

TOWN OF LITTLETON HAZARD MITIGATION PLAN 2025 UPDATE



**Adopted by the Town
June 23, 2025**

**Town of Littleton
Metropolitan Area Planning Council**



TOWN OF LITTLETON HAZARD MITIGATION PLAN 2025 UPDATE

ACKNOWLEDGEMENTS AND CREDITS

This plan was prepared for the Town of Littleton by the Metropolitan Area Planning Council (MAPC) under the direction of the Massachusetts Emergency Management Agency (MEMA) and the Massachusetts Department of Conservation and Recreation (DCR). The plan was funded by the Federal Emergency Management Agency's (FEMA) Hazard Mitigation Grant Program (HMGP).

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SECTION 1: EXECUTIVE SUMMARY

Hazard Mitigation planning is a proactive effort to identify actions that can be taken to reduce the dangers to life and property from natural hazard events. In the communities of the Boston region of Massachusetts, hazard mitigation planning tends to focus most on flooding, the most likely natural hazard to impact these communities. The Federal Disaster Mitigation Act of 2000 requires all municipalities that wish to be eligible to receive FEMA funding for hazard mitigation grants, to adopt a local multi-hazard mitigation plan and update this plan in five-year intervals.

PLANNING PROCESS

This is an update of the original Littleton Hazard Mitigation Plan, which was approved by FEMA on April 13, 2017. Prior to that, Littleton's first plan was approved by FEMA on August 7, 2008. Planning for the Hazard Mitigation Plan update was led by the Littleton Local Hazard Mitigation Planning Team, composed of staff from a number of different Town Departments. This team met on July 10, 2023, September 27, 2023, January 4, 2024, and April 4, 2024. The Team discussed where the impacts of natural hazards most affect the Town, goals for addressing these impacts, updates to the Town's existing mitigation measures and new or revised hazard mitigation measures that would benefit the Town.

Public participation in this planning process is important for improving awareness of the potential impacts of natural hazards and to build support for the actions the Town takes to mitigate them. The Town's Hazard Mitigation Planning Team hosted two public meetings, the first on November 16, 2023 and the second on May 28th, 2024, and the draft plan update was posted on the Town's website for public review. Key town stakeholders and neighboring communities were notified and invited to review the draft plan and submit comments. Several public comments were received and can be found in Appendix C.

RISK ASSESSMENT

The Littleton Hazard Mitigation Plan assesses the potential impacts to the Town from flooding, high winds, winter storms, brush fire, geologic hazards, extreme temperatures, and drought. These are shown on the map series (Appendix B).

The Littleton Local Hazard Mitigation Planning Team identified 71 Critical Facilities. These are also shown on the map series and listed in Table 37, identifying which facilities are located within the mapped hazard zones. The locations of the Critical Facilities are shown on the hazard map series, copies of which are found in Appendix A.

A HAZUS-MH analysis provided estimates of damages from Hurricanes damages of 100 year and 500-year storms (\$15 million to \$53 million), earthquakes of magnitudes 5 and 7 (\$353 million to \$2.7billion), and flood damage estimates for the 100- and 500-year storms (\$13 million to \$19 million).

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HAZARD MITIGATION GOALS

The Littleton Local Hazard Mitigation Planning Team identified the following hazard mitigation goals for the Town:

Goal 1: Prevent and reduce the loss of life, injury, public health impacts and property damages resulting from all major natural hazards.

Goal 2: Identify and seek funding for measures to mitigate or eliminate each known significant flood hazard area.

Goal 3: Integrate hazard mitigation planning as an integral factor in all relevant municipal departments, committees and boards.

Goal 4: Prevent and reduce the damage to public infrastructure resulting from all hazards.

Goal 5: Encourage the business community, major institutions and non-profits to work with the Town to develop, review and implement the hazard mitigation plan.

Goal 6: Work with surrounding communities, state, regional and federal agencies to ensure regional cooperation and solutions for hazards affecting multiple communities.

Goal 7: Ensure that future development meets federal, state and local standards for preventing and reducing the impacts of natural hazards.

Goal 8: Take maximum advantage of resources from FEMA and MEMA to educate Town staff and the public about hazard mitigation.

Goal 9: Consider the potential impacts of future climate change. Incorporate climate sustainability and resiliency in hazard mitigation planning.

Goal 10: Address priority populations in the hazard mitigation process, including outreach and engagement, analysis of hazard impacts, and development and implementation of mitigation measures.

Goal 11: Take proactive measures to manage trees, invasive species and their impacts on public and private properties.

HAZARD MITIGATION STRATEGY

The Littleton Local Hazard Mitigation Planning Team identified a number of mitigation measures that would serve to reduce the Town's vulnerability to natural hazard events. These include reviewing the open space residential development bylaw, creating a beaver control plan and maintaining fire access roads.

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Overall, the hazard mitigation strategy recognizes that mitigating hazards for Littleton will be an ongoing process as our understanding of natural hazards and the steps that can be taken to mitigate their damages changes over time. Global climate change and a variety of other factors impact the Town's vulnerability now and in the future, and local officials will need to work together across municipal lines and with state and federal agencies in order to understand and address these changes. The Hazard Mitigation Strategy will be incorporated into the Town's other related plans and policies.

PLAN REVIEW & UPDATE PROCESS

The process for developing Littleton's Hazard Mitigation Plan 2025 Update is summarized in Table 1 below.

Table 1: Plan Review and Update Process

Section	Reviews and Updates
3 – Public Participation	The Local Hazard Mitigation Planning Team placed an emphasis on public participation for the update of the Hazard Mitigation Plan, discussing strategies to enhance participation opportunities at the first local committee meeting. During plan development, the plan was discussed at two public meetings hosted by the Planning Board and the Board of Selectmen. The plan was also available on the Town's website for public comment.
4 – Risk Assessment	MAPC gathered the most recently available hazard and land use data and met with town staff to identify changes in local hazard areas and development trends. Town staff reviewed critical infrastructure with MAPC staff in order to create an up-to-date list. MAPC also used the most recently available version of HAZUS to assess the impacts of flooding, hurricanes, and earthquakes.
5 - Goals	The Hazard Mitigation Goals were reviewed and endorsed by the Littleton Local Hazard Mitigation Planning Team.
6 – Existing Mitigation Measures	The list of existing mitigation measures was updated to reflect current mitigation activities in the town.
7 & 8 – Hazard Mitigation Strategy	Mitigation measures from the 2017 plan were reviewed and assessed as to whether they were completed, in-progress, or deferred. The Local Hazard Mitigation Planning Team determined whether to carry forward measures into the 2025 Plan Update or modify or delete them. The Plan Update's hazard mitigation strategy reflects both new

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	measures and measures carried forward from the 2017 plan. The Local Hazard Mitigation Team prioritized all of these measures based on current conditions.
9 – Plan Adoption & Maintenance	This section of the plan was updated with a new on-going plan for implementation review and a five-year update process that will assist the Town in incorporating hazard mitigation issues into other Town planning and regulatory review processes and better prepare the Town for the next comprehensive plan update.

As indicated on Table 43, Littleton made good progress on implementing mitigation measures identified in the 2017 Hazard Mitigation Plan. Several projects have been completed, including drainage improvements at New Estate Road and Nagog Hill Road, installation of a fiber back-up to the radio system, site plan review regulations on slope stabilization; adoption of a stormwater bylaw with operation and maintenance plans for impervious surfaces and alternative designs for impervious surfaces, and with location of additional snow storage areas. Several longer-term measures were partially completed, including purchase of a major open space parcel, revision of the Open Space Development bylaw, adoption of flexible zoning measures, beaver control measures, management of fire access roads, public education on wildfire hazards, installation of Green Roofs, public education on water use and drought, and inclusion of sustainability in the Master Plan and Open Space Recreation Plan.

For Littleton to succeed in reducing hazard risks over the long term, the information, ideas, conclusions, and strategic recommendations of this hazard mitigation plan should be integrated throughout government operations. Effective integration means to include mitigation principles, vulnerability information, and mitigation actions into other existing community planning mechanisms to leverage activities that have co-benefits, reduce risk, and increase resilience. 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.

Littleton's most recent integration of the previous 2017 Hazard Mitigation Plan was into its new Open Space and Recreation Plan (OSRP). The 2024 – 2031 OSRP outlines the importance of community sustainability and climate resilience strategies across various elements of this separate planning document. Other planning documents and processes that include hazard mitigation elements outlined in Littleton's 2017 HPM include the following:

- April 2017 Littleton Master Plan “cultivating the future” that guides sustainable development over a 10 to 15-year period.
- June 2018 Littleton Municipal Vulnerability Preparedness (MVP) Program planning Report on integrating climate change into Town planning.
- January 2019 Littleton Common Revitalization Road Map that guides redevelopment around Littleton Common, including public sewer, stormwater management, and use of other green infrastructure techniques.

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- January 2020 Littleton Station Village Vision Plan that encourages mixed-use development near the Commuter Rail station.
- June 2020 Town Meeting adoption of the Village Common Form-Based Code zoning to support revitalization of Littleton Common, providing a regulatory framework for new work and living opportunities in a thriving town center community.
- October 2021 Town Meeting adoption of the King Street Common mixed-use zoning district to allow comprehensive redevelopment of a vacant 40-acre office park near Littleton Common.
- August 2023 Bicycle and Pedestrian Master Plan that advances safe, convenient, and enjoyable biking, walking, and “rolling”, providing alternative transportation solutions.

Going forward, the Town will help to ensure that all new or updated local plan documents and bylaw updates are informed by and consistent with the goals and actions of this hazard mitigation plan and will not contribute to increased hazard vulnerability in Littleton.

Moving forward into the next five-year plan implementation period there will be many more opportunities to incorporate hazard mitigation into the Town's decision-making processes, plans, policies, and operations. The Town will document any actions taken within this iteration of the Hazard Mitigation Plan, including challenges met and actions successfully adopted as part of the ongoing plan maintenance to be conducted by the Littleton Hazard Mitigation Implementation Team, as described in Section 9, Plan Adoption and Maintenance.

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SECTION 2: INTRODUCTION

PLANNING REQUIREMENTS UNDER THE FEDERAL DISASTER MITIGATION ACT

The Federal Disaster Mitigation Act, passed in 2000, requires that after November 1, 2004, all municipalities that wish to continue to be eligible to receive FEMA funding for hazard mitigation grants, must adopt a local multi-hazard mitigation plan and update this plan in five-year intervals. This planning requirement does not affect disaster assistance funding.

Federal hazard mitigation planning and grant programs are administered by the Federal Emergency Management Agency (FEMA) in collaboration with the states. These programs are administered in Massachusetts by the Massachusetts Emergency Management Agency (MEMA) in partnership with the Department of Conservation and Recreation (DCR).

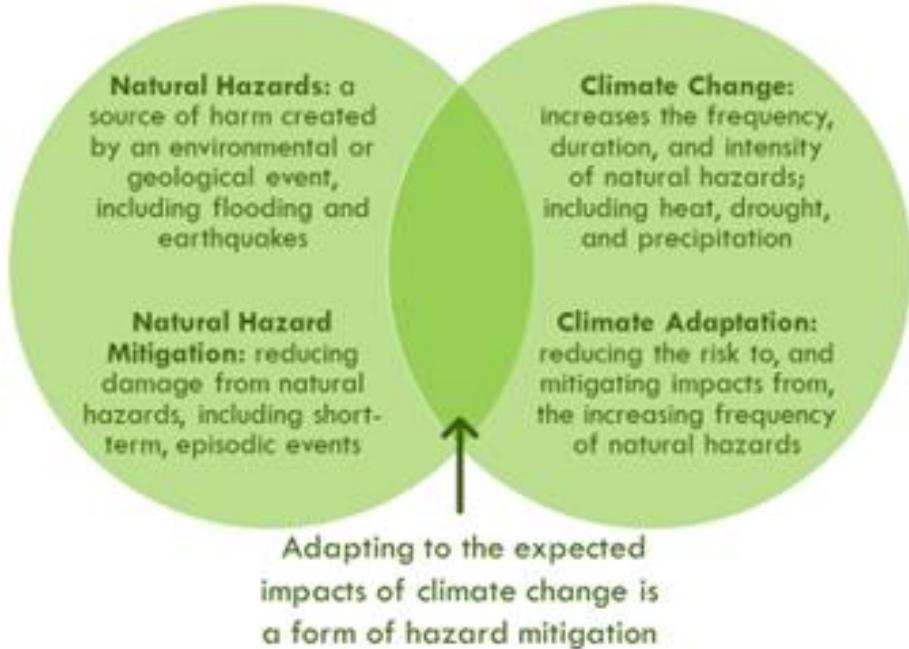
The Town of Littleton contracted with the Metropolitan Area Planning Council (MAPC), to assist the Town in updating its local Hazard Mitigation Plan, which was first adopted in 2010 as a multijurisdictional plan, and later updated in 2017. This Hazard Mitigation Plan 2025 Update is designed to meet the Town's requirements under the Disaster Mitigation Act for each community while listing regional concerns and hazards that impact the Town. MAPC is the state-designated Regional Planning Agency (RPA) serving the 101 communities in the greater Boston area. MAPC provided facilitation and technical support for Littleton for this project and has provided similar support for 90 municipalities in the region.

WHAT IS A HAZARD MITIGATION PLAN?

Natural hazard mitigation planning is the process of determining how to systematically reduce or eliminate the loss of life and property damage resulting from natural hazards such as floods, earthquakes, and hurricanes. Hazard mitigation means to permanently reduce or alleviate the losses of life, injuries, and property resulting from natural hazards through long-term strategies. These long-term strategies include planning, policy changes, programs, projects, and other activities. FEMA's 2022 Local Mitigation Planning Policy Guide recognized that adapting to the expected impacts of climate change is a form of hazard mitigation (FEMA, 2022). Therefore, this plan incorporates consideration of future risks due to projections for the increased frequency and severity of extreme weather fueled by a warming planet.

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Figure 1: Natural Hazards and Climate Change Overlap



PREVIOUS FEDERAL/STATE DISASTERS

Since 1991, there have been 25 natural hazard events that triggered Federal disaster declarations that included Middlesex County, which includes the Town of Littleton. These are listed in Table 2 below. The majority of these events involved flooding, while others were due to hurricanes or nor'easters, and severe winter weather.

