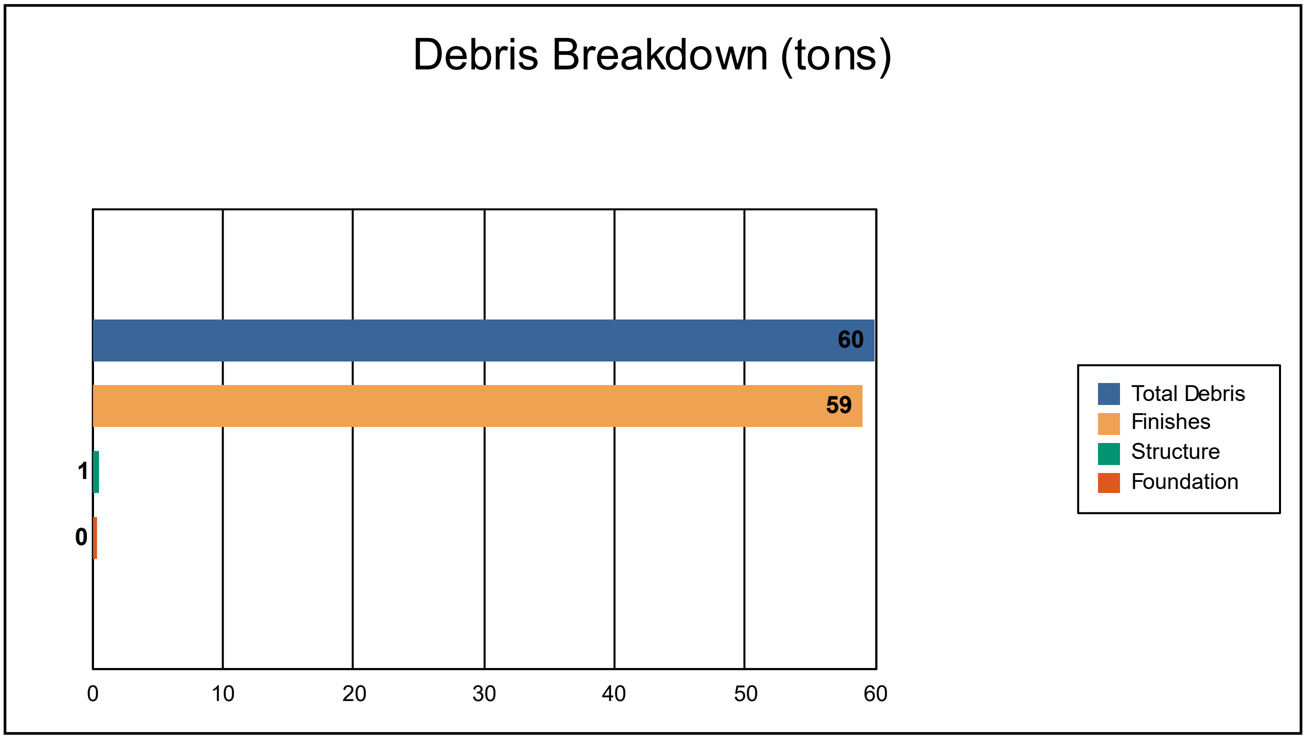
(1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.

(2) The analysis was not run. This can be tested by checking the run box on the Analysis Menu and seeing if a message box asks you to replace the existing results.

Induced Flood Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris.

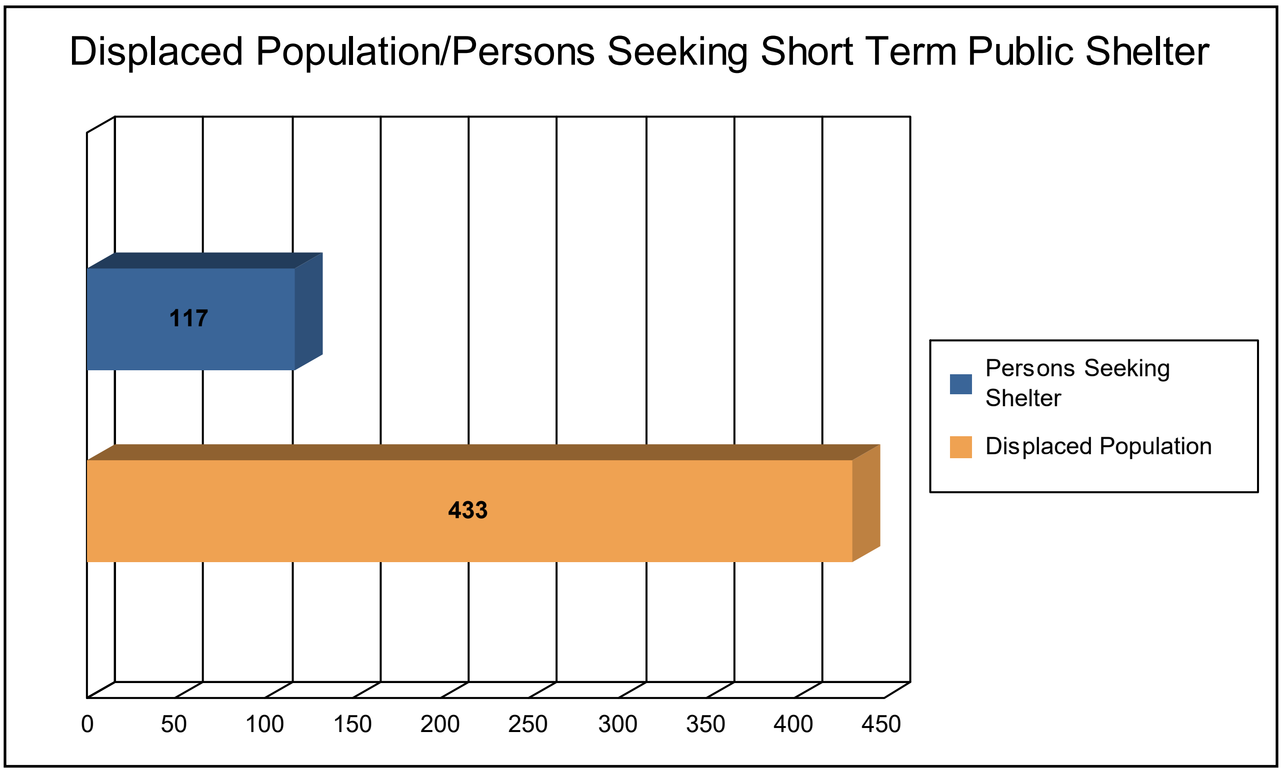


The model estimates that a total of 60 tons of debris will be generated. Of the total amount, Finishes comprises 99% of the total, Structure comprises 1% of the total, and Foundation comprises 1%. If the debris tonnage is converted into an estimated number of truckloads, it will require 3 truckloads (@25 tons/truck) to remove the debris generated by the flood.

Social Impact

Shelter Requirements

Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 144 households (or 433 of people) will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 117 people (out of a total population of 27,982) will seek temporary shelter in public shelters.



Economic Loss

The total economic loss estimated for the flood is 63.28 million dollars, which represents 3.76 % of the total replacement value of the scenario buildings.

Building-Related Losses

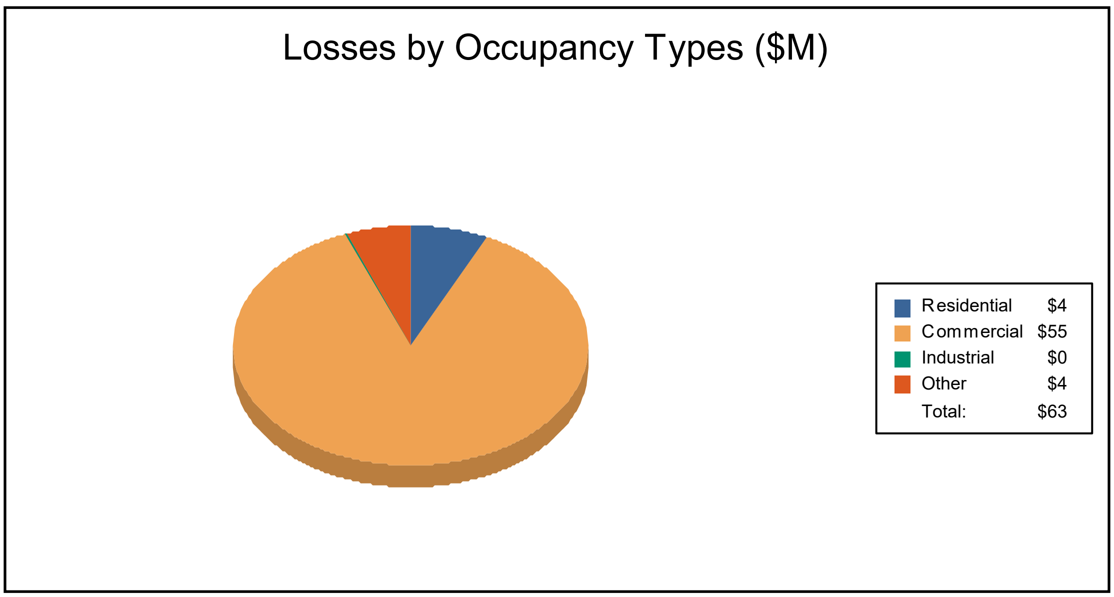
The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood.

The total building-related losses were 5.63 million dollars. 91% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 6.98% of the total loss. Table 6 below provides a summary of the losses associated with the building damage.

Table 6: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	1.80	1.01	0.09	0.01	2.90
	Content	0.60	1.89	0.10	0.12	2.71
	Inventory	0.00	0.01	0.01	0.00	0.02
	Subtotal	**2.39**	**2.90**	**0.20**	**0.13**	**5.63**
Business Interruption						
	Income	0.00	25.92	0.01	0.88	26.81
	Relocation	1.54	7.16	0.02	0.40	9.13
	Rental Income	0.48	5.22	0.00	0.02	5.72
	Wage	0.00	13.73	0.02	2.24	15.99
	Subtotal	**2.03**	**52.02**	**0.06**	**3.54**	**57.65**
ALL	**Total**	**4.42**	**54.93**	**0.26**	**3.67**	**63.28**



Appendix A: County Listing for the Region

Massachusetts

- Norfolk

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Massachusetts				
Norfolk	27,982	4,258,449	1,466,607	5,725,056
Total	**27,982**	**4,258,449**	**1,466,607**	**5,725,056**
Total Study Region	**27,982**	**4,258,449**	**1,466,607**	**5,725,056**

Hazus: Hurricane Global Risk Report

Region Name: WellesleyHU

Hurricane Scenario: Probabilistic 500-year Return Period

Print Date: Wednesday, November 23, 2022

Disclaimer:
This version of Hazus utilizes 2010 Census Data.
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Hurricane. These results can be improved by using enhanced inventory data.