Table 2: Previous Federal/State Disaster Declaration 1991-2023

Disaster Name	Date of Event	Declared Areas
Hurricane Bob	August 1991	Counties of Barnstable, Bristol, Dukes, Essex, Hampden, Middlesex, Plymouth, Nantucket, Norfolk, Suffolk
Severe Coastal Storm No Name Storm	October 1991	Counties of Barnstable, Bristol, Dukes, Essex, Middlesex, Plymouth, Nantucket, Norfolk, Suffolk
Blizzard	March 1993	Statewide
Blizzard	January 1996	Statewide
Severe Storms, Flood	October 1996	Counties of Essex, Middlesex, Norfolk, Plymouth, Suffolk
Heavy Rain, Flood	June 1998	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester

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Severe Storms, Flood	March 2001	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester
Snowstorm	March 2001	Berkshire, Essex, Franklin, Hampshire, Middlesex, Norfolk, Worcester
Snowstorm	February 2003	Statewide
Snowstorm	December 2003	Barnstable, Berkshire, Bristol, Essex, Franklin, Hampden, Hampshire, Middlesex, Norfolk, Plymouth, Suffolk, Worcester
Flooding	April 2004	Essex, Middlesex, Norfolk, Suffolk, Worcester
Snow	January 2005	Statewide
Hurricane Katrina	August 2005	Statewide
Severe Storms, Flooding	October 2005	Statewide
Severe Storms, Flooding	May 2006	Statewide
Severe Storm, Inland, Coastal Flooding	April 2007	Statewide
Severe Winter Storm	December 2008	Berkshire, Bristol, Essex, Franklin, Hampden, Hampshire, Middlesex, Suffolk, Worcester
Severe Storms, Flooding	December 2008	Statewide
Severe Storms, Flooding	March/April 2010	Bristol, Essex, Middlesex, Suffolk, Norfolk, Plymouth, Worcester
Severe Winter Storm, Snowstorm	January 2011	Berkshire, Essex, Hampden, Hampshire, Middlesex, Norfolk, Suffolk
Severe Storm, Snowstorm	October 2011	Berkshire, Franklin, Hampden, Hampshire, Middlesex, Worcester
Severe Winter Storm, Snowstorm, Flooding	February, 2013	Statewide
Severe winter storm, snowstorm, and flooding	April 2015	Barnstable, Bristol, Dukes, Essex, Middlesex, Nantucket, Norfolk, Plymouth, Suffolk, Worcester
Severe winter storm and Snowstorm	March 2018	Essex, Middlesex, Norfolk, Suffolk, Worcester

Source: database provided by MEMA

In addition to Federal disaster declarations the Commonwealth of Massachusetts has declared state emergencies fourteen times since 2011. Eight of these emergencies were related to natural hazards such as winter storms, Nor'easters, flooding, and hurricanes (Table 3).

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Table 3: Massachusetts State Declared Emergencies

Declaration Date	Termination Date	Event
9/15/23	9/16/23	Hurricane Lee
9/12/23	9/16/23	Severe Weather & Flooding
2/9/15	2/25/15	Winter Storm
1/26/15	1/28/15	Winter Storm
2/8/13	2/13/13	Winter Storm
10/27/12	11/1/12	Hurricane Sandy
10/29/11	11/7/11	Nor'easter
8/26/11	9/6/11	Hurricane Irene

Source: Massachusetts Emergency Management Agency [State of Emergency Information | Mass.gov](https://www.mass.gov/info-details/state-of-emergency-information)

FEMA FUNDED MITIGATION PROJECTS

The Town of Littleton has not received funding from FEMA for mitigation projects under the various Hazard Mitigation Grant Programs.

COMMUNITY PROFILE

Littleton is located in Middlesex County in Northeastern Massachusetts and is bordered by Ayer and Harvard on the west, Groton on the northwest, Westford on the northeast, Acton on the southeast, and Boxborough on the south. Littleton is about 12 miles south of Lowell, 20 miles east of Fitchburg, and 26 miles northwest of Boston. Littleton is serviced by State Routes 2, 2A, 110, and 119, and Interstate Route 495. Commuter rail service is available to North Station in Boston. Freight rail service is available from the Springfield Terminal Railway. Littleton is a member of the Montachusett Regional Transit Authority (MART), which provides paratransit services to the elderly and disabled through the Council on Aging. The closest airport to Littleton is the Fitchburg Municipal Airport.

The town is governed by a five-member Select Board and a Town Administrator. The town operates under the open town meeting format. The Town Manager, appointed by the Selectmen, carries out the day-to-day governing functions of the town.

The Town of Littleton was incorporated in 1715. At the time, the town was primarily agricultural. Over time, the Town established a significant cider industry as well as brick and tile industry, based on the local clay deposits. The town still has an active dairy farm, several vegetable farms, and has preserved several 18th century center-chimney houses and unique brick cottages. Recent development has been primarily suburban, but much of the community has retained its original character.

There are about 6755 jobs in Littleton, most of which historically were centered around tourism, the town center and agriculture. Littleton's proximity to Interstate 495 and Route 2 has made it ideal for technology companies.

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According to the 2020 Census, just over 10,134 people live in Littleton. Of the town's 3,504 housing units, approximately 650 were built before 1940.

Some of Littleton's unique characteristics to keep in mind include:

- Littleton's small-town character and historic agricultural lands are still present, with a significant amount of open space preserved or in the process of acquisition.
- Littleton contains major transportation infrastructure such as Route 2, Route 495 and the MBTA commuter rail which draws residents who commute to the Boston area.
- Littleton is continuously growing with numerous developments, both residential and commercial.
- Littleton houses a technology-oriented job base.
- Littleton relies solely on subsurface wells for drinking water and has a very active water department and stringent aquifer protection regulations.

The Town of Littleton maintains a website at <http://www.littletonma.org/>

The significant demographic characteristics of the Town of Littleton are summarized in Table 4. Some of these features are important to keep in mind for hazard mitigation as well as emergency preparedness and response in the town.

Table 4: Town of Littleton Characteristics

Population	
Total population	10,134
Residents under 5 years old	6%
Residents 65 years old and over	16.3%
Race & Ethnicity	
American Indian and Alaska Native	0.1%
Asian	5.8%
Black or African American	0.1%
Native Hawaiian and Pacific Islander	0.0
White	89.7%
Other Race	
Two or More Races	2.9%
Hispanic or Latino	2%
White alone, Not Hispanic or Latino	88.6%
Household Income	
Occupied Housing Units	3,504
Mean Household Income	\$140,511
Housing units built before 1960	1,270
Renter occupied housing units	7.6%
Languages	
Speak a language other than English at home	8.7%
Spanish	1.0%

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Other Indo-European languages	2.7%
Asian and Pacific Island languages	2.9%
Other languages	2.1%
Speaks English less than "very well"	1.4%
Additional Information	
Residents with a Disability	9.9%
Age 65 to 74 with a disability	12.9%
Age 75 and over with a disability	48.2%
Residents in Poverty	6.3%
Households with no vehicle	0.4%

Sources: 2020 Decennial Census and American Community Survey (ACS) 5-Year Estimates (US Census Bureau, 2021)

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SECTION 3: PLANNING PROCESS & PUBLIC PARTICIPATION

PLANNING PROCESS SUMMARY

MAPC employs a six-step planning process based on FEMA's hazard mitigation planning guidance focusing on local needs and priorities, but maintaining a regional perspective matched to the scale and nature of natural hazard events. Public participation is a central component of this process, providing critical information about the local occurrence of hazards while also serving as a means to build a base of support for hazard mitigation activities. MAPC supports participation by the general public and other plan stakeholders through:

- Meetings and work with the Local Teams
- Two public meetings, shared on Local Access TV and advertised through email, webpage content, a flyer, press release to local media, and social media posts,
- A project website at: www.mapc.org/resource-library/littleton-hmp and a dedicated email for public comments,
- Launching a public comment period at the second public meeting, and posting the draft plan to the project website to facilitate public review,
- Outreach to neighboring communities, Town boards and commissions, the local chamber of commerce and businesses, and other local or regional entities.

The six-step planning process outlined in Figure 2 is based on the guidance provided by FEMA in the Local Multi-Hazard Mitigation Planning Guidance. Public participation is a central element of this process, which attempts to focus on local problem areas and identify needed mitigation measures based on where gaps occur in the existing mitigation efforts of the municipality. By working on municipal hazard mitigation plans in groups of neighboring cities and towns, MAPC is able to identify regional opportunities for collaboration and facilitate communication between communities. In plan updates, the process described below allows staff to bring the most recent hazard information into the plan, including new hazard occurrence data, changes to a municipality's existing mitigation measures, and progress made on actions identified in previous plans.

Figure 2: Six-Step Planning Process



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- **Map the Hazards** – MAPC relies on data from a number of different federal, state, and local sources in order to map the areas with the potential to experience natural hazards. This mapping represents a multi-hazard assessment of the municipality and is used as a set of base maps for the remainder of the planning process. A particularly important source of information is the knowledge drawn from local municipal staff on where natural hazard impacts have occurred. These maps can be found in Appendix A.
- **Assess the Risks & Potential Damages** – Working with local staff, critical facilities, infrastructure, vulnerable populations, and other features are mapped and contrasted with the hazard data from the first step to identify those that might represent particular vulnerabilities to these hazards. Land use data and development trends are also incorporated into this analysis. In addition, MAPC develops estimates of the potential impacts of certain hazard events on the community. MAPC drew on the following resources to complete the plan:
 - Blue Hills Observatory
 - Town of Littleton, Annual Report 2022
 - Code of the Town of Littleton
 - Commonwealth of Massachusetts, Resilient MA Plan, 2023
 - Commonwealth of Massachusetts, State Hazard Mitigation and Climate Adaptation Plan (SHMCAP), 2018 and 2023
 - Commonwealth of Massachusetts, MA Climate Change Assessment, 2022
 - DCR, Community Information System, Community Overview, 2022
 - DCR, Massachusetts State Dam Inventory, 2012
 - FEMA, Disaster Declarations for States and Counties, 2023
 - Town of Littleton Master Plan 2017
 - Town of Littleton Plan for 2030 (public input)
 - Town of Littleton Open Space and Recreation Plan, 2016
 - Town of Littleton Capital Plan 2017 Review of Requests
 - FEMA, Flood Risk Report, Concord River Watershed, 2/27/2013
 - FEMA, Local Mitigation Plan Review Guide; October 1, 2011
 - FEMA, Flood Insurance Rate Maps for Middlesex County, MA, 2012
 - FEMA, Flood Insurance Study for Middlesex County, Updated 2021
 - FEMA, Local Mitigation Planning Policy Guide, 2022
 - Massachusetts Office of Dam Safety, Inventory of Dams, 2018
 - Metropolitan Area Planning Council, GIS Lab, Regional Plans and Data.
 - New England Seismic Network, Boston College Weston Observatory,
 - NOAA National Centers for Environmental Information,
 - Northeast States Emergency Consortium
 - US Census, 2020, American Community Survey
 - USDA Forest Service, Wildfire Risk to Communities
 - USGS, National Water Information System,
 - US Global Change Research Program, Fourth National Climate Assessment, 2018
 - USACE Ice Jam Database

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- **Review Existing Mitigation** – Municipalities in the Boston Metropolitan Region have an active history in hazard mitigation as most have adopted flood plain zoning districts, wetlands protection programs, and other measures as well as enforcing the State building code, which has strong provisions related to hazard resistant building requirements. All current municipal mitigation measures must be documented.
- **Develop Mitigation Strategies** – MAPC works with the local municipal staff to identify new mitigation measures, utilizing information gathered from the hazard identification, vulnerability assessments, and the community's existing mitigation efforts to determine where additional work is necessary to reduce the potential damages from hazard events. Additional information on the development of hazard mitigation strategies can be found in Section 8.
- **Plan Approval & Adoption** – Once a final draft of the plan is complete it is sent to MEMA for the state level review and, following that, to FEMA for approval. Typically, once FEMA has approved the plan, the agency issues a conditional approval (Approval Pending Adoption), with the condition being adoption of the plan by the municipality. More information on plan adoption can be found in Chapter IX and documentation of plan adoption can be found in Appendix D.
- **Implement & Update the Plan** – Implementation is the final and most important part of any planning process. Hazard Mitigation Plans must also be updated on a five-year basis making preparation for the next plan update an important on-going activity. Chapter IX includes more detailed information on plan implementation.

2017 PLAN IMPLEMENTATION & MAINTENANCE

The 2017 Town of Littleton Hazard Mitigation Plan contained a risk assessment of identified hazards for the Town and mitigation measures to address the risk and vulnerability from these hazards. As indicated on Table 43, Littleton made good progress on implementing numerous mitigation measures identified in the 2017 plan. Projects that have been completed include drainage improvements at New Estate Road and Nagog Hill Road, installation of a fiber back-up to the radio system, site plan review regulations on slope stabilization; adoption of a stormwater bylaw with operation and maintenance plans for impervious surfaces and alternative designs for impervious surfaces, and with location of additional snow storage areas.

Several longer-term measures were partially completed, including purchase of a major open space parcel, revision of the Open Space Development bylaw, adoption of flexible zoning measures, beaver control measures, management of fire access roads, public education on wildfire hazards, installation of Green Roofs, public education on water use and drought, and inclusion of sustainability in the Master Plan and Open Space Recreation Plan.

In addition, the Town completed a Municipal Vulnerability Preparedness planning process in 2018 and has been designated an MVP Community by the Executive Office of Energy and Environmental Affairs. The MVP Plan incorporated data from Littleton's Hazard Mitigation Plan such as the assessment of critical infrastructure and local hazard vulnerability. Several mitigation actions discussed at the MVP workshop were reviewed by the local team in considering the mitigation strategy for this plan update.

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THE LOCAL HAZARD COMMUNITY PLANNING TEAM

MAPC worked with the local community representatives to organize a Local Hazard Mitigation Planning Team for Littleton. MAPC briefed the local representatives as to the desired composition of that team as well as the need for public participation in the local planning process.

The Local Hazard Mitigation Planning Team is central to the planning process as it is the primary body tasked with developing a mitigation strategy for the community. The local team was tasked with working with MAPC to set plan goals, provide information on the hazards that impact the town, existing mitigation measures, and help to develop new mitigation measures for this plan update. The Local Hazard Mitigation Planning Team membership can be found in Table 5.

The Littleton Planning Board, as well as the Littleton Conservation Commission, are the primary entities responsible for regulating development in town. Feedback from the Planning Board and the Conservation Commission was assured through the participation of the Planning Administrator, Conservation Coordinator and both the Town Administrator and Assistant Town Administrator. In addition, MAPC, the State-designated regional planning authority for Littleton, works with all agencies that regulate development in the region, including the listed municipal entities and state agencies, such as MassDOT.

Table 5 - Littleton Hazard Mitigation Planning Team

Maren Toohill	Town Planner
Cooper Mathews	Assistant Town Planner
Matthew Pinard	Police Chief
Jeff Patterson	Deputy Police Chief
Stephen Jahnle	DPW Director
James Duggan	Town Administrator
Ryan Ferrara	Assistant Town Administrator
Liz Tretiak	Elder and Human Resources
Amy Green	Conservation Coordinator
Nick Lawler	General Manager, Littleton Electric Light and Water Dept.
Dave Ketchen	Assistant Manager, Littleton Electric Light and Water Dept.
Tom Clancy	Interim Fire Chief
Sean Coffey	Deputy Fire Chief
Francis Dagle	Health Director
Dan Kane	Board of Health member
James Garreffa	Health Agent
Sarah Rambacher	Sustainability Committee, Chair
Don MacIver	Sustainability Committee, Member

The Local Team met four times on the dates listed below. The agendas for these meetings are included in Appendix C. The topics of each meeting are summarized below. The agendas for these meetings are included in Appendix B.

TOWN OF LITTLETON HAZARD MITIGATION PLAN 2025 UPDATE

- **July 10, 2023:** discuss the project overview and update the inventory and GIS maps of local flood and fire hazard areas and critical facilities.
- **September 27, 2023:** update the hazard mitigation goals and review the current status of the existing mitigation measures, and prepare for Public Meeting #1
- **January 4, 2024:** Review the status of the recommended mitigation from the 2017 plan and determine which measures should be retained in the 2023 plan.
- **April 4, 2024:** to develop new recommended mitigation measures and prepare for Public Meeting #2.

PUBLIC MEETINGS

Public participation in the hazard mitigation planning process is important, both for plan development and for later implementation of the plan. Residents, business owners, and other community members are an excellent source for information on the historical and potential impacts of natural hazard events and particular vulnerabilities the community may face from these hazards. Their participation in this planning process also builds understanding of the concept of hazard mitigation, potentially creating support for mitigation actions taken in the future to implement the plan. To gather this information and educate residents on hazard mitigation, the Town hosted two public meetings, one during the planning process and one after a complete draft plan was available for review. Several public comments were received and can be found in Appendix C.

One of the best strategies for increasing the impact of local meetings is to invite one of the municipal boards or commissions to host the public discussion of the hazard mitigation plan. With this strategy, the meeting receives widespread advertising and a guaranteed audience of the board or commission members plus those members of the public who attend the meeting. These board and commission members represent an engaged audience that is informed and up to date on many of the issues that relate to hazard mitigation planning in the locality and will likely be involved in plan implementation, making them an important audience with which to build support for hazard mitigation measures. In addition, these meetings frequently receive press coverage, expanding the audience that has the opportunity to hear the presentation and provide comments.

The public had an opportunity to provide input to the Littleton hazard mitigation planning process during a meeting on November 16, 2023, held in the Planning Board Room of the Town Hall. The draft plan update was presented at a Select Board meeting on May 28, 2024, at the Reuben Hoar Library. Both meetings were publicized in accordance with the Massachusetts Public Meeting Law. See public meeting notices in Appendix C.

LOCAL STAKEHOLDER INVOLVEMENT

The Hazard Mitigation Planning Team reached out to local stakeholders that might have an interest in the Hazard Mitigation Plan including neighboring communities, agencies, businesses, nonprofits, and other interested parties. Notice was sent to the following organizations and neighboring towns inviting them to attend the meeting and review the Hazard Mitigation Plan:

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Local Communities

- Town of Boxborough
- Town of Acton
- Town of Westford
- Town of Groton
- Town of Ayer
- Town of Harvard

Businesses & Employers

- Acton Medical
- Acton Toyota
- Amazon
- CVS
- Donelan's Super Market
- FIBA Technology
- Littleton Cinemas (now closed)
- Concord Lumber and Building Center
- Market Basket
- Nashoba Valley Life Care
- Patriot Beverages

Faith-Based Organizations

- Blessed Trinity Parish, St. Anne Church
- Boston MetroWest Bible Church
- Congregational Church of Littleton
- First Baptist Church of Littleton
- First Church Unitarian
- First Littleton Partnership
- The Church of Jesus Christ of Latter-Day Saints

Schools, Camps

- Camp Nashoba
- Littleton Public Schools
- Littleton Park & Rec.
- Oak Meadow Montessori School
- Mill Pond
- Pine Tree Park
- Pondside at Littleton
- Rodgers Family Holdings
- Village Green Littleton

The flyer sharing information about the plan, found in appendix C, was disseminated in the following ways:

- Posted on Planning Board page of town website
- “News Blast” from IT on town website
- Posted on Littleton Community Television
- Delivered copies of flyer to business around Town by hand
- Emailed flyer to Town boards/committees

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See Appendix C for public meeting notices and an example of the email that was sent to companies.

As shown on Map 1A (Appendix A), the Town of Littleton does not have any Environmental Justice populations as defined by the Commonwealth. Criteria for designated Environmental Justice areas include income, race, and English language proficiency. As shown in Table 4 above, the Town's median household income is \$140,511, and its population is 88.6% white. 8.7% of Littleton's population speaks a language other than English at home.

Given that the Town of Littleton is a community above the median age for Massachusetts communities and its continuing trend towards greater aging, the Town considers this portion of the community population and their needs as important to sound and effective plans for hazard mitigation and climate change adaptation. People over age 65 make up 16.3% of the Town's population (Table 5). The Town's local contacts for community outreach included Elder and Human Resources.

The draft Littleton Hazard Mitigation Plan 2025 Update was posted on the Town's website for the second public meeting. Members of the public could access the draft document and submit comments or questions to the Town.

CONTINUING PUBLIC PARTICIPATION

Following the adoption of the plan update, the Littleton Hazard Mitigation Team will continue to provide residents, businesses, and other stakeholders the opportunity to learn about the hazard mitigation planning process and to contribute information that will update the town's understanding of local hazards. The Littleton Fire Chief will act as the coordinator for the Team. As updates and a review of the plan are conducted by the Hazard Mitigation Implementation Team, these will be placed on the Town's web site, and any meetings of the Hazard Mitigation Implementation Team will be publicly noticed in accordance with town and state open meeting laws.

PLANNING TIMELINE

PLAN UPDATE PROCESS

Major milestones in the planning process to prepare this plan update included the following:

July 10, 2023	1 st meeting of the Littleton Hazard Mitigation Team
September 27, 2023	2nd meeting of the Littleton Hazard Mitigation Team
November 16, 2023	First Public Meeting before the Planning Board
January 4, 2024	3 rd meeting of the Littleton Hazard Mitigation Team
April 4, 2024	4th meeting of the Littleton Hazard Mitigation Team
May 28,br 2024	Second Public Meeting before the Select Board
July 17, 2024	Draft Plan Update submitted to MEMA
September 9, 2024	Comments on the Draft Plan received from MEMA

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February 7, 2025	Revised Draft Plan Update submitted to MEMA
April 23, 2025	Plan Review Tool Received from FEMA
May 17, 2025	Revised Draft Plan submitted to MEMA
June 4, 2025	Approval Pending Adoption notice issued by FEMA
June 23, 2025	Plan Adopted by the Town (Select Board vote)
TBD	FEMA Approval of the Plan

PLAN IMPLEMENTATION MILESTONES 2023-28

After this plan update is approved by FEMA for a five-year period, the Littleton should take note of the following milestones for the ongoing implementation, review, and updating of this plan:

2027	Conduct Mid-Term Plan Survey on Progress
2028	Seek FEMA grant to prepare next plan update
2029	Begin process to update the plan
2030	Submit Draft 2029 Plan Update to MEMA and FEMA
2029	FEMA approval of 2029 Plan Update39

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SECTION 4: RISK ASSESSMENT

The risk assessment analyzes the potential natural hazards that could occur within the Town of Littleton as well as the relationship between those hazards and current land uses, potential future development, and critical infrastructure. This section also includes a vulnerability assessment that estimates the potential damages that could result from certain large scale natural hazard events.

In order to update Littleton's risk assessment, MAPC gathered the most recently available hazard and land use data and met with Town staff to identify changes in local hazard areas and development trends. MAPC also used FEMA's damage estimation software, HAZUS (described below).

"Global climate is changing rapidly compared to the pace of natural variations in climate that have occurred throughout Earth's history. Global average temperature has increased by about 1.8°F from 1901 to 2016, and observational evidence does not support any credible natural explanations for this amount of warming; instead, the evidence consistently points to human activities, especially emissions of greenhouse or heat-trapping gases, as the dominant cause."

Fourth National Climate Assessment, 2018 (Chapter 2-1)

The projected impacts of our warming climate on natural hazards are integrated throughout this risk assessment. Key impacts include rising temperatures, which in turn affect precipitation patterns and extreme weather. Analysis of these impacts included in this plan aligned closely with the data and assessment presented in Massachusetts' 2018 State Hazard Mitigation and Climate Adaptation Plan (2018 SHMCAP) and the Massachusetts' 2022 Climate Change Assessment.

CLIMATE CHANGE OBSERVATIONS AND PROJECTIONS

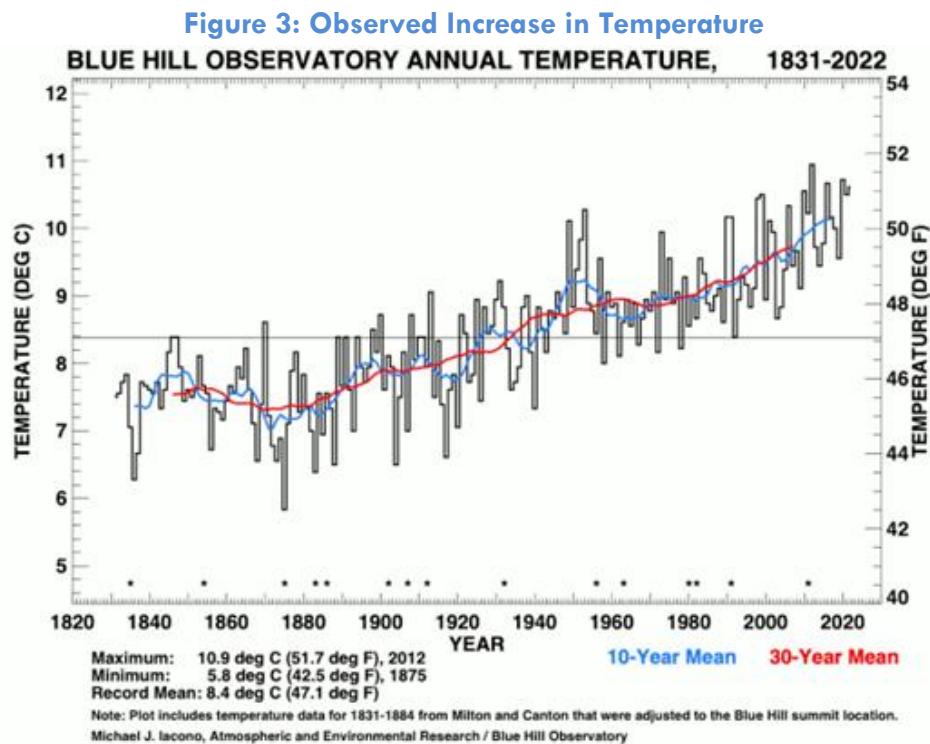
Climate change observations come from a variety of data sources that have measured and recorded changes in recent decades and centuries. Climate change projections, however, predict future climate impacts and, by their nature, cannot be observed or measured. As a result of the inherent uncertainty in predicting future conditions, climate projections are generally expressed as a range of possible impacts.

TEMPERATURE

Our climate has always been regulated by gases, including carbon dioxide, methane, and nitrous oxide, which blanket the earth. These gases trap heat that would otherwise be reflected out to space; without them our planet would be too cold to support life. We refer to these gases as "greenhouse gases" (GHGs) for their heat trapping capacity. The combustion of fossil fuels, our primary energy source in the age of industrialization, releases GHGs into the atmosphere. In the past century, human activity associated with industrialization has contributed to a growing concentration of GHGs in our atmosphere. According to the Resilient MA: Climate Change Clearinghouse for the Commonwealth website, Massachusetts has experienced a recorded 3.5°F increase in average temperatures since 1900. Average temperatures during the winter are expected to increase more than average summer temperatures, resulting in less snow and ice,

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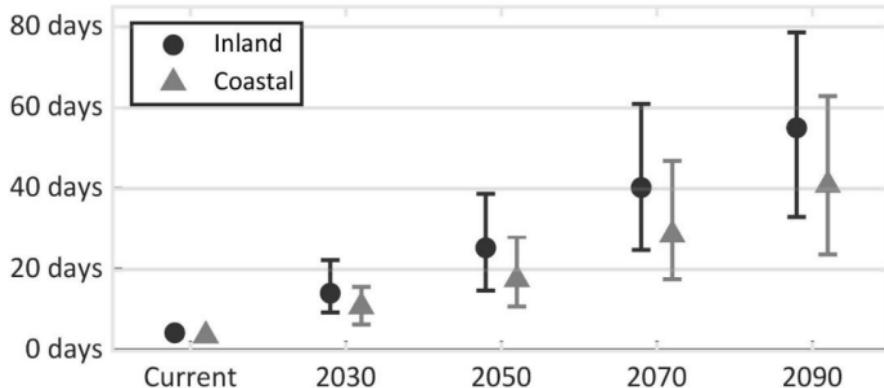
increased invasive species, challenging timber harvests, and other issues related to increasing hazard intensity. Also, according to the Resilient MA website, with increased temperatures, extreme heat days (days with temperatures over 90 degrees) will also increase across the state, increasing public health implications such as heat-related illness and mortality. Between 1971 and 2000, the Commonwealth experienced four days with temperatures over 90°F. By mid-century, it is expected to experience between 10 and 28 such days. Records from the Blue Hill Observatory in Milton, MA show that average temperatures (30-year mean) have risen approximately 3 degrees (F) in the almost 200 years since record keeping began in 1831. See Figure 3 below for more information.



Climate projections include an increase in average temperature and in the number of extreme heat days. Extreme cold days are projected to decrease in number. By 2030, the summer mean temperature could increase by 3.6°F from the historical period (1950-2013). By 2070, there could be 58 fewer days below freezing, which could lead to an increase in ticks. By mid-century, the State anticipates about 25 more days per year where the temperature exceeds 90°F for inland areas, and about 19 more days above 90°F for coastal areas (Commonwealth of Massachusetts, 2022).

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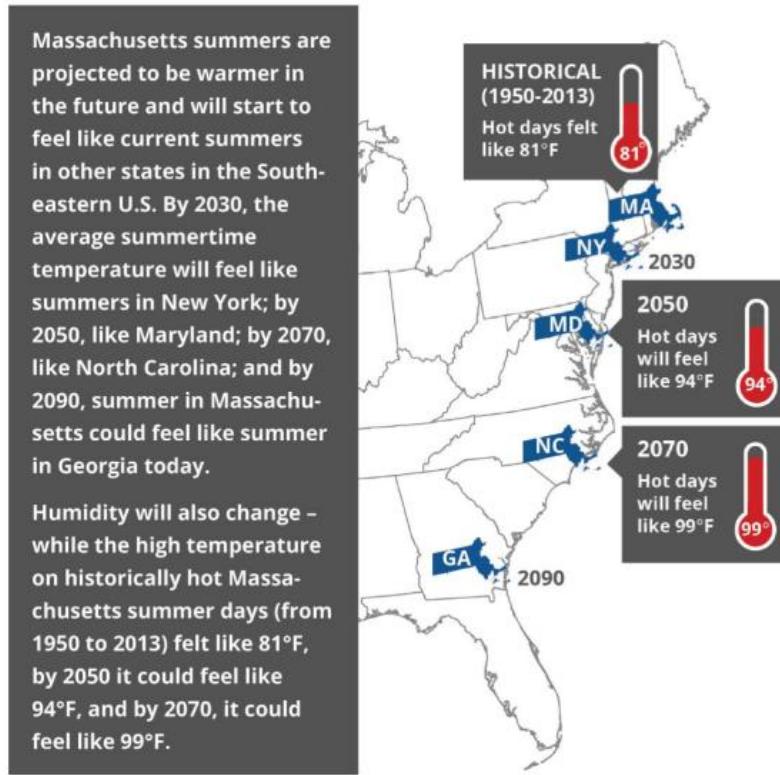
Figure 4: Change in the Annual Number of Days Over 90°F Compared to Today



Sources: 2022 MA Climate Change Assessment and Stochastic Weather Generator

These changes could result in Massachusetts summers feeling like a more southern state, as described in the infographic in Figure 5 from the State's 2022 Climate Change Assessment.