Table of Contents

General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The hurricane loss estimates provided in this report are based on a region that includes 1 county(ies) from the following state(s):

- Massachusetts

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 10.51 square miles and contains 6 census tracts. There are over 8 thousand households in the region and a total population of 27,982 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 9 thousand buildings in the region with a total building replacement value (excluding contents) of 5,725 million dollars (2014 dollars). Approximately 88% of the buildings (and 74% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 9,013 buildings in the region which have an aggregate total replacement value of 5,725 million (2014 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

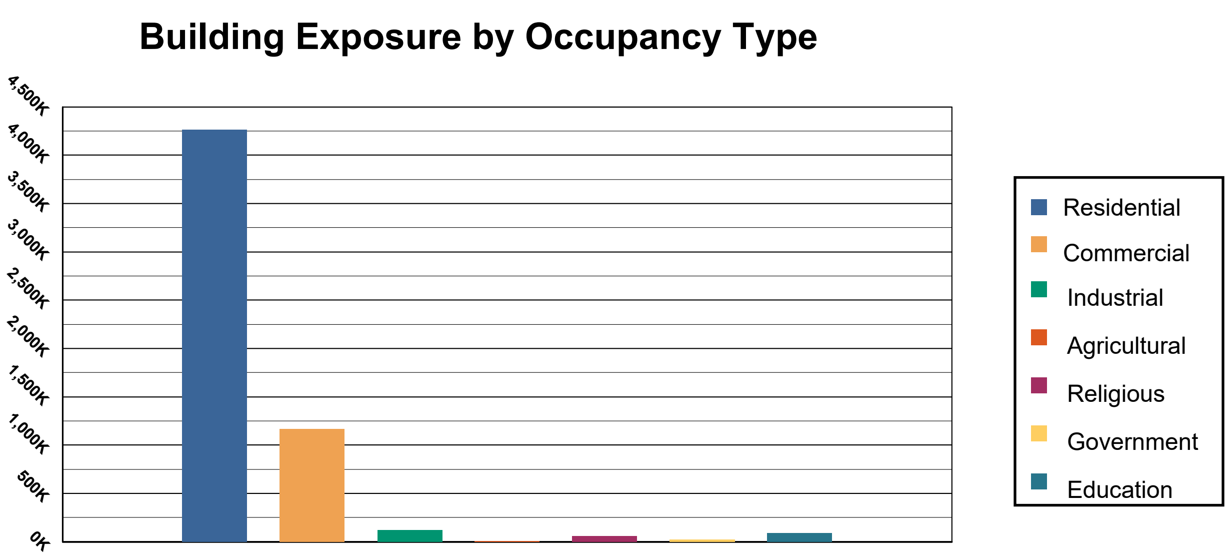


Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	4,258,449	74.38%
Commercial	1,168,926	20.42%
Industrial	119,475	2.09%
Agricultural	6,674	0.12%
Religious	59,798	1.04%
Government	22,214	0.39%
Education	89,520	1.56%
Total	**5,725,056**	**100.00%**

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 17 schools, 2 fire stations, 4 police stations and 2 emergency operation facilities.

Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 304 buildings will be at least moderately damaged. This is over 3% of the total number of buildings in the region. There are an estimated 6 buildings that will be completely destroyed. The definition of the 'damage states' is provided in the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

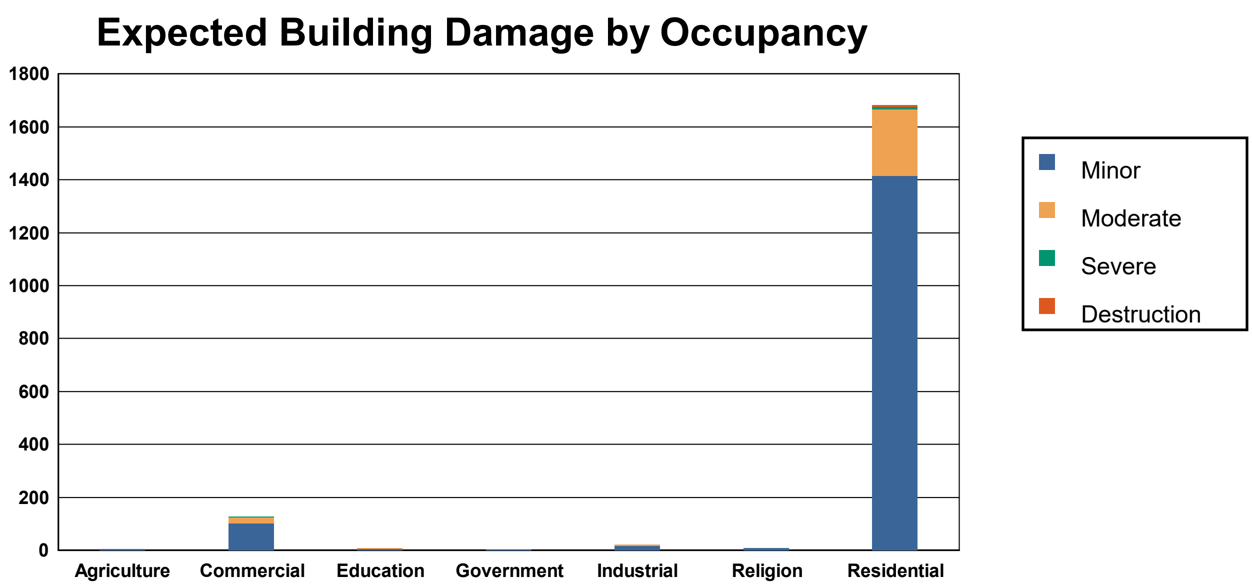


Table 2: Expected Building Damage by Occupancy : 500 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	19.17	79.86	3.45	14.37	0.90	3.77	0.43	1.80	0.05	0.20
Commercial	668.72	84.01	100.47	12.62	24.47	3.07	2.33	0.29	0.01	0.00
Education	42.59	85.17	6.06	12.12	1.27	2.55	0.08	0.16	0.00	0.00
Government	16.30	85.80	2.21	11.66	0.46	2.41	0.03	0.14	0.00	0.00
Industrial	116.96	84.75	16.19	11.73	4.10	2.97	0.71	0.51	0.04	0.03
Religion	47.40	84.63	7.36	13.14	1.18	2.10	0.07	0.13	0.00	0.00
Residential	6,248.57	78.80	1,413.66	17.83	252.51	3.18	9.06	0.11	6.19	0.08
Total	**7,159.70**		**1,549.41**		**284.90**		**12.71**		**6.28**	

Table 3: Expected Building Damage by Building Type : 500 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	110	78.79	22	16.01	7	5.10	0	0.10	0	0.00
Masonry	580	78.41	112	15.11	46	6.27	1	0.18	0	0.02
MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	403	83.87	58	12.12	17	3.58	2	0.43	0	0.00
Wood	6,144	80.24	1,333	17.41	165	2.16	9	0.12	6	0.08

Essential Facility Damage

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (0%) are available for use by patients already in the hospital and those injured by the hurricane. After one week, none of the beds will be in service. By 30 days, none will be operational.

Thematic Map of Essential Facilities with greater than 50% moderate

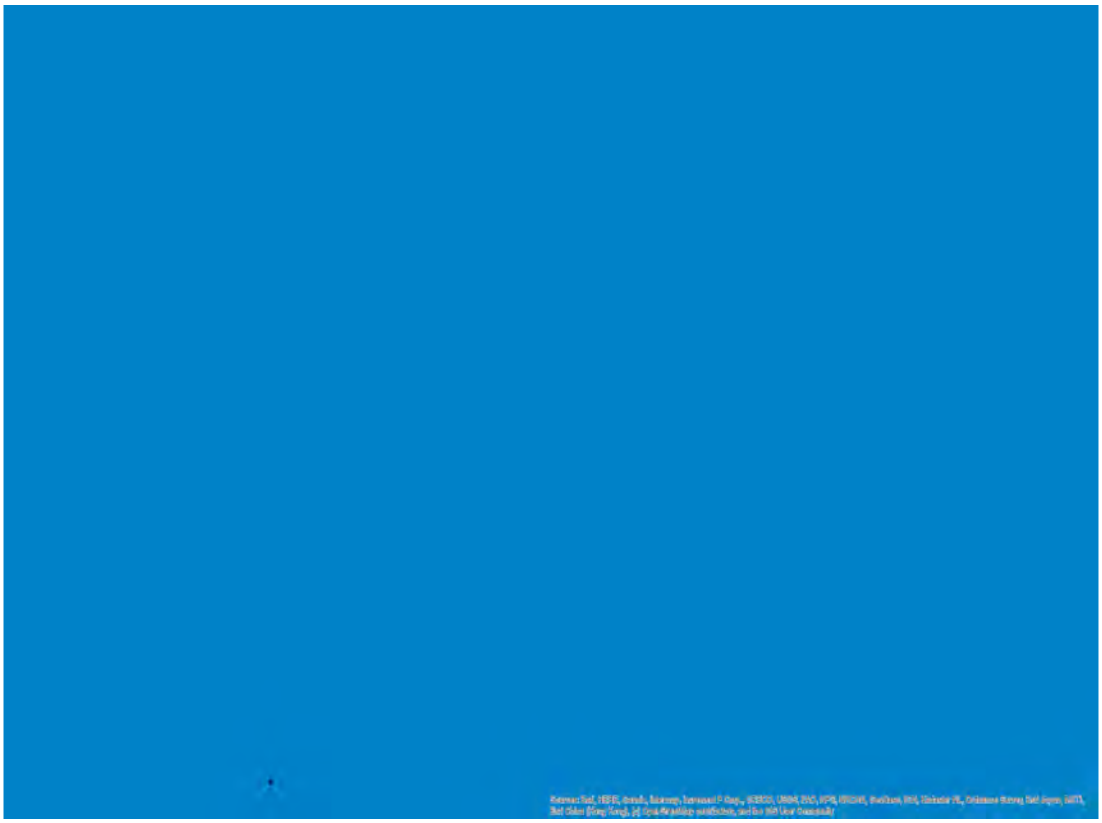
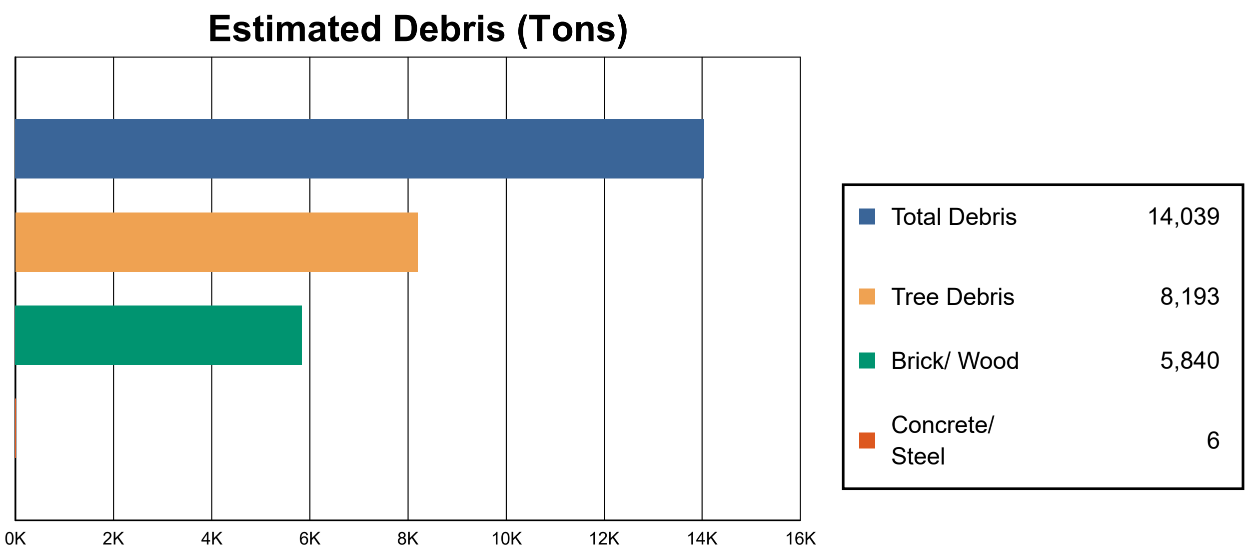


Table 4: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**Probability of at Least Moderate**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 day**
EOCs	2	0	0	2
Fire Stations	2	0	0	2
Police Stations	4	0	0	4
Schools	17	0	0	2

Induced Hurricane Damage

Debris Generation

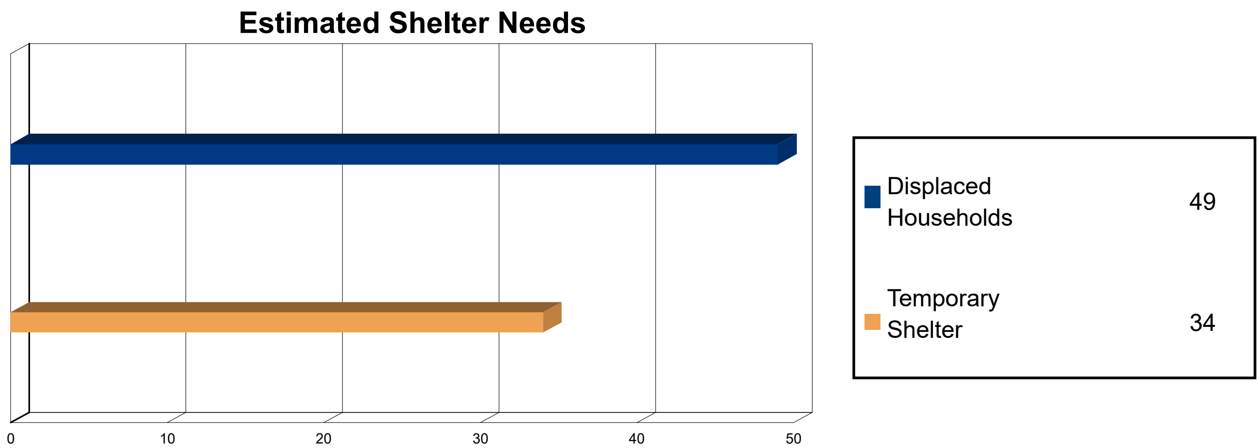


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 14,039 tons of debris will be generated. Of the total amount, 2,362 tons (17%) is Other Tree Debris. Of the remaining 11,677 tons, Brick/Wood comprises 50% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 234 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 5,831 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

Social Impact

Shelter Requirement



Hazus estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 49 households to be displaced due to the hurricane. Of these, 34 people (out of a total population of 27,982) will seek temporary shelter in public shelters.