Figure 5: Change in Average Summertime Temperatures for Massachusetts



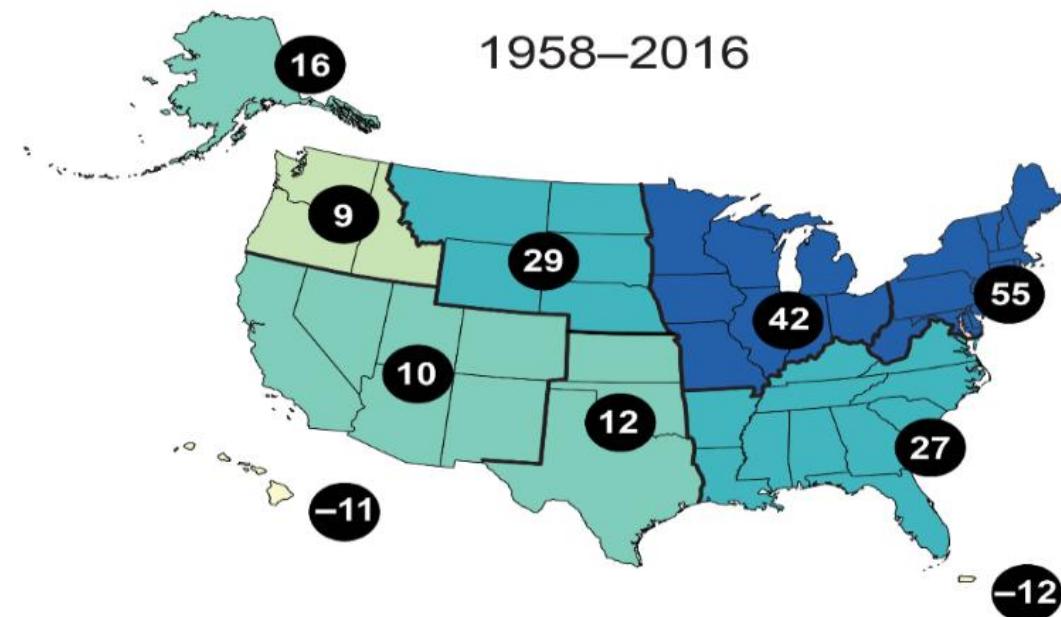
Source: 2022 MA Climate Change Assessment

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PRECIPITATION PATTERNS

Annual precipitation in Massachusetts has increased by approximately 10% in the fifty-year period from 1960 to 2010 (MA EEA, 2011). Moreover, there has been a significant increase in the frequency and intensity of large rain events. For the Northeast US, according to the Fourth National Climate Assessment 2018, in the past sixty years there has been a 55% increase in the amount of annual precipitation that falls in the top 1% of storm events, as shown in Figure 6 below (US Global Change Research Program, 2018). Changes in precipitation are fueled by warming temperatures which increase evaporation and, therefore, the amount of water vapor in the air.

Figure 6: Observed Change in Total Annual Precipitation in the Heaviest 1% Events



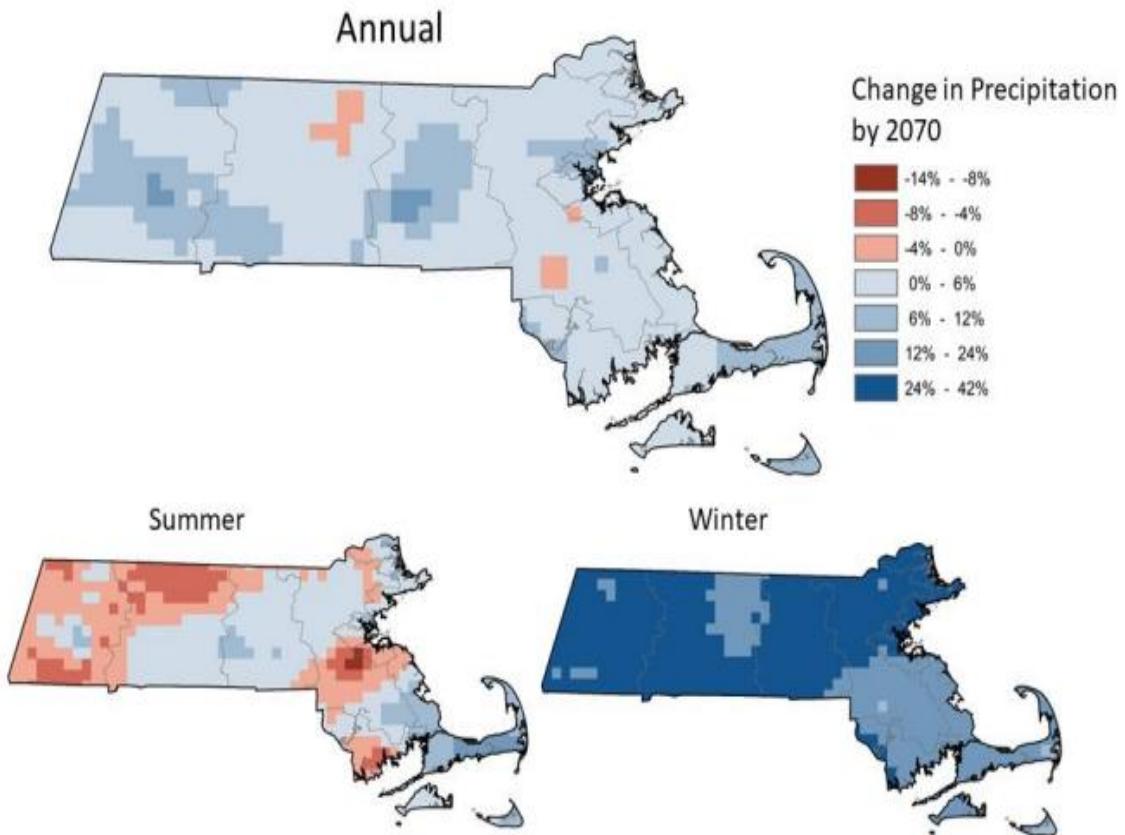
Source: Fourth National Climate Assessment, 2018
Numbers circled in black indicate % change.

Massachusetts' 2022 Climate Change Assessment anticipates that most parts of the State will see a future increase in annual total precipitation of less than 8% per year. Most of these increases are anticipated during the winter months (see Figure 7 below).

Additionally, the historic 10% annual chance daily rainfall event (2.8-4.0" of rain) could occur four times more frequently by 2090 (Commonwealth of Massachusetts, 2022).

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Figure 7: Change in Annual and Seasonal Precipitation in 2070 Compared to Today



Source: 2022 MA Climate Change Assessment. Current climate is the 1986-2005 era, the projection for 2070 is for a 20-year era centered on 2070. Maps show LOCA downscaled GCM projections at the 50th percentile across 20 LOCA GCMs that overlap with the GCMs used in the Stochastic Weather Generator.

Despite overall increasing precipitation, more frequent and significant summer droughts are also a projected consequence of climate change. This is due to projections that precipitation will increase in winter and spring and decrease slightly in the summer and, as a result of earlier snow melt, and higher temperatures that will reduce soil moisture. Massachusetts' 2022 Climate Change Assessment anticipates that these changes will vary by region. The Eastern Inland region where Littleton is located may experience slightly more consecutive dry days, and significantly more days without rain per year, by 2090 (Commonwealth of Massachusetts, 2022). See Figure 8 below for more information.

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Figure 8: Consecutive dry day events (number of multiple-dry-day events per year)

Panel A: Consecutive dry day events (number of multiple-dry-day events per year)

Region	Baseline	2030	2050	2070	2090
Berkshires & Hilltowns	29	29	30	30	31
Greater Connecticut River Valley	31	31	32	32	33
Central	32	32	32	33	33
Eastern Inland	32	32	32	33	33
Boston Harbor	31	31	32	32	33
North & South Shores	31	31	32	32	33
Cape, Islands, & South Coast	31	31	32	32	33
Statewide	31	31	31	32	33
Statewide Percent Change	0%	1%	2%	4%	6%

Source: Stochastic Weather Generator

Panel B: Annual number of days without rain (days per year)

Region	Baseline	2030	2050	2070	2090
Berkshires & Hilltowns	159	161	165	167	170
Greater Connecticut River Valley	171	172	175	178	181
Central	180	182	185	188	192
Eastern Inland	186	181	185	188	193
Boston Harbor	192	185	192	194	198
North & South Shores	184	182	187	190	195
Cape, Islands, & South Coast	186	182	187	191	194
Statewide	176	175	179	182	187
Statewide Percent Change	0%	-1%	2%	3%	6%

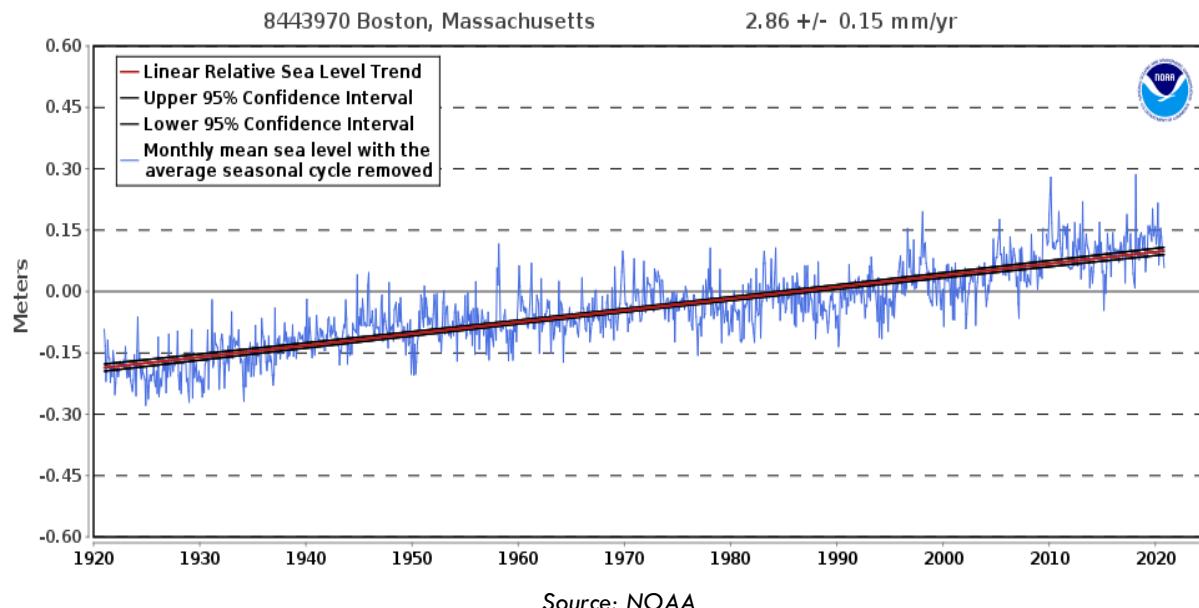
Source: 2022 MA Climate Change Assessment.

SEA LEVEL RISE

While Littleton is not a coastal community, high-level information on sea level rise is discussed here as the regional economy of the Boston Metro area may be impacted by sea level rise in the future. Warming temperatures contribute to sea level rise in three ways. First, warm water expands to take up more space. Second, rising temperatures are melting land-based ice which enters the oceans as melt water. A third, quite minor, contributor to sea level rise in New England is not related to climate change. New England is still experiencing a small amount of land subsidence (drop in elevation) in response to the last glacial period. NOAA's records from the Boston Tide Station show nearly one foot of sea level rise over the past century. See Figure 9 below for more information.

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Figure 9: Observed Increase in Sea Level Rise



The sea level rise information in Massachusetts' 2022 Climate Change Assessment considers sea-level changes, land-level changes, and other regional facts that can impact the rate of change. The report includes the following approximate sea level rise projections for the State:

- **Northern Massachusetts:** 21 inches by 2050, and 43 inches by 2070
- **Southern Massachusetts:** 23 inches by 2050 and 45 inches by 2070

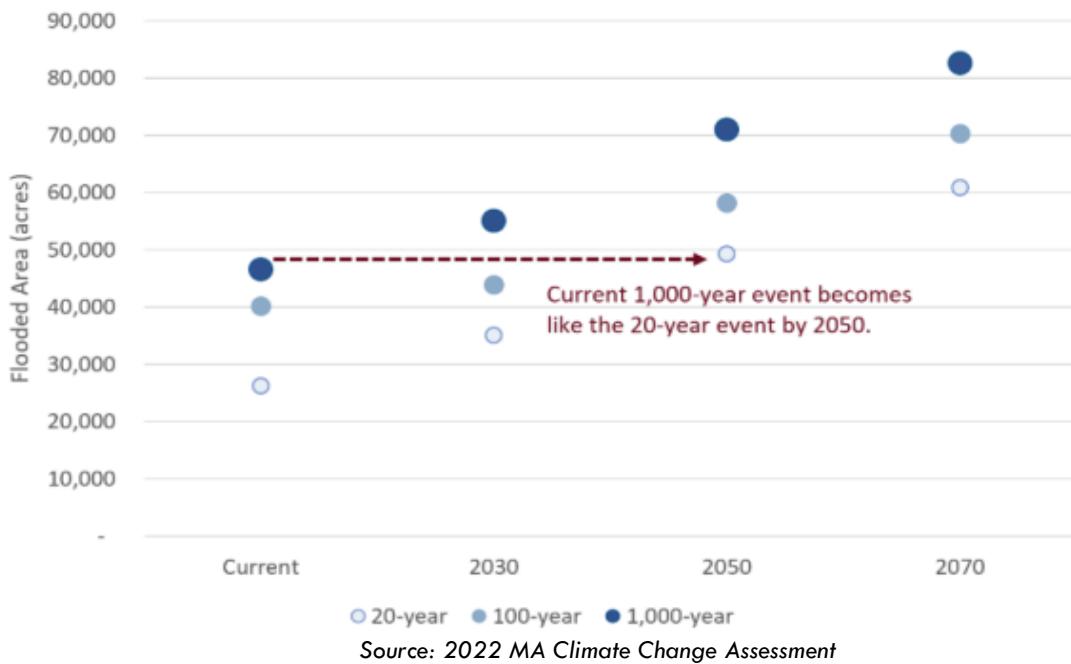
The 2022 Climate Change Assessment also quantified the developed land area flooded for events including:

- the 20-year (5% annual probability)
- 100-year (1% probability)
- 1000-year (0.1% probability) events

This approach found that the area flooded by the current 1000-year event is comparable to the area of a 20-year event by 2050. Even more areas could be impacted by the annual probability event by 2070. See Figure 10 below for more information.

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Figure 10: Total Flooded Area of the Commonwealth for Selected Events



Following the outline of the 2018 Massachusetts State Hazard Mitigation and Climate Adaptation Plan (SHMCAP), this local hazard mitigation plan organizes consideration of natural hazards based on their relationship to projected climate changes. The table below, which is originally from the SHMCAP, summarizes the natural hazards reviewed in this plan, climate interactions, and expected impacts.

Table 6: Climate Change & Natural Hazards

Primary Climate Change Interaction	Natural Hazard	Other Climate Change Interactions	Representative Climate Change Impacts
 Change in Precipitation	Inland Flooding	Extreme Weather	Flash flooding, urban flooding, drainage system impacts (natural and human-made), lack of groundwater recharge, impacts to drinking water supply, public health impacts from mold and worsened indoor air quality, vector-borne diseases from stagnant water, increased potential for loss of life, episodic drought, changes in snow-rain ratios, changes in extent and duration of snow cover, degradation of stream channels and wetland
	Drought	Rising Temperatures, Extreme Weather	
	Landslide	Rising Temperatures, Extreme Weather	

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 Sea Level Rise	Coastal Flooding	Extreme Weather	Increase in tidal and coastal floods, storm surge, coastal erosion, marsh migration, inundation of coastal and marine ecosystems, loss of wetlands
	Coastal Erosion	Extreme Precipitation	
	Tsunami	Rising Temperatures	
 Rising Temperatu res	Average/Extreme Temperatures	N/A	Shifting in seasons (longer summer, early spring, including earlier timing of spring peak flow), increase in length of growing season, increase of invasive species, increase in vector-borne illnesses (West Nile, Zika, EEE), ecosystem stress, energy brownouts from higher energy demands, more intense heat waves, public health impacts from high heat exposure and poor outdoor air quality, increased potential for loss of life, drying of streams and wetlands, eutrophication of lakes and ponds
	Wildfires	Changes in Precipitation	
	Invasive Species	Changes in Precipitation, Extreme Weather	
 Extreme Weather	Hurricanes/Tropical Storms	Rising Temperatures, Changes in Precipitation	Increase in frequency and intensity of extreme weather events, resulting in greater damage to natural resources, property, and infrastructure, as well as increased potential for loss of life
	Severe Winter Storm / Nor'easter		
	Tornadoes		
	Other Severe Weather (Strong Wind & Thunderstorms)		

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OVERVIEW OF HAZARDS AND IMPACTS

In order to update Littleton risk assessment, MAPC gathered the most recently available hazard and land use data and met with Town staff to identify changes in local hazard areas and development trends. The Resilient MA Plan, the SHMCAP (2018) and the State Hazard Mitigation Plan (2013) are key planning documents that examine natural hazards that have the potential to impact the Commonwealth. The 2013 State HMP set the stage by defining considerations such as frequency and severity and summarizing the frequency and severity of hazards of greatest concern. The 2018 SHMCAP used similar definitions for hazard considerations and expanded on this research by including additional climate projections. Because the 2013 State HMP includes definitions that were not specified in the SHMCAP, both resources are referred to in this report. MAPC also used FEMA's damage estimation software, HAZUS (described below).

Table 7 below summarizes the hazard risks for Littleton. This evaluation takes into account the frequency and severity of each hazard for Massachusetts and Littleton, based on available data, including:

- **State-level data**, including the Resilient MA Plan, the 2022 Climate Change Assessment, and 2018 SHMCAP.
- **County-level data** from NOAA's National Climatic Data Center and Storm Events
- **Local-level information** including input from the Local Team, the hazard mapping included in Appendix A, and the HAZUS results.

The statewide hazard risk assessment is based on the definitions for hazard frequency and severity listed below. The statewide assessment was modified to reflect local conditions in Littleton using the same criteria.

Definitions of Hazard Frequency and Severity	
<u>Frequency</u>	
Very low:	Very unlikely; minimal examples of historical occurrences.
Low:	Likely to occur at least once by the end of the century; some examples of historical occurrences; anticipated every 100 years.
Medium:	Likely to occur at least once every 50 years (two or more occurrences in the next century)
High:	Almost certain to occur at least once a year.
Very High:	Almost certain to occur multiple times a year.
<u>Severity</u>	
Minor:	Limited and scattered property damage; limited damage to public infrastructure and essential services not interrupted; limited injuries or fatalities.
Serious:	Scattered major property damage; some minor infrastructure damage; essential services are briefly interrupted; some injuries and/or fatalities.
Extensive:	Widespread major property damage; major public infrastructure damage (up to several days for repairs); essential services are interrupted from several hours to several days; many injuries and/or fatalities.
Catastrophic:	Property and public infrastructure destroyed; essential services stopped; numerous injuries and fatalities.

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Table 7: Overview of Hazards and Impacts

Hazard	Frequency		Severity	
	Massachusetts	Littleton	Massachusetts	Littleton
Flooding from Precipitation	Very High	High	Serious	Serious
Dam failures	Very Low	Very Low	Extensive	Minor
Coastal Erosion	Very High	N/A	Serious-Extensive	N/A
Coastal Flooding	Very High	N/A	Serious-Extensive	N/A
Tsunami	Very Low	N/A	Extensive-Catastrophic	N/A
Hurricane/Tropical Storm	Medium	Medium	Serious - Catastrophic	Extensive
Tornadoes	High	Very Low	Serious - Extensive	Serious
Other Severe Weather (Wind/Thundersstorms)	Very High	High	Minor - Extensive	Minor-Serious
Severe Winter/Nor'easter	High	High	Minor - Extensive	Minor-Serious
Winter-Ice Storms	Medium	Medium	Minor - Extensive	Minor
Earthquakes	Medium	Medium	Serious - Catastrophic	Serious
Landslides	High	Very Low	Minor - Extensive	Minor
Wildfire/Brushfires	Very High	Medium	Minor - Extensive	Minor-Serious
Extreme Temperatures	Very High	High	Minor -Serious	Minor
Drought	Medium	Medium	Minor - Serious	Minor-Serious

Sources: Resilient MA Plan (Frequency), State Hazard Mitigation Plan 2013 (Severity), HAZUS, Local information.

The town is not addressing mitigation measures for Coastal erosion, Tsunamis, and Coastal flooding as these hazards are not relevant to an inland community. Additionally, Littleton has not experienced any changes in groundwater, so it has not been addressed in this plan.

CLIMATE TRENDS: CHANGES IN PRECIPITATION

FLOODING HAZARDS

Flooding is generally caused by severe rainstorms, thunderstorms, hurricanes, and nor'easters. Large rainstorms can occur year-round. Hurricanes are most common in the summer and early fall. Nor'easters are most common in winter. Spring snowmelt may exacerbate flooding during storm

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events. Large rainstorms can occur year-round. Climate change has the potential to exacerbate these issues over time due to increasing extreme rainfall events. Increase in average annual rainfall may also lead to more incidents of basement flooding caused by high seasonal groundwater levels.

Flooding has not been a widespread natural hazard identified by local officials in Littleton, however the town does contain several floodplain areas and is also subject to localized flooding. Despite the limited flooding exposure, the town has been active in implementing regulatory strategies that will serve to prevent future flooding by preserving natural capacity for stormwater infiltration. Flooding can occur during hurricanes, nor'easters, severe rainstorms and thunderstorms. Flooding is generally caused by hurricanes, nor'easters, severe rainstorms, and thunderstorms. Global climate change has the potential to exacerbate these issues over time with the potential for changing rainfall patterns leading to heavier storms.

REGIONALLY SIGNIFICANT FLOODS

There have been a number of major floods that have affected the Metro Boston region over the last fifty years. Significant historic flood events in Littleton have included

- The blizzard of 1978
- January 1979
- April 1987
- October 1991
- October 1996
- June 1998
- March 2001
- April 2004
- May 2006
- April 2007
- March 2010
- February 2013
- January 2018
- March 2018
- June 2020

The best available local data on flooding events is for Middlesex County through the National Center for Environmental Information (see Table 8). Middlesex County, which includes the Town of Littleton, experienced 60 flood events from 1996 –2016. No deaths or injuries were reported and the total reported property damage in the county was \$40.9 million dollars. Of that total, \$35.2 million is attributed to the two major events of March 2010.

Table 8: Middlesex County Flood Events, 2010-2022

Date	Deaths	Injuries	Property Damage (\$)
3/14/2010	0	0	26,430,000
3/29/2010	0	0	8,810,000
4/1/2010	0	0	0

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8/28/2011	0	0	5,000
10/14/2011	0	0	0
6/8/2012	0	0	0
6/23/2012	0	0	15,000
7/18/2012	0	0	5,000
10/29/2012	0	0	0
6/7/2013	0	0	0
7/1/2013	0	0	0
7/23/2013	0	0	0
9/1/2013	0	0	10,000
3/30/2014	0	0	35,000
7/27/2014	0	0	0
8/31/2014	0	0	0
10/22/2014	0	0	20,000
10/23/2014	0	0	0
12/9/2014	0	0	5,000
12/9/2014	0	0	30,000
5/31/2015	0	0	0
8/4/2015	0	0	0
8/15/2015	0	0	125,000
9/30/2015	0	0	0
4/6/2017	0	0	0
6/27/2017	0	0	1,000
7/12/2017	0	0	1,000,000
7/18/17	0	0	0
8/2/2017	0	0	5,000
10/25/17	0	0	0
10/30/2017	0	0	0
1/12/2018	0	0	0
1/13/2018	0	0	0
4/16/2018	0	0	0
6/25/2018	0	0	15,000
8/8/2018	0	0	35,000
8/12/2018	0	0	30,000
8/17/2018	0	0	0
10/29/2018	0	0	0
11/3/2018	0	0	0
11/10/2018	0	0	0
7/6/2019	0	0	0

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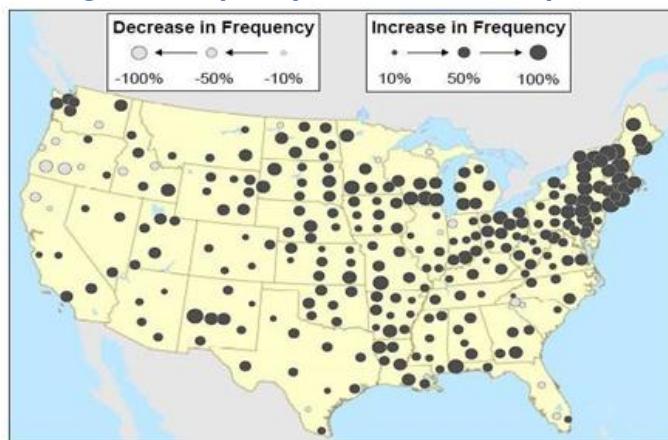
8/07/19	0	0	0
9/2/2019	0	0	300
6/21/20	0	0	0
6/28/20	0	0	5,000
7/23/20	0	0	0
9/10/20	0	0	3,000
7/9/21	0	0	0
9/2/21	0	0	0
11/12/21	0	0	10,000
8/5/22	0	0	0
8/7/22	0	0	0
9/5/22	0	0	0
5/20/23	0	0	0
6/26/23	0	0	50,000
Total	0	0	\$42.06 M

Source: NOAA, National Centers for Environmental Information

FLOODING AND CLIMATE CHANGE

Littleton's average annual precipitation is 42 inches. While total annual precipitation has not changed significantly, according to the 2012 report *When It Rains It Pours – Global Warming and the Increase in Extreme Precipitation from 1948 to 2011*, intense rainstorms and snowstorms have become more frequent and more severe over the last half century in the northeastern United States. Extreme downpours are now happening 30 percent more often nationwide than in 1948 (see Figure 11). In other words, large rain or snow storms that happened once every 12 months, on average, in the middle of the 20th century, now happen every nine months.

Figure 11 Changes in Frequency of Extreme Downpours, 1948 – 2011



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Source: *When It Rains It Pours – Global Warming and the Increase in Extreme Precipitation*, Environment America Research and Policy Center, July 2012

Not only are these intense storm events more frequent, they are also more severe; the largest annual storms now produce 10 percent more precipitation, on average, than in 1948. In particular, the report finds that New England has experienced the greatest change with intense rain and snow storms occurring 85 percent more often than in 1948.

Data from the 2022 MA Climate Change Assessment related to changes in precipitation patterns is included in an earlier section of this chapter. Those projections suggest that future rain events will be increasingly intense and lengthy, which could lead to increased inland and stormwater flooding.

Precipitation frequency estimates, which are used to derive stormwater design standards, were published in 1961 by the U.S. Commerce Department in a document known as TP-40 (Technical Paper 40). The 10-year, 24-hour storm for eastern Massachusetts was calculated as a 4.5-inch event. Recently the National Oceanic and Atmospheric Administration published updated estimates (NOAA Atlas 14), which increased this design storm by 0.6 inches to 5.14 inches for eastern Massachusetts. Communities should consider future rainfall rates when designing infrastructure.

For example, communities could consider using NOAA Atlas 14 rainfall rates with an additional allowance to account for projected rainfall during the life of projects permitted today when sizing stormwater infrastructure. DEP takes a similar approach to describe current (not future) rainfall rates, called “NOAA14+”. Mystic River Watershed Association (MyRWA) communities propose “NOAA14++”, which they say reflects 2070 projections. The NOAA 14+ number is calculated by multiplying the NOAA 14 precipitation frequency estimate upper confidence interval by 0.9 (i.e., current but extreme precipitation events reflect 90% of upper confidence intervals). The NOAA 14++ number is the upper confidence interval. A comparison of these numbers is summarized in the table below (NOAA, 2023).

Table 9: Rainfall rates for the 10-year 24-hour storm

NOAA 14	NOAA 14+	NOAA 14++
5.27 inches	5.90 inches	6.56 inches

NOAA, 2023

The 2022 MA Climate Change Assessment also highlights the following flooding climate impacts:

- By 2050, the 1 percent annual chance river flood could be two times more likely to occur
- By 2090, the historical 10 percent annual chance daily rainfall event (2.8 to 4 inches) could occur four times more frequently
- Damage could occur to inland buildings from heavy rainfall and overwhelmed drainage systems
- Damage could occur to transit service due to flooding
- There could be a reduction in the availability of affordably priced housing from direct damage including from flooding (Commonwealth of Massachusetts, 2022)

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OVERVIEW OF TOWN-WIDE FLOODING

FEMA-designated flood plains are found throughout Littleton, mainly along the town's water ways (see Map 3 in Appendix A). The significant bodies of water in Littleton include Beaver Brook, Spectacle Pond, Mill Pond, Long Pond, Fort Pond, Nagog Pond, Lake Matawanakee, and numerous tributary streams. The northwestern half of Littleton consists mainly of sandy soils and contains the main aquifer for the town's drinking water supply. The other half has glacial till soils and much of the area is tributary to the SuAsCo (Sudbury, Assabet, Concord Rivers) watershed.

Flooding in Littleton is occasional, usually within or near floodplain areas. Damage may consist of flooding basements, and the Fire Department may be called in to help pump out basements. In some areas of town, localized flooding occurs due to beaver activity or improperly functioning drainage infrastructure. The Littleton Highway Department has been effective at replacing outdated culverts and drainage systems.

Littleton's water supply system depends solely on the subsurface aquifer in the northwestern half of town; therefore water quality has been a main issue. The town has an active water department and aggressive aquifer protection regulations that have been effective in protecting the water quality of the groundwater supply.

Although Littleton's flooding issues in the past have not been as significant as some of its nearby more developed neighbors, Littleton is facing a large amount of new development. New impervious areas and more engineered drainage systems can bring a greater possibility of future flooding problems. Therefore, protection of open space and development controls will be critical to mitigate against future flooding. Littleton has a history of being active in this regard.