Economic Loss

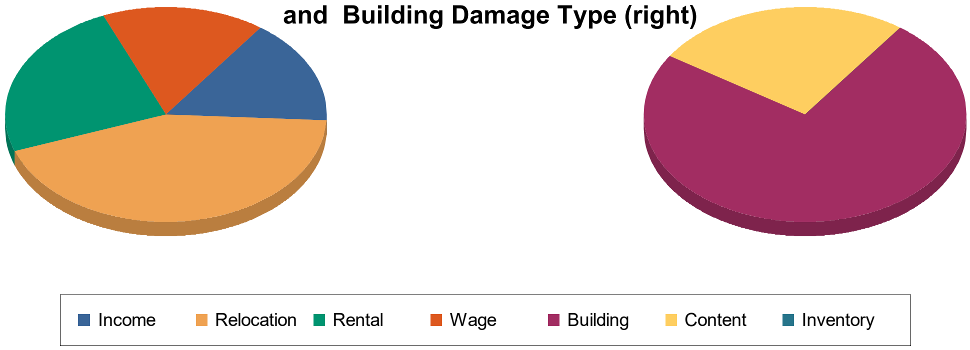
The total economic loss estimated for the hurricane is 121.4 million dollars, which represents 2.12 % of the total replacement value of the region's buildings.

Building-Related Losses

The building related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.

The total property damage losses were 121 million dollars. 6% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 88% of the total loss. Table 5 below provides a summary of the losses associated with the building damage.

Loss by Business Interruption Type (left)
and Building Damage Type (right)



Loss Type by General Occupancy

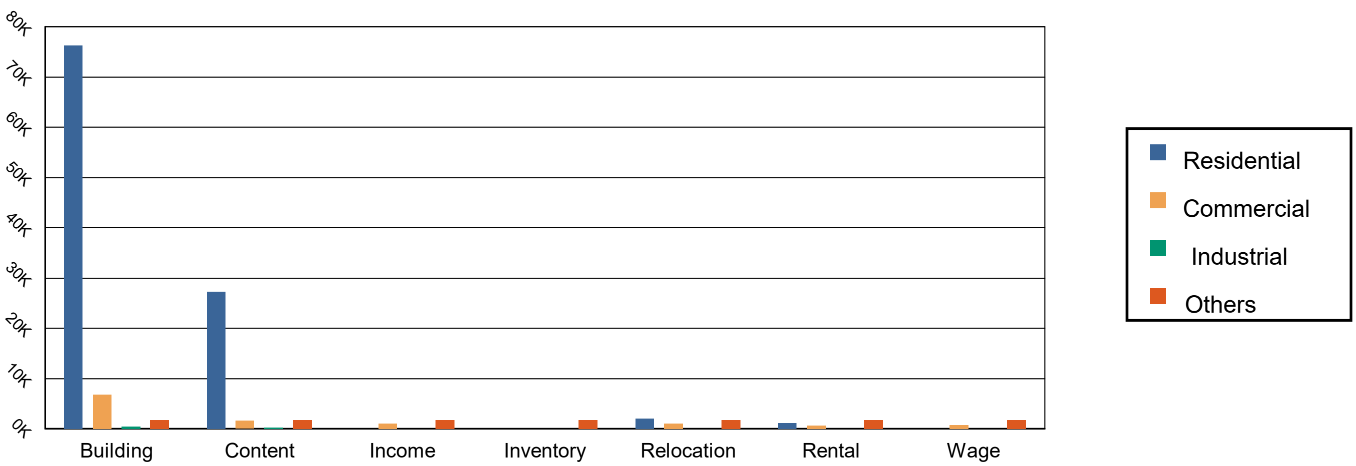


Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	76,260.28	6,846.27	501.28	865.68	84,473.51
	Content	27,275.43	1,609.19	191.90	193.32	29,269.84
	Inventory	0.00	16.45	18.64	2.72	37.81
	Subtotal	**103,535.71**	**8,471.91**	**711.82**	**1,061.72**	**113,781.16**
Business Interruption Loss						
	Income	0.00	1,093.54	7.23	104.52	1,205.30
	Relocation	2,064.77	1,081.34	49.97	136.19	3,332.27
	Rental	1,173.44	653.16	5.23	13.40	1,845.23
	Wage	0.00	812.65	12.84	428.06	1,253.55
	Subtotal	**3,238.20**	**3,640.69**	**75.28**	**682.18**	**7,636.34**

Total

Total	**106,773.91**	**12,112.61**	**787.09**	**1,743.90**	**121,417.51**

Appendix A: County Listing for the Region

Massachusetts
- Norfolk

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
Massachusetts				
Norfolk	27,982	4,258,449	1,466,607	5,725,056
Total	**27,982**	**4,258,449**	**1,466,607**	**5,725,056**
Study Region Total	**27,982**	**4,258,449**	**1,466,607**	**5,725,056**

Hazus: Hurricane Global Risk Report

Region Name: WellesleyHU

Hurricane Scenario: Probabilistic 1000-year Return Period

Print Date: Wednesday, November 23, 2022

Disclaimer:
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Totals only reflect data for those census tracts/blocks included in the user's study region.

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- Massachusetts

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There are an estimated 9 thousand buildings in the region with a total building replacement value (excluding contents) of 5,725 million dollars (2014 dollars). Approximately 88% of the buildings (and 74% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 9,013 buildings in the region which have an aggregate total replacement value of 5,725 million (2014 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

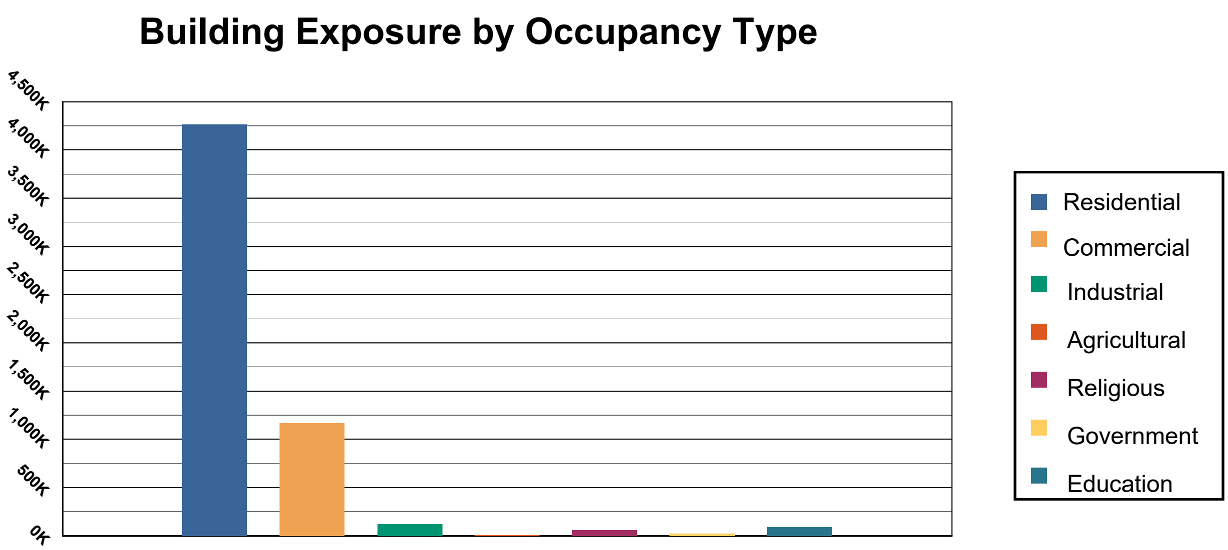


Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	4,258,449	74.38%
Commercial	1,168,926	20.42%
Industrial	119,475	2.09%
Agricultural	6,674	0.12%
Religious	59,798	1.04%
Government	22,214	0.39%
Education	89,520	1.56%
Total	**5,725,056**	**100.00%**

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 17 schools, 2 fire stations, 4 police stations and 2 emergency operation facilities.

Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 594 buildings will be at least moderately damaged. This is over 7% of the total number of buildings in the region. There are an estimated 19 buildings that will be completely destroyed. The definition of the 'damage states' is provided in the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

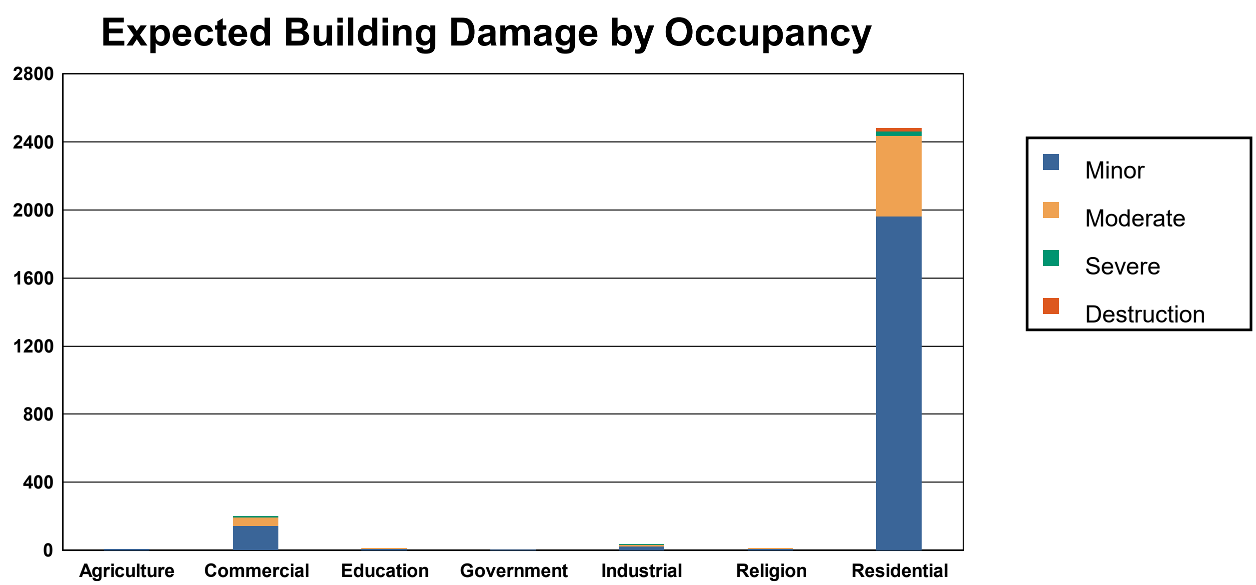


Table 2: Expected Building Damage by Occupancy : 1000 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	16.67	69.47	4.88	20.33	1.58	6.58	0.76	3.18	0.11	0.45
Commercial	596.79	74.97	144.11	18.10	49.34	6.20	5.72	0.72	0.03	0.00
Education	38.01	76.02	8.82	17.63	2.90	5.81	0.27	0.54	0.00	0.00
Government	14.65	77.10	3.22	16.95	1.04	5.48	0.09	0.47	0.00	0.00
Industrial	104.48	75.71	23.20	16.81	8.60	6.23	1.62	1.17	0.10	0.07
Religion	42.27	75.48	10.82	19.32	2.69	4.80	0.22	0.40	0.00	0.00
Residential	5,446.79	68.69	1,964.00	24.77	471.66	5.95	28.72	0.36	18.83	0.24
Total	**6,259.66**		**2,159.05**		**537.81**		**37.41**		**19.06**	

Table 3: Expected Building Damage by Building Type : 1000 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	94	67.95	30	21.25	15	10.46	0	0.35	0	0.00
Masonry	506	68.34	150	20.27	80	10.83	4	0.50	0	0.06
MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	358	74.58	82	17.05	35	7.35	5	1.02	0	0.01
Wood	5,395	70.45	1,890	24.67	327	4.27	28	0.36	18	0.24

Essential Facility Damage

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (0%) are available for use by patients already in the hospital and those injured by the hurricane. After one week, none of the beds will be in service. By 30 days, none will be operational.