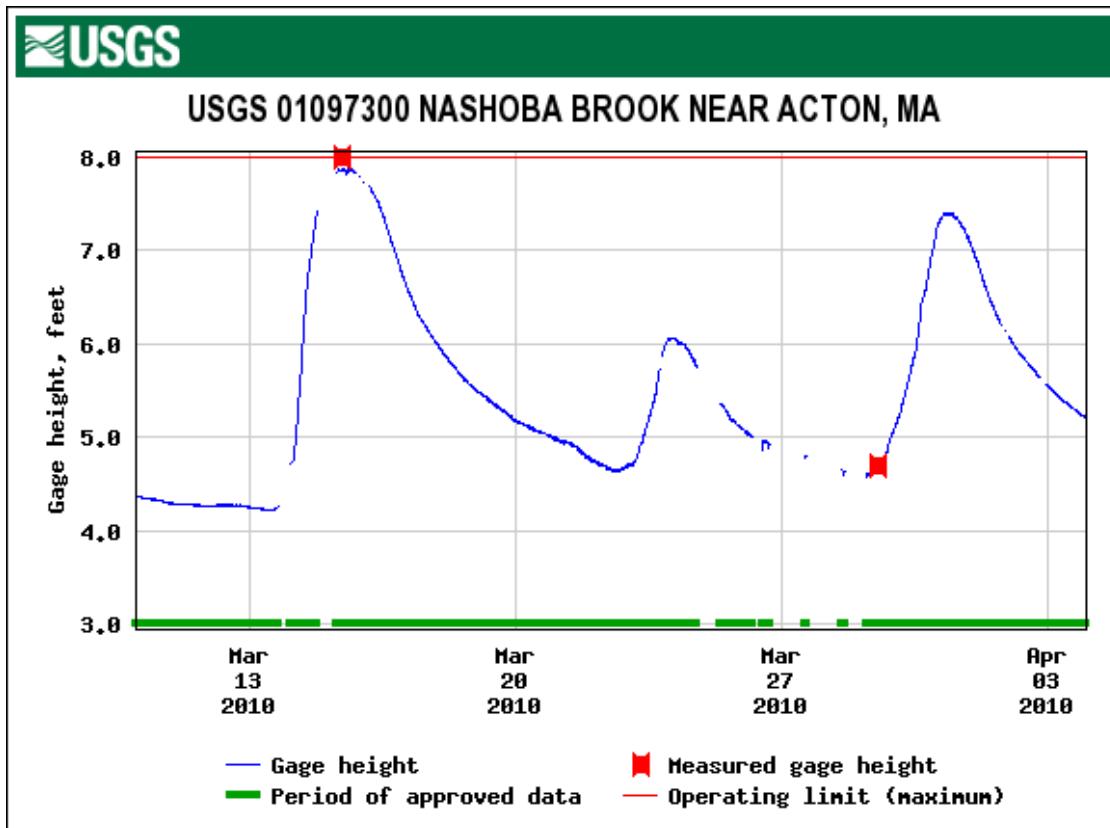
SEVERE PRECIPITATION

The most severe recent flooding occurred during the major storms of March 2010, when a total of 17.7 inches of rainfall was recorded by the Blue Hills Observatory from three storms over 19 days from March 13 to 31. accumulation was officially recorded by the National Weather Service (NWS). The weather pattern that caused these floods consisted of early springtime prevailing westerly winds that moved three successive storms, combined with tropical moisture from the Gulf of Mexico, across New England. Torrential rainfall caused March 2010 to be the wettest month on record. The March 2010 rainstorms fit the profile of a type of severe precipitation event expected to increase in frequency as the climate warms. That is, significant precipitation, falling in late winter as rain rather than snow, on frozen ground, and while vegetation is still dormant.

One indication of the extent of flooding is the height of the garage at the nearest USGS streamflow gauging station, which is on the Nashoba Brook in neighboring Acton, which is in the same watershed as Littleton. The USGS gage height, shown in Figure 12, was nearly eight feet on March 16 (which is the operating limit of the gage), and exceeded 7.3 feet on March 31, 2010. Normal gage height in March is about 4.5 feet.

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Figure 12 Nashoba Brook Gage Heights, March-April 2010



Source, US Geological Service, National Water Information System

Damages from flooding from 2010 to 2022 in Middlesex County totaled \$42.5 million. It is notable that \$35.2 million of that was due to the March 2010 storms. Those storms were a federally declared disaster, making federal assistance available to residents who did not carry flood insurance. The HAZUS analysis estimates damages in Littleton from a 100-year flood at \$13.6 million and \$19.7 million from a 500-year flood.

POTENTIAL FLOOD HAZARD AREAS

Flood Insurance Rate Maps

Information on potential flood hazard areas was taken from two sources. The first was the National Flood Insurance Rate Maps (FIRM). The FIRM flood zones are shown on Map 3 in Appendix A and their definitions are listed below. Mapped flood plains are primarily along the Town's ponds, brooks, and associated wetlands.

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Flood Insurance Rate Map Zone Definitions

Zone A (1% annual chance) - Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study (FIS) by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no BFEs (base flood elevations) or depths are shown within this zone. Mandatory flood insurance purchase requirements apply.

Zone AE and A1-A30 (1% annual chance) - Zones AE and A1-A30 are the flood insurance rate zones that correspond to the 100-year floodplains that are determined in the FIS by detailed methods. In most instances, BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone. Mandatory flood insurance purchase requirements apply.

Zones X500 (0.2% annual chance) - Zone X500 is the flood insurance rate zone that correspond to the 500-year floodplains that are determined in the Flood Insurance Study (FIS) by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no BFEs (base flood elevations) or depths are shown within this zone.

Zone VE (1% annual chance) - Zone VE is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone. Mandatory flood insurance purchase requirements apply.

The FIRM maps currently in effect for Littleton were adopted in 2010 and 2014. However, as described below, Revised Preliminary FIRMs have been issued by FEMA, and they are expected to go into effect and replace the current FIRMs in mid-2025. This process is expected to result in a Letter of Final Determination (LFD) from FEMA by late December 2024 or January 2025.

The Town will need to adopt an updated floodplain zoning bylaw to reflect the new FIRM mapping and to comply with a state model floodplain bylaw before the updated Flood Insurance Rate Map (FIRM) and Middlesex County Flood Insurance Study (FIS) become effective in June or July 2025. The State model floodplain ordinance is available from the Department of Conservation and Recreation to assist municipalities with making these updates. Municipalities can also go above and beyond the State's minimum requirements by including additional language. This additional language can be related to strengthening floodplain overlay district requirements, stormwater regulations, site plan review, and more. MAPC's online Climate Resilient Land Use toolkit provides guidance and examples of local bylaws, available at www.mapc.org/resource-library/climate-resilient-land-use-strategies/

The Middlesex County Flood Insurance Study (FIS), Revised July 2016, provides supporting data and analysis regarding flooding in Norfolk. The FIS provides the following overview description of flooding trends and impacts in Middlesex County:

Principal Flood Problems – Middlesex County

Historically, excessive rainfall along, or in combination with, snowmelt runoff has produced flooding in low-lying areas of Middlesex County. Severe flooding occurred during August 1955. The flood of August 1955 resulted from two hurricanes that arrived almost concurrently-Hurricane Connie, occurring between August 11 and 15; and Hurricane Diane occurring between August 17 and 20. As a result of these two storms, roads and bridges were overtopped, and residences and businesses were flooded. Further, significant recorded floods were those occurring in May 1850, December 1878, July 1891, July 1897, February and March 1900, November 1927, March

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1936, July and September 1938, October 1942, October 1955, April 1960, March 1968, and January 1979.

Flooding in Middlesex County may be caused by a number of factors: inadequate and deteriorated river channels, constricting culverts and bridges, heavy precipitation in combination with frozen ground conditions, summer and fall hurricanes, winter northeasters, inadequate storm drain discharge, increased development, topographic conditions, and undersized culverts. The following tabulation, taken from a USACE Flood Plain Information report, presents the relative flood heights at the Carlisle Road bridge (State Route 225) for the 10 major floods in the Concord River basin in order of magnitude.

Table 10 Historic Floods in Middlesex County

Date of Crest	Elevation	Discharge (cfs)
August 23, 1955	118.6	4,540
January 26, 1979	118.5	5,400
March 20, 1936	118.4	6,000
March 27, 1968	117.9	4,900
July 29, 1938 1	17.3	3,790
September 15, 1954	116.7	3,340
September 24, 1938	116.5	3,210
March 24, 1948	116.5	3,200
January 30, 1958	116.4	3,120
April 18, 1956	116.2	2,970

The duration of flooding is generally sustained due to the large drainage area, shallow channel slopes, and wide meadow flood-storage areas. Records indicate that the 1936 flood remained higher than an elevation of 117.2 feet North American Vertical Datum of 1988 (NAVD88) at the Carlisle Road bridge for more than 11 days. Hurricane Diane occurred on August 19 and 20, 1955, but the Concord River did not crest until late on August 22 with water levels remaining above an elevation of 117.2 feet NAVD88 for over 3 days. The Shawsheen River, on the other hand, rises fairly rapidly and crests within 36 to 48 hours after the time of maximum precipitation over the watershed.

Middlesex County also saw flooding from severe storms in October 1996, June 1998, April 2001, April 2004, October 2005 and May 2006. The May 2006 storms damaged 14,000 homes in 44 communities on the North Shore, including Middlesex County (NOAA, 2013). Boston recorded four- and six-day rainfalls of 8.49 and 13-15 inches respectively. Several rivers, including Merrimack, Ipswich, Saugus, and Parker Rivers, and their tributaries, were impacted by flooding. Flooding was heavy in the floodplain of the Shawsheen River, a tributary of the Merrimack River. Widespread flooding caused evacuation of residents threatened by flooding. Redman Cloth Dam, located upstream of Essex Street, was washed away during the 2006 flood event. Shawsheen River watershed experienced flooding again in July 2007.

In March 2010, heavy rainfall of 6 to 10 inches fell over much of Southern New England resulting in major flooding across eastern Massachusetts and Rhode Island, including the Middlesex County area. Each of the seven gaged mainstem rivers in Middlesex County rose above flood stage, the Nashua River at East Pepperell, Shawsheen River at Wilmington and the Assabet River at

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Maynard all reach major flood levels. The Concord River at Lowell and the Shawsheen River at Wilmington set record floods stages.

Discharge-frequency relationship data for Beaver Brook in the Town of Littleton and Westford was developed using the procedures described by the USGS in Estimating the Magnitude and Frequency of Floods for Natural-flow Streams in Massachusetts (U.S. Department of the Interior, 1977). The technique was developed using multiple regression analyses to estimate flood peaks in ungauged, natural-flow streams in Massachusetts by relating peak discharges to basin and climatic parameters. The resulting peak discharges were used to develop corresponding peak discharges at the inlet of Forge Pond using multiplication factor equal to the ratio of the drainage areas to 0.75 power. The discharges for Beaver Brook have been incorporated into Table 11 below.

Table 11 Summary of Discharges Beaver Brook

Flooding Source	Drainage	Peak Discharge (cfs)			
		Area (sq mi)	10%	2%	1%
BEAVER BROOK					
At inlet to Forge Pond	13.6	420	690	845	1,280
Downstream of Westford/Littleton corporate limits	11.8	380	620	760	1,150
Approximately 200 feet upstream of King Street	9.8	339	563	686	1,045
Upstream of Mill Pond	7.9	296	494	601	920
At State Route 2	5.8	241	403	493	756
At Boxborough/Littleton limits	4.3	145	215	250	330
Approximately 7,280 feet upstream of Capt. Isaac Davis Highway/Route 2	3.0	92	140	160	220
Approximately 3,260 feet downstream of West Whitcomb Road	1.9	66	100	120	150
At Interstate Route 495	1.4	55	84	98	120

Flood Protection Measures in Middlesex County

Various measures have been taken in Middlesex County for flood protection. Among them: the adoption of local floodplain zoning ordinances (which are intended to regulate construction, excavation, filling, and grading of any land situated below specified elevations); construction of dams to control flooding (for example, along the Assabet River and its major tributaries); zoning by-laws (which may, for example, allow development within the floodplain only by special permit); stormwater drainage programs; dredging of channels; replacement of inadequate culverts; preserving natural runoff and flow patterns of streams and floodwater storage areas; wetland identification; flood retention structures; formation of Floodplain Conservancy Districts; The Flood Control Acts of 1936 and 1938; flood protection dikes and walls; holding pond storage; natural storage that exists in the many swamps and ponds; and establishing wetlands protection districts. Ten dams have been constructed within the Upper Assabet River basin to control flooding and provide recreation. These dams are in Berlin, Bolton, Stow, Marlborough, Westborough, Northborough, and Shrewsbury, and they were designed to reduce the peak water-surface elevations of the 1-percent-annualchance flood by 2.3 feet at the Maynard USGS gaging station.

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Locally Identified Flood Hazards

In addition, to the Flood Insurance Rate Maps, information on areas subject to flooding was provided by local officials. The Locally Identified Areas of Flooding described below were identified by town staff as areas where flooding is known to occur. All of these areas do not necessarily coincide with the flood zones from the FIRM maps. Some may be areas that flood due to inadequate drainage systems or other local conditions rather than location within a flood zone. The numbers correspond to the numbers on Map 8, "Local Hazard Areas" in Appendix A.

1. Beaver Brook/Great Road

Beaver Brook at Great Road (a state highway) has not overtopped in heavy rains. At times there will be high water in the brook, but overtopping does not occur (Jeff Patterson, Police Dept, has never seen it overtopped. The cause of the flooding is due more to the fact that it is within a floodplain area than it does with inadequate drainage infrastructure.

2. King Street

The stream located near a floodplain at this King Street location has caused surface flooding in the past. Note that King Street is a state highway.

3. Nashoba Road

Nashoba Road had routinely flooded, often due to beaver activity. This site is also located near a floodplain. The town raised the road approximately 2.5 feet at its lowest point by installing retaining walls and fill slopes for a total length of 2400 feet, and the road was repaved in the Fall of 2022. This solution has appeared to alleviate the problem. Water still comes up on to the edge of the road but doesn't flood the road.

12. Gilson Road

Gilson road by the train tracks has been having some issues with beaver problems, this has required drains to be cleaned. This has not overtopped the road, but this is an area that needs to be checked.

13. Ayer Road

Ayer Road in front of 39 right by Littleton Electric has experienced occasional problems by intense rainfall, maybe a state culvert issue.

16. Russell Street Drainage System

Stormwater backs up into the Russell Street Drainage System from Russell Street, Route 119, and Constitution Ave. It appears that either the drainage system "under" route 495 near the Route 119/I-495 interchange and/or the "ditch" at the ramp is causing a significant backup that threatens public infrastructure: the only access road to the Russell Street elementary school, and the drainage structures for the "Alumni Field" (Littleton's turf football field) appear to be at risk. In addition, DPW Director Steve Jahnle identified the area on the "other side of the I-495 ramp") as causing stormwater to back up into the Russell Street drainage system on the "other" end of Russell Street near the intersection of Russell Street, Route 119, and Constitution Ave.

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Figure 13 Russell Street Drainage Example 1



Figure 14 Russell St Drainage Example 2



17. Rt. 495 Interchange/Russell Street

Littleton DPW Director identified the area on the other side of the I-495 ramp (red oval-shaped polygon in Figure 15) as causing stormwater to back up into the Russell Street drainage system on the other end of Russell Street near the intersection of Russell Street, Route 119, and Constitution Ave.

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Figure 15 Rt. 495 Interchange/Russell Street Resiliency Concern



Repetitive Loss Structures

As defined by the National Flood Insurance Program (NFIP), a repetitive loss property is any property for which the NFIP has paid two or more flood claims of \$1,000 or more in any given 10-year period since 1978. There is one repetitive loss structure in Littleton. It is a single-family residence that has received reimbursement for two claims for a total of \$21,338, including \$18,648 for building damages and \$2,490 for damage to contents. For more information on repetitive losses see <http://www.fema.gov/business/nfip/replps.shtm>

Littleton experiences limited flooding and flood damage compared to most towns in the region. Nevertheless, based on the record of previous occurrences flooding events in Littleton are High frequency events. This hazard may occur more frequently than once in five years, or a greater than 20% chance per year.

Flooding and Climate Change

Data from the 2022 MA Climate Change Assessment related to changes in precipitation patterns is included in an earlier section of this chapter. Those projections suggest that future rain events will be increasingly intense and lengthy, which could lead to increased inland and stormwater flooding.

Precipitation frequency estimates, which are used to derive stormwater design standards, were published in 1961 by the U.S. Commerce Department in a document known as TP-40 (Technical Paper 40). The 10-year, 24-hour storm for eastern Massachusetts was calculated as a 4.5-inch

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event. Recently the National Oceanic and Atmospheric Administration published updated estimates (NOAA Atlas 14), which increased this design storm by 0.6 inches to 5.14 inches for eastern Massachusetts. Communities should consider future rainfall rates when designing infrastructure. For example, communities could consider using NOAA Atlas 14 rainfall rates with an additional allowance to account for projected rainfall during the life of projects permitted today when sizing stormwater infrastructure. DEP takes a similar approach to describe current (not future) rainfall rates, called “NOAA14+”. Mystic River Watershed Association (MyRWA) communities propose “NOAA14++”, which they say reflects 2070 projections. The NOAA 14+ number is calculated by multiplying the NOAA 14 precipitation frequency estimate upper confidence interval by 0.9 (i.e., current but extreme precipitation events reflect 90% of upper confidence intervals). The NOAA 14++ number is the upper confidence interval. A comparison of these numbers is summarized in the table 12 below (NOAA, 2023) .

Table 12: Rainfall rates for the 10-year 24-hour storm

NOAA 14	NOAA 14+	NOAA 14++
5.27 inches	5.90 inches	6.56 inches

- By 2050, the 1 percent annual chance river flood could be two times more likely to occur
- By 2090, the historical 10 percent annual chance daily rainfall event (2.8 to 4 inches) could occur four times more frequently
- Damage could occur to inland buildings from heavy rainfall and overwhelmed drainage systems
- Damage could occur to transit service due to flooding
- There could be a reduction in the availability of affordably priced housing from direct damage including from flooding (Commonwealth of Massachusetts, 2022)

Probability of Future Occurrences

Based on the record of previous occurrences, flooding in Littleton is a Very High frequency event as defined by the Resilient MA Plan. Flooding is almost certain to occur multiple times a year.

DAM HAZARDS

Dam failure can occur as a result of structural failure, independent of a hazard event, or as the result of the impacts of a hazard event such as flooding associated with storms or an earthquake. In the event of a dam failure, the energy of the water stored behind even a small dam can cause loss of life and property damage if there are people or buildings downstream. The number of fatalities from a dam failure depends on the amount of warning provided to the population and the number of people in the area in the path of the dam's floodwaters.

Dam failure is a highly infrequent occurrence, but a severe incident could result in loss of lives and significant property damage. Since 1984, three dams have failed in or very near to Massachusetts, one of which resulted in a death. There have been no recorded dam breaches in Littleton.

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The increasing intensity of precipitation is the primary climate concern related to dams, as they were designed based on historic weather patterns. The 2018 SHMCAP indicates that changing precipitation patterns may increase the likelihood of overflow events.

According to data provided by the Massachusetts Department of Conservation and Recreation and the town, there is one dam located in Littleton. The Mill Pond Dam is located on Beaver Brook and a tributary to Beaver Brook and is owned by the MA DCR. It is classified as a low hazard dam. According to the town, the spillway at Mill Pond Dam has not had any problems within the last 10-15 years.

Table 13: DCR Inventory of Dams

NATID	Dam Name	River	Impoundment	Owner	Hazard Potential
MA01149	Mill Pond Dam	Tributary of Beaver Brook	Mill Pond	DOT - Dept. of Transportation	Low

Source: Office of Dam Safety, Dept. of Conservation and Recreation

DCR defines dam hazard classifications as follows:

High: Dams located where failure or mis-operation will likely cause loss of life and serious damage to homes(s), industrial or commercial facilities, important public utilities, main highways(s) or railroad(s).

Significant: Dams located where failure or mis-operation may cause loss of life and damage home(s), industrial or commercial facilities, secondary highway(s) or railroad(s) or cause interruption of use or service of relatively important facilities.

Low: Dams located where failure or mis-operation may cause minimal property damage to others. Loss of life is not expected.

Future land use development in areas below a dam could increase the Town's vulnerability to dam hazards. However, there is no indication of increased vulnerability in Littleton.

Probability of Future Occurrences

Based on the record of no previous occurrences dam failure in Littleton this is a Very Low frequency event. This hazard may occur less frequently than once in 100 years (less than 1% chance per year)

DROUGHT HAZARDS

Drought is a temporary irregularity in precipitation and differs from aridity since the latter is restricted to low rainfall regions and is a permanent feature of climate. Drought is a period characterized by long durations of below normal precipitation. Drought conditions occur in virtually all climatic zones yet its characteristics vary significantly from one region to another, since it is relative to the normal precipitation in that region. Drought can affect agriculture, water supply, aquatic ecology, wildlife, and plant life.

In Massachusetts, droughts are caused by the prevalence of dry northern continental air and a decrease in coastal- and tropical-cyclone activity. During the 1960's, a cool drought occurred

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because dry air from the north caused lower temperatures in the spring and summer of 1962-65. The northerly winds drove frontal systems to sea along the Southeast Coast and prevented the Northeastern States from receiving moisture (U.S. Geological Survey). This is considered the drought of record in Massachusetts.

Average annual precipitation in Massachusetts is 44 inches per year, with approximately 3 to 4 inch average amounts for each month of the year. Regional monthly precipitation ranges from zero to 17 inches. Statewide annual precipitation ranges from 30 to 61 inches. Thus, in the driest calendar year (1965), the statewide precipitation total of 30 inches was 68 percent of average.

Although Massachusetts is relatively small, it has a number of distinct regions that experience significantly different weather patterns and react differently to the amounts of precipitation they receive. The DCR precipitation index divides the state into seven regions: Western, Central, Connecticut River Valley, Northeast, Southeast, Cape Cod, and Islands.

The Massachusetts Drought Management Plan was revised in 2019 to change the state's classification of droughts by establishing four levels to characterize drought severity beyond normal conditions:

- Level 0-Normal Conditions (no drought)
- Level 1-Mild Drought (formerly Advisory)
- Level 2-Significant Drought (formerly Watch)
- Level 3-Critical Drought (formerly Warning)
- Level 4-Emergency Drought (formerly Emergency)

The Massachusetts drought levels are shown in comparison to the U.S. Drought Monitor levels in Table 13. The two sets of drought indices are similar, but Massachusetts combines the USDM's level D2 and D3 into one category, Critical Droughts.

These levels are based on conditions of natural resources and provide information on the current status of water resources. As dry conditions can have a range of different impacts, a number of drought indices are available to assess these impacts. Massachusetts uses a multi-index system that takes advantage of several of these indices to determine the severity of a given drought or extended period of dry conditions. Drought level is determined monthly based on the number of indices which have reached a given drought level. Drought levels are declared on a regional basis for each of seven regions in Massachusetts. County by county or watershed-specific determinations may also be made. A determination of drought level is based on seven indices:

1. Standardized Precipitation Index (SPI) reflects soil moisture and precipitation.
2. Crop Moisture Index: (CMI) reflects soil moisture conditions for agriculture.
3. Keetch Byram Drought Index (KBDI) is designed for fire potential assessment.
4. Precipitation Index is a comparison of measured precipitation amounts to historic normal precipitation.
5. The Groundwater Level Index is based on the number of consecutive month's groundwater levels are below normal (lowest 25% of period of record).
6. The Stream flow Index is based on the number of consecutive months that stream flow levels are below normal (lowest 25% of period of record).

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7. The Reservoir Index is based on the water levels of small, medium and large index reservoirs across the state, relative to normal conditions for each month.

As shown in Table 14, another measure of drought is the U.S. Drought Monitor, which characterizes droughts as abnormally dry, moderate, severe, extreme, and exceptional. Extreme drought is characterized by likely crop and pasture losses, water shortages, and water restrictions.

Table 14: US Drought Monitor Compared to MA Statewide Drought Levels

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

Source: Massachusetts Drought Management Plan, 2019

Table 15 shows the range of values for each of the indices associated with the drought levels. Because drought tends to be a regional natural hazard, this plan references state data as the best available data for previous drought occurrences.

Determinations regarding the end of a drought or reduction of a drought level focus on precipitation and groundwater levels. These factors have the greatest long-term impact on stream flow, water supply, reservoir levels, soil moisture, and forest fire potential.

The drought levels provide a framework from which to take actions to assess, communicate, and respond to drought conditions. Drought levels are used to coordinate both state agency and local response to drought situations. Water restrictions might be appropriate at the significant drought stage, depending on the capacity of each individual water supply system. A critical drought level indicates a severe situation and the possibility that a drought emergency may be necessary. A drought emergency is one in which mandatory water restrictions or use of emergency supplies is necessary.

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Table 15: Indices Values Corresponding to Drought Index Severity Levels

Index Severity Level	Standardized Precipitation Index	Streamflow	Lakes and Impoundments	Groundwater	Keetch-Byram Drought Index	Crop Moisture Index
0		>30 th percentile			< 200	> -1.0
1		≤30 and >20			200-400	≤-1.0 and > -2.0
2		≤20 and >10			400-600	≤-2.0 and < -3.0
3		≤10 and >2			600-700	≤ -3.0 and > -4.0
4		≤2			700-800	≤-4.0

Source: Massachusetts Drought Management Plan, 2019

Previous Occurrences

Because drought tends to be a regional natural hazard, the best available data on previous drought occurrences is state-wide data, summarized below.

The Executive Office of Energy and Environment's Drought Management Task Force also provides information on historic drought status for each drought level in Massachusetts. That information is summarized below.

Mild Drought/Advisory	2001, 2002, 2007, 2014, 2016, 2017, 2020, 2021, 2022
Significant Drought/Watch	2002, 2016, 2017, 2020, 2021, 2022
Critical Drought/Warning	2016, 2017, 2020, 2022
Emergency Drought/Emergency	None

A summary of Massachusetts long term historic drought events from 1879 to 2019 is shown in Table 15. This table was prepared for the 2019 Massachusetts Drought Management Plan, so it does not include the more recent droughts of 2020 (Level 3) and 2021 (Level 2).

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Table 16: Chronology of major droughts in Massachusetts since 1879

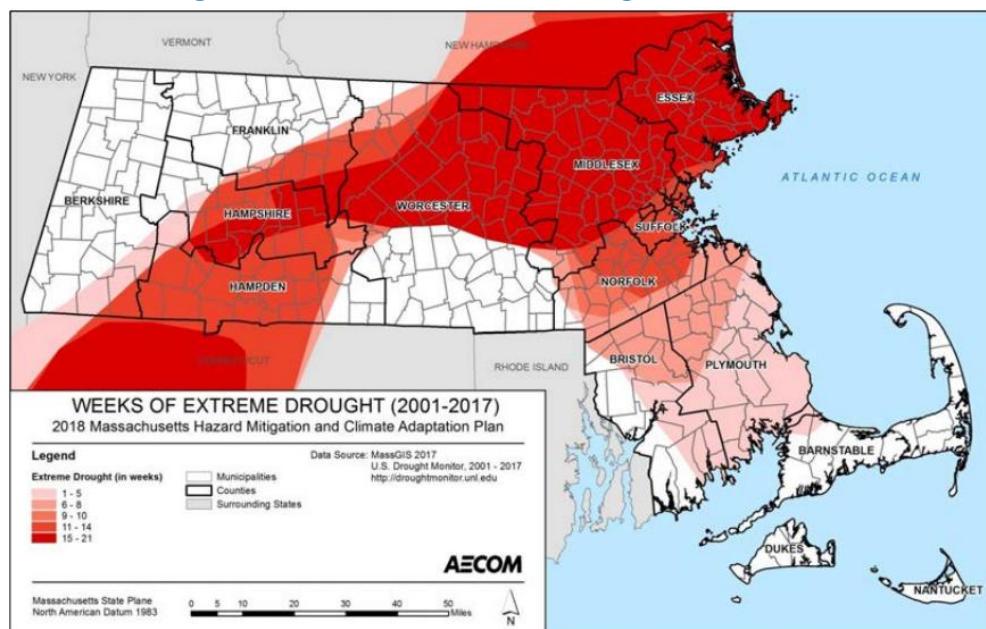
Date	Area affected	Recurrence interval (years)	Remarks	Reference
1879-83	-	-	Kinnison 1931 referenced these periods as two of three worst droughts on record in 1931, the third being the then current drought of 1929-1932.	Kinnison 1931
1908-12	-	-		
1929-32	Statewide	10 to >50	Water-supply sources altered in 13 communities. Multistate.	USGS 1989
1939-44	Statewide	15 to >50	More severe in eastern and extreme western Massachusetts. Multistate.	USGS 1989
1957-59	Statewide	5 to 25	Record low water levels in observation wells, northeastern Massachusetts.	USGS 1989
1961-69	Statewide	35 to >50	Water-supply shortages common. Record drought. Multistate.	USGS 1989
1980-83	Statewide	10 to 30	Most severe in Ipswich and Taunton River basins; minimal effect in Nashua River basin. Multistate.	USGS 1989
1985-88	Housatonic River Basin	25	Duration and severity as yet unknown. Streamflow showed mixed trends elsewhere.	USGS 1989
1995	-	-	Based on statewide average precipitation	DMP 2013
1998-1999	-	-	Based on statewide average precipitation	DMP 2013
Dec 2001 - Jan 2003	Statewide	-	Level 2 drought (out of 4 levels) was reached statewide for several months	DCR 2017
Oct 2007 - Mar 2008	Statewide except West and Cape & Islands regions	-	Level 1 drought (out of 4 levels)	DCR 2017
Aug 2010 - Nov 2010	Connecticut River Valley, Central and Northeast regions	-	Level 1 drought (out of 4 levels)	DCR 2017
Oct 2014 - Nov 2014	Southeast and Cape & Islands regions	-	Level 1 drought (out of 4 levels)	DCR 2017
Jul 2016 - Apr 2017	Statewide	-	Level 3 drought (out of 4 levels)	DCR 2017

Source: Massachusetts Drought Management Plan, 2019

As shown in Figure 16, Littleton experienced between 15 and 21 weeks of severe drought between 2001 and 2017.