Thematic Map of Essential Facilities with greater than 50% moderate

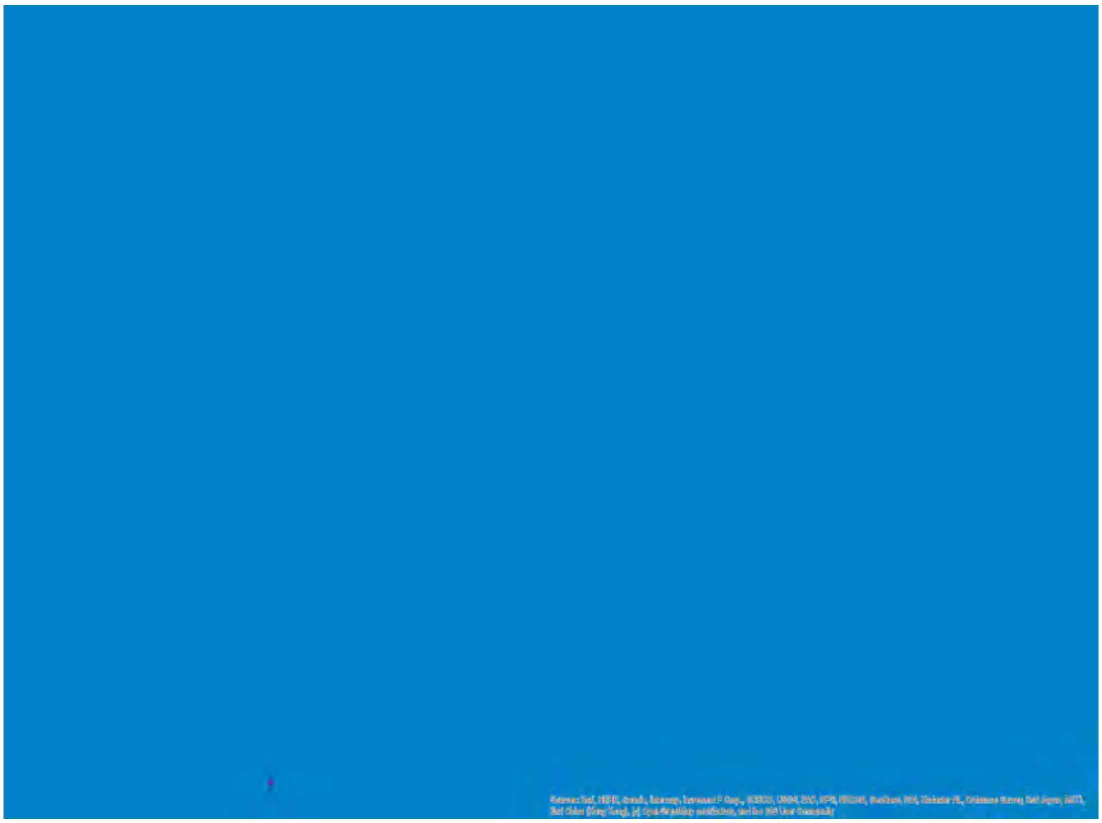


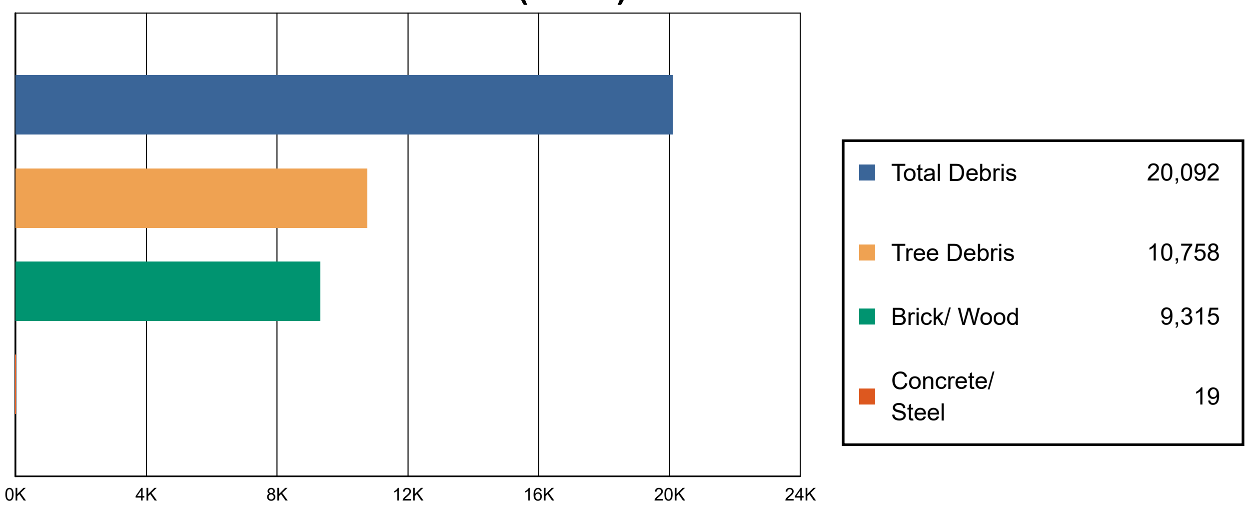
Table 4: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**Probability of at Least Moderate**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 day**
EOCs	2	0	0	2
Fire Stations	2	0	0	2
Police Stations	4	0	0	4
Schools	17	3	0	0

Induced Hurricane Damage

Debris Generation

Estimated Debris (Tons)

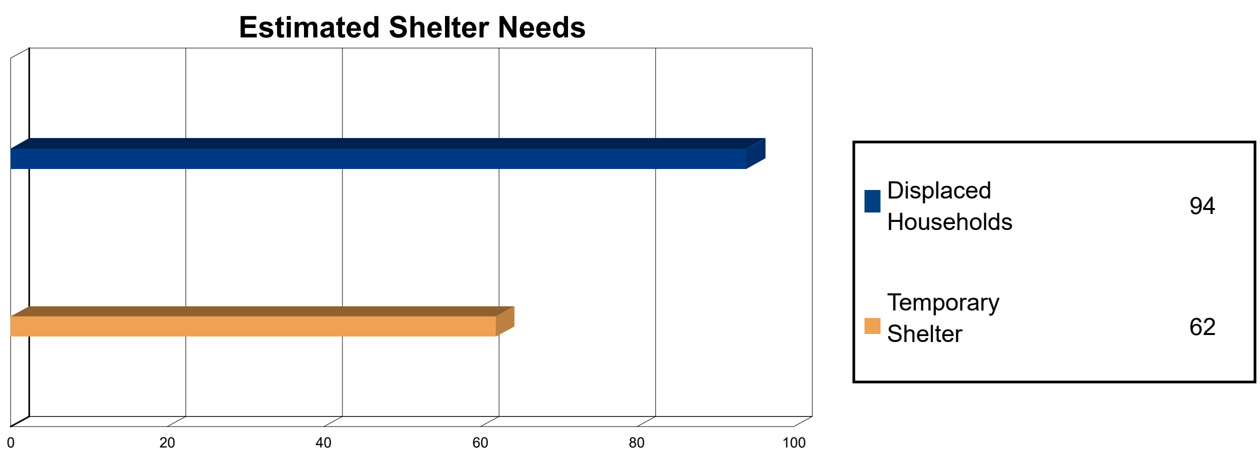


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 20,092 tons of debris will be generated. Of the total amount, 3,070 tons (15%) is Other Tree Debris. Of the remaining 17,022 tons, Brick/Wood comprises 55% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 373 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 7,688 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

Social Impact

Shelter Requirement



Hazus estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 94 households to be displaced due to the hurricane. Of these, 62 people (out of a total population of 27,982) will seek temporary shelter in public shelters.

Economic Loss

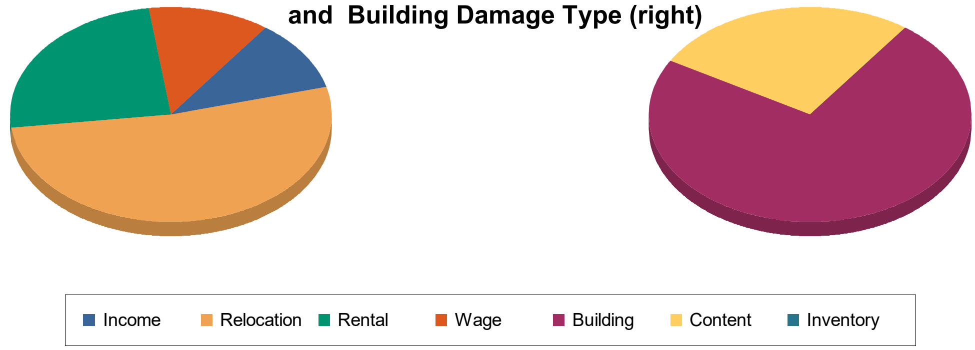
The total economic loss estimated for the hurricane is 196.2 million dollars, which represents 3.43 % of the total replacement value of the region's buildings.

Building-Related Losses

The building related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.

The total property damage losses were 196 million dollars. 7% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 87% of the total loss. Table 5 below provides a summary of the losses associated with the building damage.

Loss by Business Interruption Type (left) and Building Damage Type (right)



Loss Type by General Occupancy

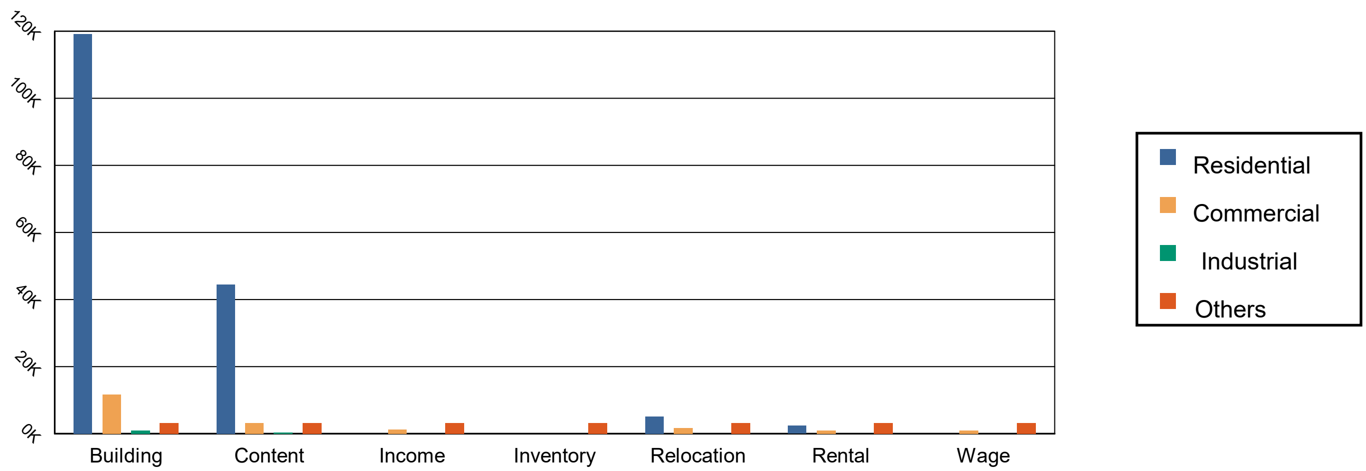


Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	119,177.38	11,781.42	973.35	1,596.01	133,528.16
	Content	44,558.19	3,289.64	424.10	456.83	48,728.76
	Inventory	0.00	36.56	41.58	5.39	83.53
	Subtotal	**163,735.57**	**15,107.63**	**1,439.03**	**2,058.22**	**182,340.45**
Business Interruption Loss						
	Income	0.00	1,338.56	10.46	157.45	1,506.47
	Relocation	5,091.31	1,807.10	99.86	267.93	7,266.21
	Rental	2,358.12	1,024.68	9.02	24.81	3,416.65
	Wage	0.00	1,058.54	18.55	635.91	1,713.00
	Subtotal	**7,449.44**	**5,228.89**	**137.90**	**1,086.10**	**13,902.33**

Total

Total	171,185.01	20,336.51	1,576.93	3,144.33	196,242.79

Appendix A: County Listing for the Region

Massachusetts

- Norfolk

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
Massachusetts				
Norfolk	27,982	4,258,449	1,466,607	5,725,056
Total	**27,982**	**4,258,449**	**1,466,607**	**5,725,056**
Study Region Total	**27,982**	**4,258,449**	**1,466,607**	**5,725,056**

Hazus: Earthquake Global Risk Report

Region Name: WellesleyEQ

Earthquake Scenario: 1500year

Print Date: November 23, 2022

Disclaimer:

This version of Hazus utilizes 2010 Census Data.

Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

Table of Contents

General Description of the Region

Hazus-MH is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 1 county(ies) from the following state(s):

Massachusetts

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 10.50 square miles and contains 6 census tracts. There are over 8 thousand households in the region which has a total population of 27,982 people (2010 Census Bureau data). The distribution of population by Total Region and County is provided in Appendix B.

There are an estimated 9 thousand buildings in the region with a total building replacement value (excluding contents) of 5,725 (millions of dollars). Approximately 88.00 % of the buildings (and 74.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 391 and 211 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 9 thousand buildings in the region which have an aggregate total replacement value of 5,725 (millions of dollars) . Appendix B provides a general distribution of the building value by Total Region and County.

In terms of building construction types found in the region, wood frame construction makes up 85% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

Hazus breaks critical facilities into two (2) groups: essential facilities and high potential loss facilities (HPL). Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 0 hospitals in the region with a total bed capacity of beds. There are 17 schools, 2 fire stations, 4 police stations and 2 emergency operation facilities. With respect to high potential loss facilities (HPL), there are no dams identified within the inventory. The inventory also includes no hazardous material sites, no military installations and no nuclear power plants.

Transportation and Utility Lifeline Inventory

Within Hazus, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 602.00 (millions of dollars). This inventory includes over 22.99 miles of highways, 16 bridges, 433.10 miles of pipes.

Table 1: Transportation System Lifeline Inventory

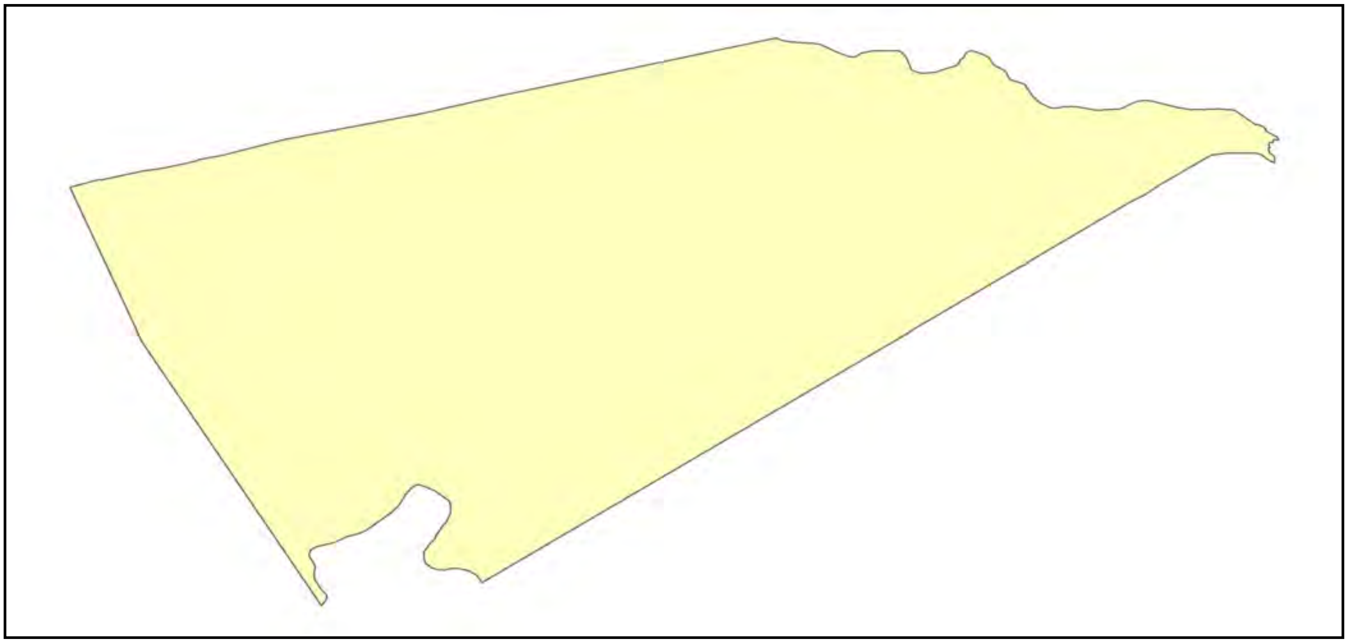
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	16	39.4908
	Segments	29	283.1065
	Tunnels	0	0.0000
		Subtotal	**322.5973**
Railways	Bridges	1	5.3607
	Facilities	0	0.0000
	Segments	15	36.5361
	Tunnels	0	0.0000
		Subtotal	**41.8968**
Light Rail	Bridges	0	0.0000
	Facilities	3	10.2925
	Segments	5	17.1273
	Tunnels	0	0.0000
		Subtotal	**27.4198**
Bus	Facilities	0	0.0000
		Subtotal	**0.0000**
Ferry	Facilities	0	0.0000
		Subtotal	**0.0000**
Port	Facilities	0	0.0000
		Subtotal	**0.0000**
Airport	Facilities	0	0.0000
	Runways	0	0.0000
		Subtotal	**0.0000**
		Total	**391.90**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	8.5926
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**8.5926**
Waste Water	Distribution Lines	NA	5.1555
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**5.1555**
Natural Gas	Distribution Lines	NA	3.4370
	Facilities	0	0.0000
	Pipelines	4	7.1601
		Subtotal	**10.5971**
Oil Systems	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**0.0000**
Electrical Power	Facilities	1	186.5528
		Subtotal	**186.5528**
Communication	Facilities	1	0.1160
		Subtotal	**0.1160**
		Total	**211.00**

Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.



Scenario Name	1500year
Type of Earthquake	Probabilistic
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	1,500.00
Longitude of Epicenter	NA
Latitude of Epicenter	NA
Earthquake Magnitude	5.00
Depth (km)	NA
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	NA

Direct Earthquake Damage

Building Damage

Hazus estimates that about 275 buildings will be at least moderately damaged. This is over 3.00 % of the buildings in the region. There are an estimated 3 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Damage Categories by General Occupancy Type

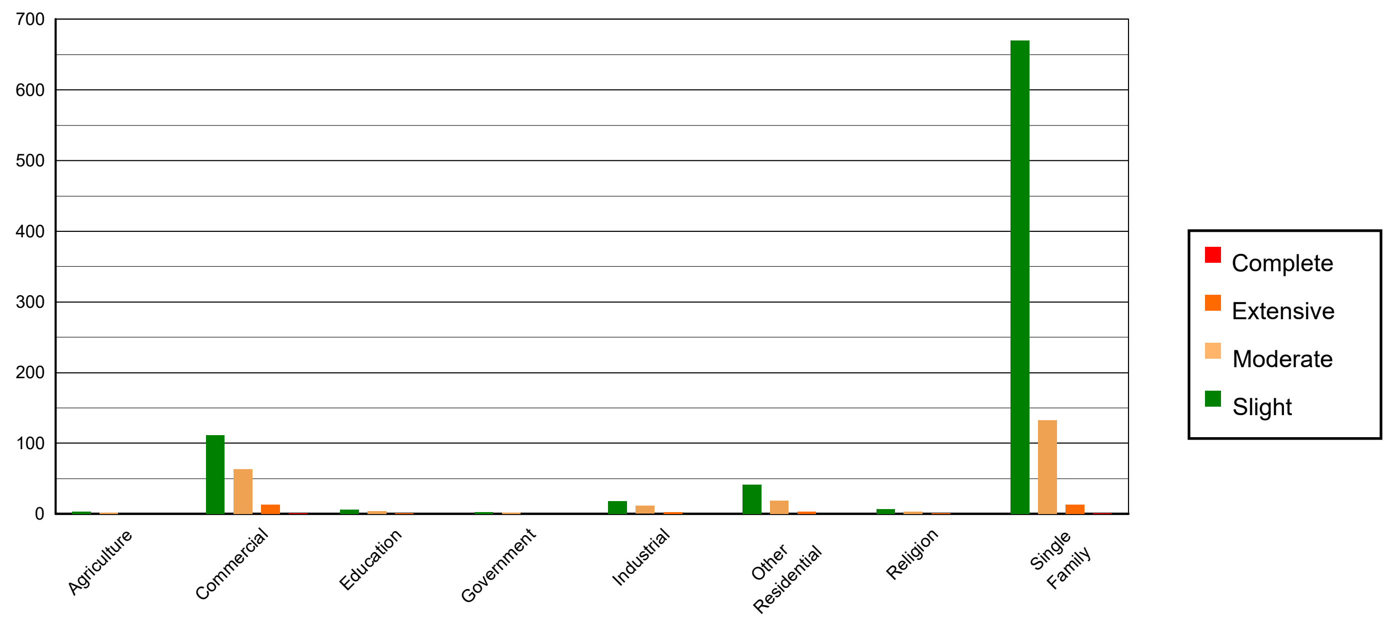


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	18.80	0.24	3.36	0.39	1.52	0.64	0.31	0.89	0.02	0.65
Commercial	606.59	7.70	111.60	12.97	63.59	26.75	13.02	38.03	1.20	37.35
Education	39.18	0.50	6.46	0.75	3.65	1.54	0.63	1.85	0.07	2.18
Government	14.82	0.19	2.46	0.29	1.45	0.61	0.25	0.73	0.02	0.67
Industrial	105.14	1.33	18.54	2.15	11.73	4.94	2.39	6.99	0.19	5.90
Other Residential	318.40	4.04	41.44	4.82	19.17	8.07	3.60	10.53	0.39	12.09
Religion	44.94	0.57	6.71	0.78	3.51	1.48	0.75	2.19	0.09	2.84
Single Family	6729.43	85.43	669.98	77.86	133.08	55.98	13.28	38.78	1.23	38.32
Total	**7,877**		**861**		**238**		**34**		**3**	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	6868.17	87.19	670.02	77.86	112.23	47.21	6.06	17.70	0.01	0.18
Steel	366.27	4.65	62.33	7.24	42.06	17.69	7.82	22.84	0.49	15.35
Concrete	72.96	0.93	13.48	1.57	9.38	3.95	1.19	3.46	0.08	2.55
Precast	31.26	0.40	5.15	0.60	5.04	2.12	1.55	4.52	0.04	1.16
RM	101.17	1.28	10.84	1.26	8.77	3.69	2.07	6.03	0.01	0.29
URM	437.46	5.55	98.74	11.47	60.23	25.34	15.56	45.44	2.59	80.47
MH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**7,877**		**861**		**238**		**34**		**3**	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had hospital beds available for use. On the day of the earthquake, the model estimates that only hospital beds (%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, % of the beds will be back in service. By 30 days, % will be operational.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**At Least Moderate Damage > 50%**	**Complete Damage > 50%**	**With Functionality > 50% on day 1**
Hospitals	0	0	0	0
Schools	17	0	0	17
EOCs	2	0	0	2
PoliceStations	4	0	0	4
FireStations	2	0	0	2

Transportation Lifeline Damage

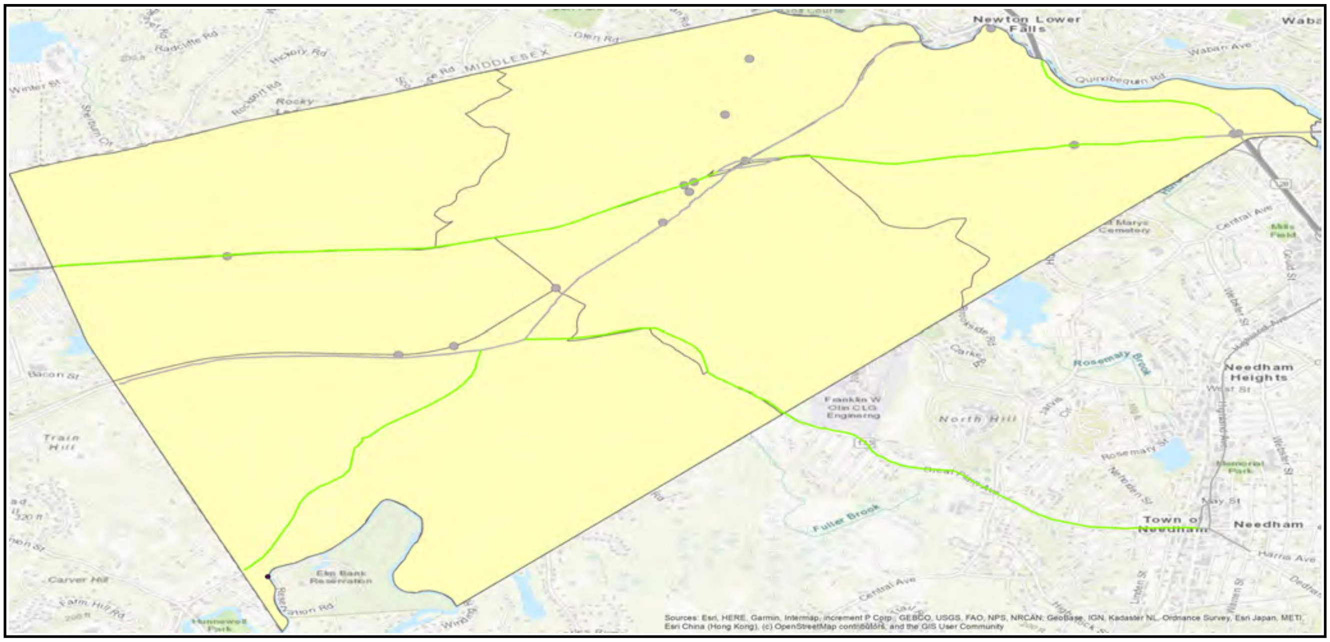


Table 6: Expected Damage to the Transportation Systems

System	Component	Number of Locations_				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	29	0	0	29	29
	Bridges	16	0	0	16	16
	Tunnels	0	0	0	0	0
Railways	Segments	15	0	0	11	11
	Bridges	1	0	0	1	1
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	5	0	0	3	3
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	3	0	0	3	3
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	0	0	0	0	0
	Runways	0	0	0	0	0

Table 6 provides damage estimates for the transportation system.

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, Hazus performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	0	0	0	0	0
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	1	0	0	1	1
Communication	1	0	0	1	1

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (miles)	Number of Leaks	Number of Breaks
Potable Water	267	4	1
Waste Water	160	2	1
Natural Gas	6	0	0
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	8,695	0	0	0	0	0
Electric Power		0	0	0	0	0

Induced Earthquake Damage

Fire Following Earthquake

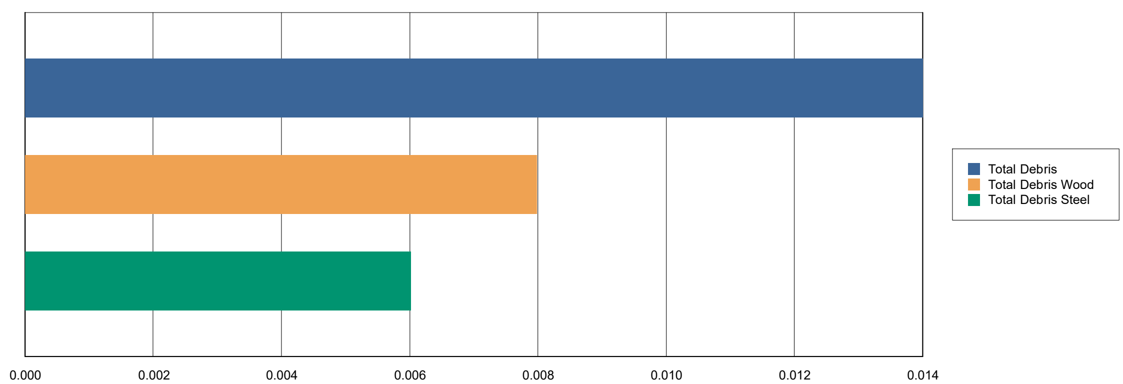
Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 0 ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (millions of dollars) of building value.

Debris Generation

Hazus estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 14,000 tons of debris will be generated. Of the total amount, Brick/Wood comprises 57.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 560 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Earthquake Debris (millions of tons)



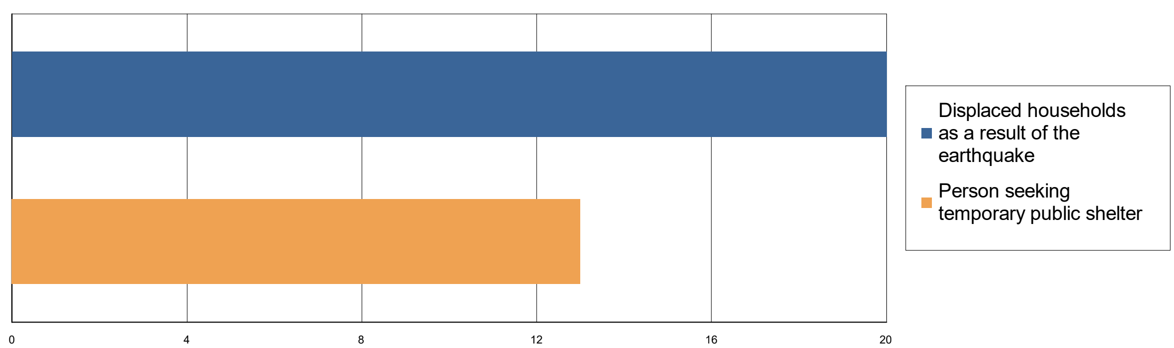
Brick/ Wood	Reinforced Concrete/Steel	Total Debris	Truck Load
0.01	0.01	0.01	560 (@25 tons/truck)

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 20 households to be displaced due to the earthquake. Of these, 13 people (out of a total population of 27,982) will seek temporary shelter in public shelters.

Displaced Households/ Persons Seeking Short Term Public Shelter



Displaced households as a result of the earthquake	Persons seeking temporary public shelter
20	13

Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0.11	0.02	0.00	0.00
	Commuting	0.00	0.00	0.00	0.00
	Educational	0.00	0.00	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	0.07	0.01	0.00	0.00
	Other-Residential	3.09	0.49	0.05	0.10
	Single Family	3.12	0.35	0.03	0.06
	Total	**6**	**1**	**0**	**0**
2 PM	Commercial	6.62	1.04	0.10	0.19
	Commuting	0.00	0.00	0.00	0.00
	Educational	4.67	0.75	0.08	0.15
	Hotels	0.00	0.00	0.00	0.00
	Industrial	0.49	0.07	0.01	0.01
	Other-Residential	0.65	0.11	0.01	0.02
	Single Family	0.64	0.08	0.01	0.01
	Total	**13**	**2**	**0**	**0**
5 PM	Commercial	4.76	0.75	0.07	0.14
	Commuting	0.00	0.00	0.00	0.00
	Educational	1.27	0.20	0.02	0.04
	Hotels	0.00	0.00	0.00	0.00
	Industrial	0.31	0.05	0.00	0.01
	Other-Residential	1.22	0.20	0.02	0.04
	Single Family	1.20	0.14	0.01	0.02
	Total	**9**	**1**	**0**	**0**

Economic Loss

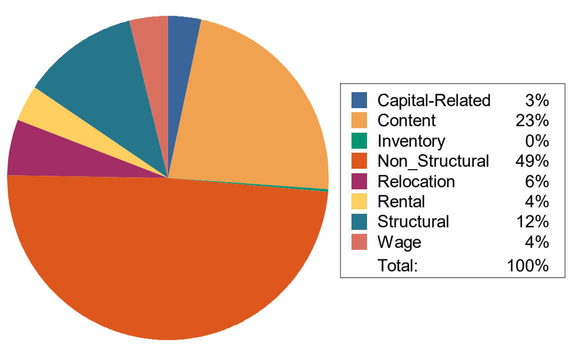
The total economic loss estimated for the earthquake is 106.67 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 97.14 (millions of dollars); 16 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 52 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Earthquake Losses by Loss Type ($ millions)



Earthquake Losses by Occupancy Type ($ millions)

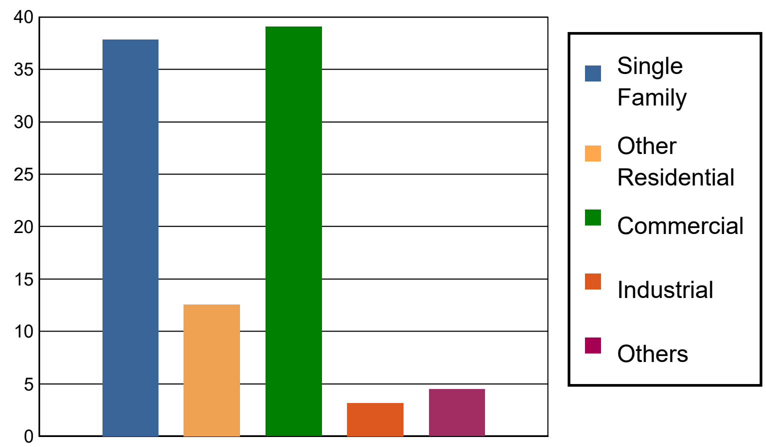


Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	0.2018	3.3374	0.0437	0.1408	3.7237
	Capital-Related	0.0000	0.0857	2.9797	0.0245	0.0370	3.1269
	Rental	0.3278	0.8072	2.2779	0.0176	0.0643	3.4948
	Relocation	1.1072	0.3488	3.2116	0.1600	0.5377	5.3653
	Subtotal	**1.4350**	**1.4435**	**11.8066**	**0.2458**	**0.7798**	**15.7107**
Capital Stock Losses							
	Structural	3.9129	1.8997	4.5371	0.3972	0.5745	11.3214
	Non_Structural	22.8568	7.1246	14.1501	1.5166	1.9249	47.5730
	Content	9.6436	2.1005	8.4720	0.8914	1.2247	22.3322
	Inventory	0.0000	0.0000	0.0822	0.1140	0.0047	0.2009
	Subtotal	**36.4133**	**11.1248**	**27.2414**	**2.9192**	**3.7288**	**81.4275**
	Total	**37.85**	**12.57**	**39.05**	**3.17**	**4.51**	**97.14**

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, Hazus computes the direct repair cost for each component only. There are no losses computed by Hazus for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

Table 12: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	283.1065	0.0000	0.00
	Bridges	39.4908	0.0064	0.02
	Tunnels	0.0000	0.0000	0.00
	Subtotal	**322.5973**	**0.0064**	
Railways	Segments	36.5361	0.0000	0.00
	Bridges	5.3607	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**41.8968**	**0.0000**	
Light Rail	Segments	17.1273	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	10.2925	1.1886	11.55
	Subtotal	**27.4198**	**1.1886**	
Bus	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Ferry	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Port	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Airport	Facilities	0.0000	0.0000	0.00
	Runways	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
	Total	**391.91**	**1.20**	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Lines	8.5926	0.0195	0.23
	Subtotal	**8.5926**	**0.0195**	
Waste Water	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Lines	5.1555	0.0098	0.19
	Subtotal	**5.1555**	**0.0098**	
Natural Gas	Pipelines	7.1601	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Lines	3.4370	0.0034	0.10
	Subtotal	**10.5971**	**0.0034**	
Oil Systems	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Electrical Power	Facilities	186.5528	8.2941	4.45
	Subtotal	**186.5528**	**8.2941**	
Communication	Facilities	0.1160	0.0052	4.48
	Subtotal	**0.1160**	**0.0052**	
	Total	**211.01**	**8.33**	

Appendix A: County Listing for the Region

Norfolk,MA

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Massachusetts					
	Norfolk	27,982	4,258	1,466	5,725
Total Region		**27,982**	**4,258**	**1,466**	**5,725**

Hazus: Earthquake Global Risk Report

Region Name: WellesleyEQ

Earthquake Scenario: 2500yearEarthquake

Print Date: November 23, 2022

Disclaimer:
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Totals only reflect data for those census tracts/blocks included in the user's study region.

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The geographical size of the region is 10.50 square miles and contains 6 census tracts. There are over 8 thousand households in the region which has a total population of 27,982 people (2010 Census Bureau data). The distribution of population by Total Region and County is provided in Appendix B.

There are an estimated 9 thousand buildings in the region with a total building replacement value (excluding contents) of 5,725 (millions of dollars). Approximately 88.00 % of the buildings (and 74.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 391 and 211 (millions of dollars), respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 9 thousand buildings in the region which have an aggregate total replacement value of 5,725 (millions of dollars) . Appendix B provides a general distribution of the building value by Total Region and County.

In terms of building construction types found in the region, wood frame construction makes up 85% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

Hazus breaks critical facilities into two (2) groups: essential facilities and high potential loss facilities (HPL). Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 0 hospitals in the region with a total bed capacity of beds. There are 17 schools, 2 fire stations, 4 police stations and 2 emergency operation facilities. With respect to high potential loss facilities (HPL), there are no dams identified within the inventory. The inventory also includes no hazardous material sites, no military installations and no nuclear power plants.

Transportation and Utility Lifeline Inventory

Within Hazus, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 602.00 (millions of dollars). This inventory includes over 22.99 miles of highways, 16 bridges, 433.10 miles of pipes.

Table 1: Transportation System Lifeline Inventory

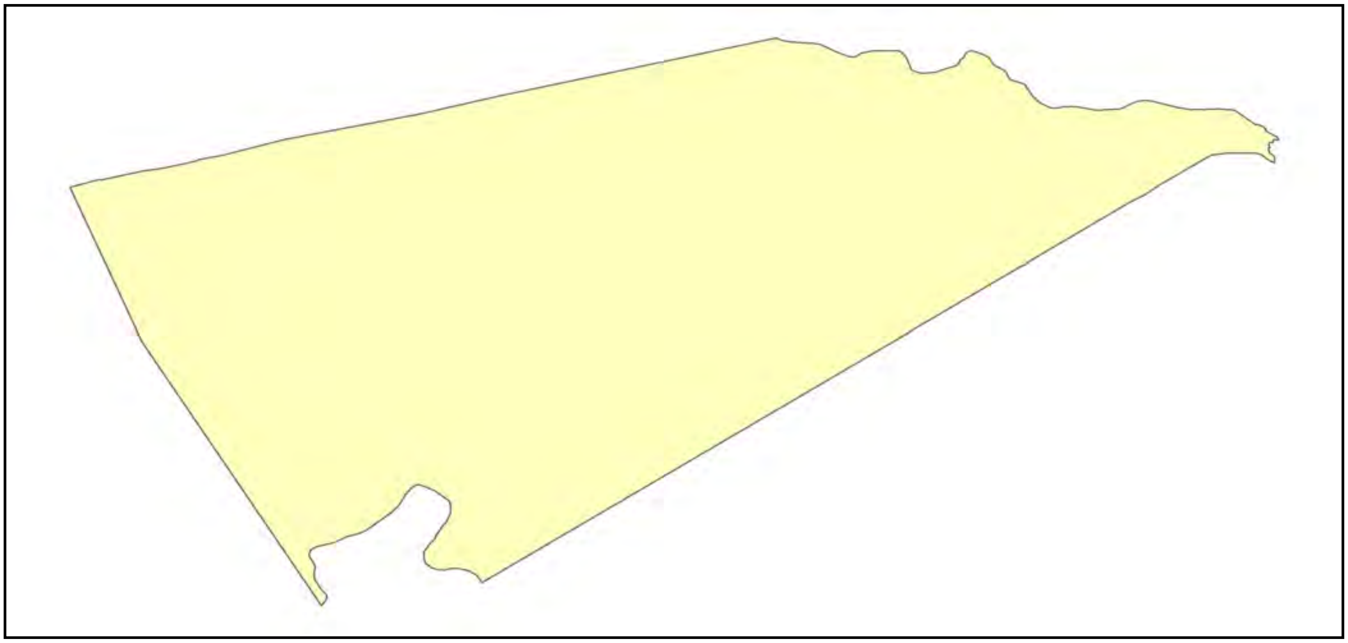
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	16	39.4908
	Segments	29	283.1065
	Tunnels	0	0.0000
		Subtotal	**322.5973**
Railways	Bridges	1	5.3607
	Facilities	0	0.0000
	Segments	15	36.5361
	Tunnels	0	0.0000
		Subtotal	**41.8968**
Light Rail	Bridges	0	0.0000
	Facilities	3	10.2925
	Segments	5	17.1273
	Tunnels	0	0.0000
		Subtotal	**27.4198**
Bus	Facilities	0	0.0000
		Subtotal	**0.0000**
Ferry	Facilities	0	0.0000
		Subtotal	**0.0000**
Port	Facilities	0	0.0000
		Subtotal	**0.0000**
Airport	Facilities	0	0.0000
	Runways	0	0.0000
		Subtotal	**0.0000**
		Total	**391.90**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	8.5926
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**8.5926**
Waste Water	Distribution Lines	NA	5.1555
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**5.1555**
Natural Gas	Distribution Lines	NA	3.4370
	Facilities	0	0.0000
	Pipelines	4	7.1601
		Subtotal	**10.5971**
Oil Systems	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**0.0000**
Electrical Power	Facilities	1	186.5528
		Subtotal	**186.5528**
Communication	Facilities	1	0.1160
		Subtotal	**0.1160**
		Total	**211.00**

Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.



Scenario Name	2500yearEarthquake
Type of Earthquake	Probabilistic
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	2,500.00
Longitude of Epicenter	NA
Latitude of Epicenter	NA
Earthquake Magnitude	6.00
Depth (km)	NA
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	NA

Building Damage

Hazus estimates that about 510 buildings will be at least moderately damaged. This is over 6.00 % of the buildings in the region. There are an estimated 7 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Damage Categories by General Occupancy Type

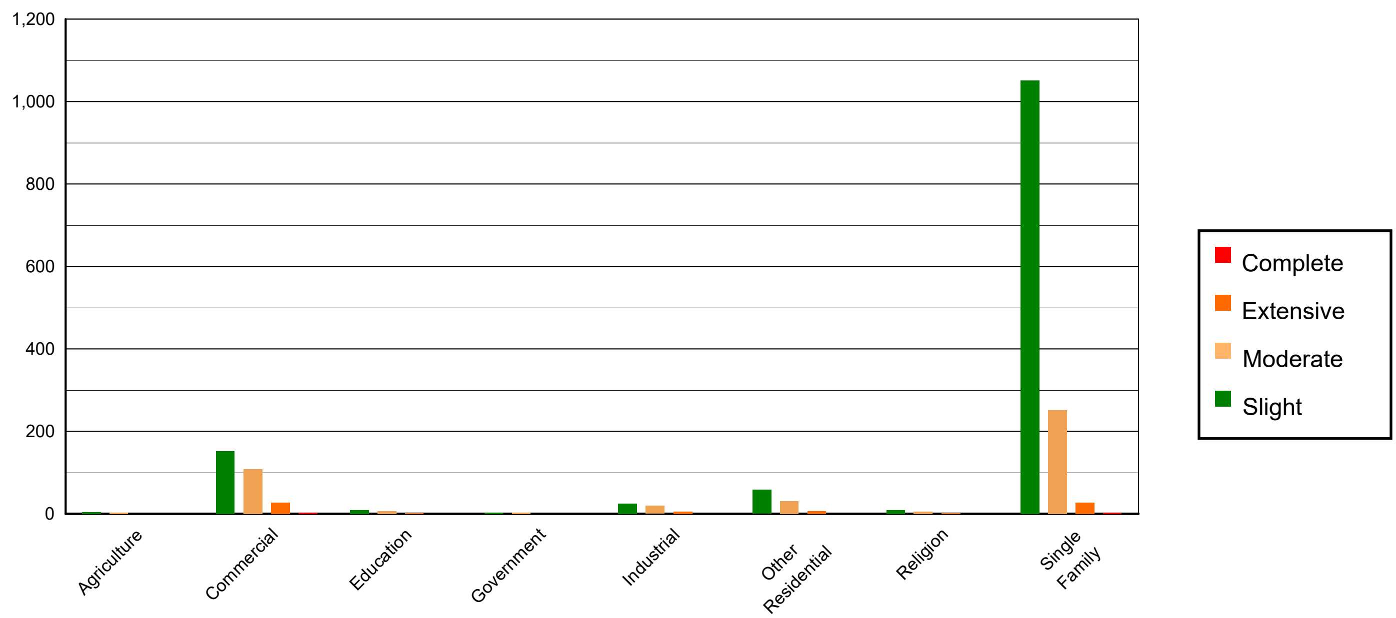


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	15.68	0.22	4.90	0.37	2.74	0.64	0.63	0.86	0.06	0.77
Commercial	503.20	7.00	152.56	11.61	109.24	25.39	27.71	38.10	3.28	41.87
Education	33.03	0.46	8.88	0.68	6.43	1.49	1.46	2.01	0.19	2.43
Government	12.39	0.17	3.37	0.26	2.58	0.60	0.59	0.81	0.06	0.82
Industrial	87.28	1.21	24.87	1.89	20.02	4.65	5.26	7.23	0.56	7.16
Other Residential	284.10	3.95	58.56	4.46	31.97	7.43	7.46	10.26	0.91	11.64
Religion	39.51	0.55	9.13	0.69	5.66	1.32	1.49	2.05	0.21	2.65
Single Family	6212.88	86.43	1051.86	80.04	251.58	58.48	28.12	38.66	2.56	32.66
Total	**7,188**		**1,314**		**430**		**73**		**8**	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	6337.63	88.17	1070.70	81.48	231.47	53.80	16.60	22.82	0.08	0.99
Steel	302.58	4.21	83.07	6.32	73.26	17.03	18.25	25.09	1.82	23.17
Concrete	59.44	0.83	17.65	1.34	16.46	3.83	3.24	4.45	0.30	3.81
Precast	24.93	0.35	6.50	0.49	8.08	1.88	3.36	4.62	0.17	2.23
RM	86.42	1.20	15.25	1.16	15.88	3.69	5.20	7.15	0.09	1.21
URM	377.09	5.25	120.96	9.20	85.07	19.77	26.09	35.87	5.37	68.59
MH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**7,188**		**1,314**		**430**		**73**		**8**	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had hospital beds available for use. On the day of the earthquake, the model estimates that only hospital beds (%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, % of the beds will be back in service. By 30 days, % will be operational.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**At Least Moderate Damage > 50%**	**Complete Damage > 50%**	**With Functionality > 50% on day 1**
Hospitals	0	0	0	0
Schools	17	0	0	17
EOCs	2	0	0	2
PoliceStations	4	0	0	4
FireStations	2	0	0	2

Transportation Lifeline Damage

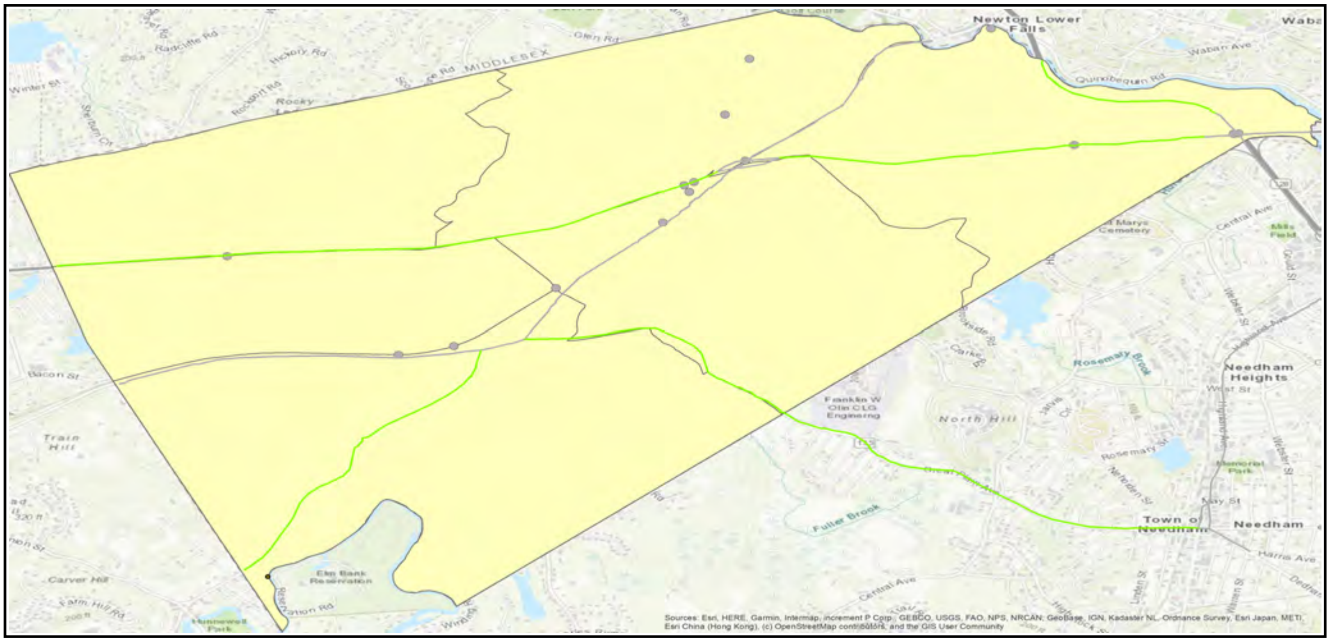


Table 6: Expected Damage to the Transportation Systems

System	Component	Number of Locations_				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	29	0	0	29	29
	Bridges	16	0	0	16	16
	Tunnels	0	0	0	0	0
Railways	Segments	15	0	0	11	11
	Bridges	1	0	0	1	1
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	5	0	0	3	3
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	3	0	0	3	3
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	0	0	0	0	0
	Runways	0	0	0	0	0

Table 6 provides damage estimates for the transportation system.

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, Hazus performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	0	0	0	0	0
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	1	0	0	1	1
Communication	1	0	0	1	1

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (miles)	Number of Leaks	Number of Breaks
Potable Water	267	8	2
Waste Water	160	4	1
Natural Gas	6	0	0
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	8,695	0	0	0	0	0
Electric Power		0	0	0	0	0

Induced Earthquake Damage

Fire Following Earthquake

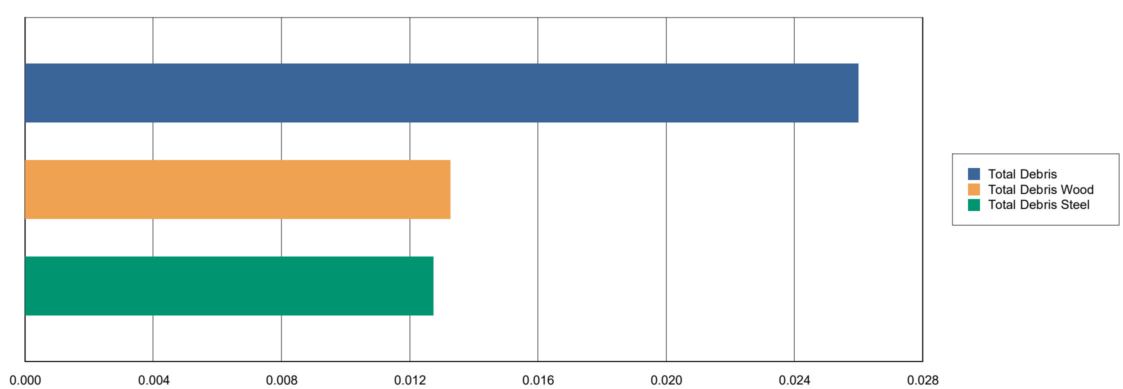
Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 0 ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (millions of dollars) of building value.

Debris Generation

Hazus estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 26,000 tons of debris will be generated. Of the total amount, Brick/Wood comprises 51.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 1,040 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Earthquake Debris (millions of tons)



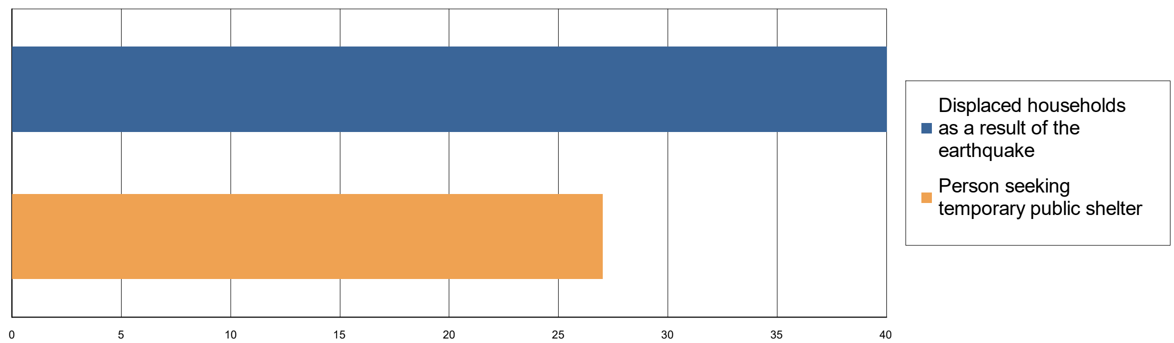
Brick/ Wood	Reinforced Concrete/Steel	Total Debris	Truck Load
0.01	0.01	0.03	1,040 (@25 tons/truck)

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 40 households to be displaced due to the earthquake. Of these, 27 people (out of a total population of 27,982) will seek temporary shelter in public shelters.

Displaced Households/ Persons Seeking Short Term Public Shelter



Displaced households as a result of the earthquake	Persons seeking temporary public shelter
40	27

Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0.22	0.04	0.00	0.01
	Commuting	0.00	0.00	0.00	0.00
	Educational	0.00	0.00	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	0.13	0.02	0.00	0.00
	Other-Residential	5.93	1.05	0.12	0.23
	Single Family	5.68	0.70	0.06	0.12
	Total	**12**	**2**	**0**	**0**
2 PM	Commercial	12.94	2.25	0.24	0.46
	Commuting	0.00	0.00	0.00	0.00
	Educational	9.36	1.68	0.19	0.36
	Hotels	0.00	0.00	0.00	0.00
	Industrial	0.98	0.17	0.02	0.03
	Other-Residential	1.25	0.23	0.03	0.05
	Single Family	1.16	0.15	0.01	0.03
	Total	**26**	**4**	**0**	**1**
5 PM	Commercial	9.30	1.63	0.17	0.33
	Commuting	0.00	0.00	0.00	0.00
	Educational	2.54	0.45	0.05	0.10
	Hotels	0.00	0.00	0.00	0.00
	Industrial	0.61	0.10	0.01	0.02
	Other-Residential	2.34	0.42	0.05	0.09
	Single Family	2.19	0.28	0.03	0.05
	Total	**17**	**3**	**0**	**1**

Economic Loss

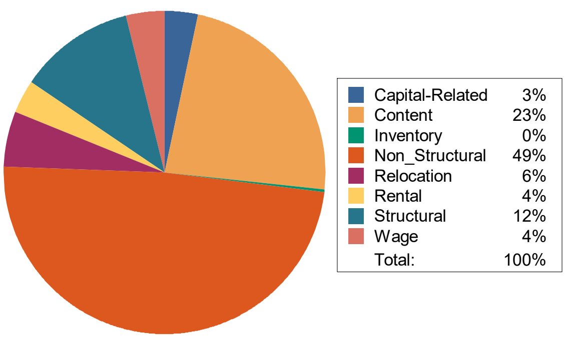
The total economic loss estimated for the earthquake is 200.29 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 183.44 (millions of dollars); 16 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 52 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Earthquake Losses by Loss Type ($ millions)



Earthquake Losses by Occupancy Type ($ millions)

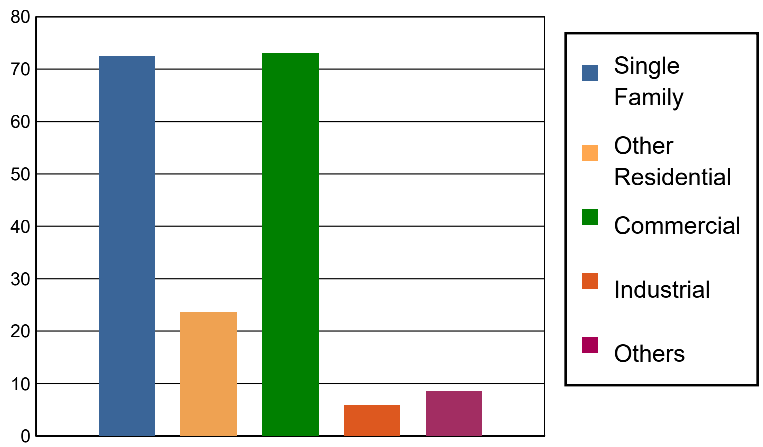


Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	0.4211	6.2888	0.0869	0.2627	7.0595
	Capital-Related	0.0000	0.1789	5.7331	0.0487	0.0695	6.0302
	Rental	0.6220	1.5123	4.2002	0.0328	0.1259	6.4932
	Relocation	2.1479	0.6220	6.1282	0.2991	1.0509	10.2481
	Subtotal	**2.7699**	**2.7343**	**22.3503**	**0.4675**	**1.5090**	**29.8310**
Capital Stock Losses							
	Structural	7.0808	3.5691	8.7039	0.7665	1.0994	21.2197
	Non_Structural	43.2017	13.3189	26.2905	2.7404	3.6128	89.1643
	Content	19.3367	4.0018	15.5900	1.6342	2.2910	42.8537
	Inventory	0.0000	0.0000	0.1513	0.2092	0.0087	0.3692
	Subtotal	**69.6192**	**20.8898**	**50.7357**	**5.3503**	**7.0119**	**153.6069**
	Total	**72.39**	**23.62**	**73.09**	**5.82**	**8.52**	**183.44**

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, Hazus computes the direct repair cost for each component only. There are no losses computed by Hazus for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

Table 12: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	283.1065	0.0000	0.00
	Bridges	39.4908	0.0284	0.07
	Tunnels	0.0000	0.0000	0.00
	Subtotal	**322.5973**	**0.0284**	
Railways	Segments	36.5361	0.0000	0.00
	Bridges	5.3607	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**41.8968**	**0.0000**	
Light Rail	Segments	17.1273	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	10.2925	1.7301	16.81
	Subtotal	**27.4198**	**1.7301**	
Bus	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Ferry	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Port	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Airport	Facilities	0.0000	0.0000	0.00
	Runways	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
	Total	**391.91**	**1.76**	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Lines	8.5926	0.0355	0.41
	Subtotal	**8.5926**	**0.0355**	
Waste Water	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Lines	5.1555	0.0178	0.35
	Subtotal	**5.1555**	**0.0178**	
Natural Gas	Pipelines	7.1601	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Lines	3.4370	0.0061	0.18
	Subtotal	**10.5971**	**0.0061**	
Oil Systems	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Electrical Power	Facilities	186.5528	15.0287	8.06
	Subtotal	**186.5528**	**15.0287**	
Communication	Facilities	0.1160	0.0093	8.02
	Subtotal	**0.1160**	**0.0093**	
	Total	**211.01**	**15.10**	

Appendix A: County Listing for the Region

Norfolk,MA

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Massachusetts					
	Norfolk	27,982	4,258	1,466	5,725
Total Region		**27,982**	**4,258**	**1,466**	**5,725**