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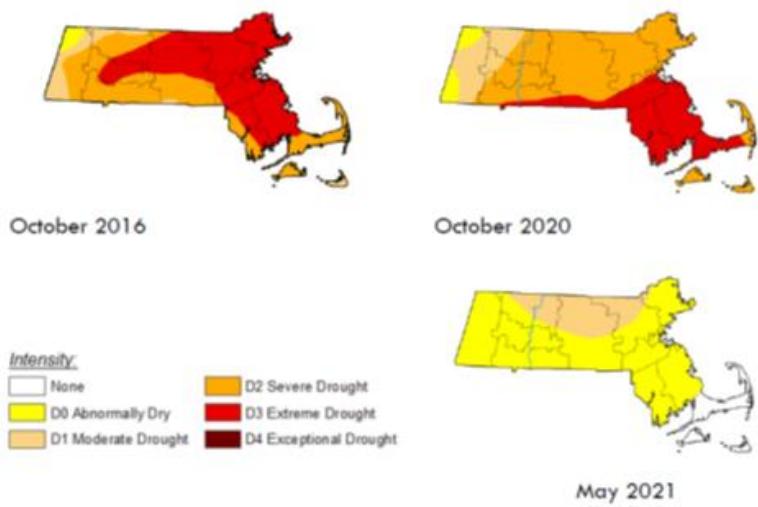
Figure 16: Weeks of Extreme Drought (2001-2017)



Source: SHMCAP 2018

In just the last eight years there have been three droughts in Massachusetts. The drought of 2016 was the worst one since 1985, with more than half of the state reaching the Extreme Drought stage for several months (Figure 16). This was followed by another drought four years later in 2020, which was most severe in Southeastern Massachusetts. Finally, in the early spring of 2021 a third, milder

Figure 17: Recent Massachusetts Drought Events (2016-2021)



Source: US Drought Monitor, 2016-2021

Potential Drought Vulnerability

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The entire Town of Littleton is potentially vulnerable to the impacts of drought. Under a severe long term drought the Town could be vulnerable to restrictions on water supply, as the town's public water supply relies on local groundwater aquifers that could experience reduced yield. Some properties in Littleton rely on private wells which also could have reduced water available in a drought. Potential damages of a severe drought could include losses of landscaped areas if outdoor watering is restricted and potential loss of business revenues if water supplies were severely restricted for a prolonged period. Littleton has active agricultural operations that could be impacted by drought due to reduced yield or loss of crops. Another potential vulnerability of droughts could be increased risk of wildfires.

As this hazard has never occurred to such a severe degree in Littleton, there are no data or estimates of potential damages, but under a severe long term drought scenario it would be reasonable to expect a range of potential damages from several million to tens of millions of dollars.

Probability of Future Occurrence

The SHMCAP, using data collected since 1850, calculates that statewide there is a 1% chance of being in a drought emergency in any given month. For drought warning and watch levels, the chance is 2% and 8% respectively in any given month. See Table 17 for more information.

Table 17: Frequency of Massachusetts Drought Levels

Drought Level	Frequency Since 1850	Probability in a Given Month
Drought Emergency	5 occurrences	1% chance
Drought Warning	5 occurrences	2% chance
Drought Watch	46 occurrences	8% chance

Source: 2018 SHMCAP

Droughts And Climate Change

Droughts are projected to increase in frequency and intensity in the summer and fall as weather patterns change. Factors contributing to this include increasing evaporation as a result of warmer weather, earlier snow melt, and more extreme weather patterns. Information from the 2022 Massachusetts Climate Change Assessment related to drought is included in the "Climate Change Observations and Projections" section of this report. Additionally, the 2022 Assessment highlights the following drought-related impacts:

- Freshwater ecosystem degradation due to drought and other impacts
- Increased contaminant concentrations in freshwater during drought conditions
- Loss of tree cover due to drought and other impacts

LANDSLIDE HAZARDS

According to the USGS, "The term landslide includes a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows. Although gravity acting on an over

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steepened slope is the primary reason for a landslide, there are other contributing factors." Among the contributing factors are: erosion by rivers or ocean waves over steepened slopes; rock and soil slopes weakened through saturation by snowmelt or heavy rains; earthquakes create stresses that make weak slopes fail; and excess weight from accumulation of rain or snow, and stockpiling of rock or ore, from waste piles, or from man-made structures.

Landslides can result from human activities that destabilize an area or can occur as a secondary impact from another natural hazard such as flooding. In addition to structural damage to buildings and the blockage of transportation corridors, landslides can lead to sedimentation of water bodies. Typically, a landslide occurs when the condition of a slope changes from stable to unstable. Natural precipitation such as heavy snow accumulation, torrential rain and run-off may saturate soil creating instability enough to contribute to a landslide. The lack of vegetation and root structure that stabilizes soil can destabilize hilly terrain.

In Massachusetts, according to the SHMCAP, the most common cause of landslides are geologic conditions combined with steep slopes and/or heavy rains. Landslides associated with heavy rains typically occur on steep slopes with permeable soils underlain by till or bedrock.

There is no universally accepted measure of landslide extent but it has been represented as a measure of destructiveness. Table 18 summarizes the estimated intensity for a range of landslides. For a given landslide volume, fast moving rock falls have the highest intensity while slow moving landslides have the lowest intensity.

The SHMCAP, utilized data from the MA Department of Transportation from 1986 to 2006 to estimates that, on average, roughly one to three known landslides have occurred each year in the state. A slope stability map published by the MA Geological Survey and UMass-Amherst indicates that the most significant risk of landslide is in western Massachusetts.

Table 18: Landslide Volume and Velocity

Estimate d Volume (m ³)	Expected Landslide Velocity		
	Fast moving (rock fall)	Rapid moving (debris flow)	Slow moving (slide)
<0.001	Slight intensity	--	--
<0.5	Medium intensity	--	--
>0.5	High intensity	---	--
<500	High intensity	Slight intensity	--
500- 10,000	High intensity	Medium intensity	Slight intensity
10,000 – 50,000	Very high intensity	High intensity	Medium intensity
>500,00 0	--	Very high intensity	High intensity
>500,00 0	--	--	Very high intensity

Source: *A Geomorphological Approach to the Estimation of Landslide Hazards and Risks in Umbria, Central Italy*, M. Cardinali et al, 2002

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Probability of Future Occurrences

Based on past occurrences and the Resilient Massachusetts Plan, landslides are very low, very unlikely, minimal examples of historical occurrences.

Climate Change and Landslides

Changes in precipitation may increase the chance of landslides, as extreme rain events could result in more frequent saturated soils which are conducive to landslides. Drought may also increase the likelihood of landslides if loss of vegetation decreases soil stability.

Most of Littleton is classified as having a low risk for landslides, while a very small corner of the western edge of Littleton is classified as moderate risk (see Map 4, Appendix A). No acreage in Littleton has been lost to landslides, as there have been no recorded incidents of landslides or damage caused by landslides in the town.

Should a landslide occur in the future, the type and degree of impacts would be highly localized, and the town's vulnerabilities could include damage to structures, damage to transportation and other infrastructure, and localized road closures. Potential damages would depend on the extent of impact, based on how many properties were affected. Given the relatively high assessed value of property in Littleton, damages affecting a single residence could exceed \$500,000, and damages affecting several homes or business properties could theoretically total several million dollars. However, there are no data available on landslide damages in Littleton, as there are no records of any damages caused by landslides in the town. Injuries and casualties, while possible, would be unlikely given the low extent and impact of landslides in Littleton.

CLIMATE TRENDS: RISING TEMPERATURES

EXTREME TEMPERATURE HAZARDS

AVERAGE AND EXTREME TEMPERATURES

Extreme temperatures occur when either high temperature or low temperatures relative to average local temperatures occur. These can occur for brief periods of time and be acute, or they can occur over long periods of time where there is prolonged period of excessively hot or cold weather. Extreme temperatures are a community-wide hazard in Littleton.

Littleton has four well-defined seasons. The seasons have several defining factors, with temperature one of the most significant. Extreme temperatures can be defined as those, which are far outside of the normal seasonal ranges for Massachusetts. The average temperatures for Massachusetts are: winter (Dec-Feb) Average = 31.8°F and summer (Jun-Aug) Average = 71°F. Extreme temperatures are a citywide hazard.

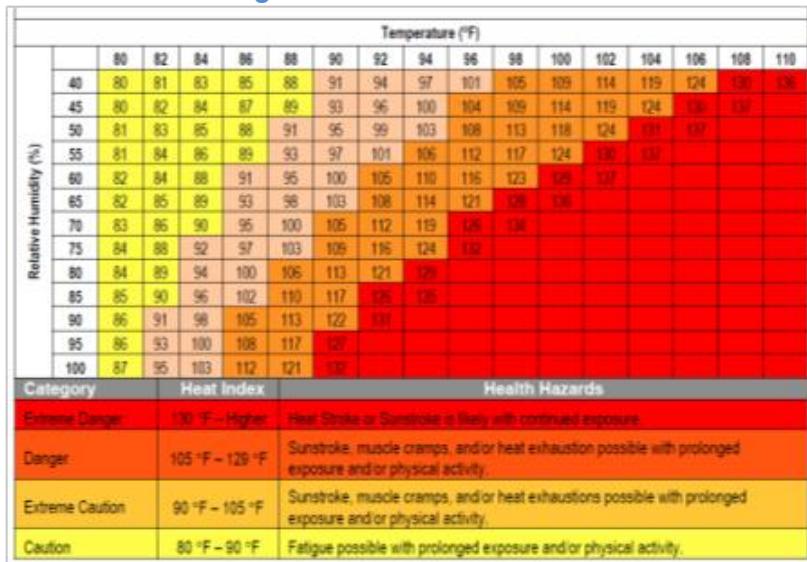
EXTREME HEAT

While a heat wave for Massachusetts is defined as three or more consecutive days above 90°F, another measure used for identifying extreme heat events is through a Heat Advisory from the

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NWS. These advisories are issued when the heat index (Figure 18) is forecast to exceed 100-degree Fahrenheit (F) for 2 or more hours; an excessive heat advisory is issued if forecast predicts the temperature to rise above 105 degree F. The highest temperature ever recorded in Littleton, Massachusetts, was 99°F (37.2°C) on July 24, 2022.

Figure 18: Heat Index Chart



Source: National Weather Service

The best available data on past occurrences of extreme heat events is from NOAA's National Centers for Environmental Information (NCEI) for Middlesex County, which includes Littleton. The NCEI records indicate that in the last decade, there have been two excessive heat events recorded, with one reported death, no injuries, and no property damage (see Table 19).

Table 19: Middlesex County Extreme Heat Occurrences 2010-2023

Date	Deaths	Injuries	Damage
7/6/2010	0	0	0
7/5/2013	1	0	0
TOTAL	1	0	0

Source: NOAA, National Centers for Environmental Information

Extreme heat poses a potentially greater risk to the elderly, children, and people with certain medical conditions. However, even young and healthy individuals can succumb to heat if they participate in strenuous physical activities during hot weather.

Older adults are often at elevated risk due to a high prevalence of pre-existing and chronic conditions; in Littleton approximately 16.3% of the population is over age 65. People who live in older housing stock and in housing without air conditioning have increased vulnerability to heat-related illnesses. Areas with less shade and darker surfaces (pavement and roofs) will experience even hotter temperatures; these surfaces absorb heat during the day and release it in the evening, keeping nighttime temperatures warmer as well.

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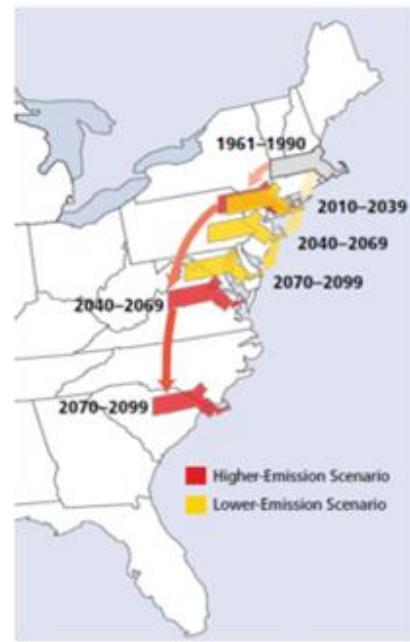
Hot summer days can worsen air pollution. With increased extreme heat, urban areas are likely to experience more days that fail to meet air quality standards. Power failures are more likely to occur during heat waves, affecting the ability of residents to remain cool during extreme heat. Individuals with pre-existing conditions and those who require electric medical equipment may be at increased risk during a power outage.

Extreme Heat and Climate Change

The 2022 MA Climate Change Assessment includes projections of climate-driven future increases in average temperature and in the number of extreme heat days. The assessment also highlights the following climate impacts for the Eastern Inland Region, related to temperatures. Over time our climate will become more similar to areas well to the south of New England (Figure 15).

- Warmer temperatures and more frequent heat waves are connected to impaired human health, increased droughts, reduced agriculture yields, species range shifts, and damaged infrastructure.
- By 2030, the summer mean temperature could increase by 3.6°F from the historical period (1950-2013), worsening stress on electric transmission and utility distribution infrastructure.
- By 2070, there could be 58 fewer days below freezing, increasing the chance of ticks overwintering and reducing winter recreation opportunities.
- Increase in vector borne diseases and bacterial infections, including West Nile Virus and Lyme disease due to more favorable conditions for ticks and mosquitoes.
- Damage to electric transmission and utility distribution infrastructure associated with heat stress
- Damage to rails and loss of transit service, including flooding and track buckling during high heat events.
- Reduced ability to work, particularly for outdoor workers during extreme heat, as well as commute delays due to damaged infrastructure.
- Reduced ability to work, particularly for outdoor workers during extreme heat, as well as commute delays due to damaged infrastructure.
- Freshwater ecosystem degradation due to warming waters.
- Forest health degradation from warming temperatures and increasing pest occurrence

Figure 19: Climate Impact Scenarios



The 2018 SHMCAP identifies ecosystems that are expected to be particularly vulnerable to warming temperatures. These include cold-water fisheries, vernal pools, spruce-fir forests, northern hardwood forests (Maple, Beach, Birch), Hemlock forests, and urban forests (due to heat island

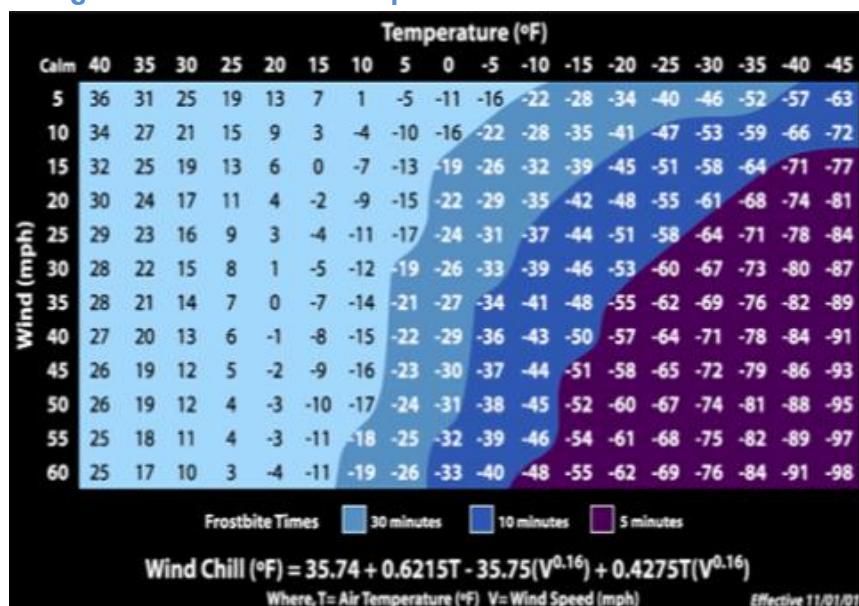
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impacts). Other Impacts on natural resources include a longer growing season and northern migration of plants and animals, including invasive species.

EXTREME COLD

Extreme cold is relative to the normal climatic lows in a region. Temperatures that drop decidedly below normal and wind speeds that increase can cause harmful wind-chill factors. The severity of extreme cold temperature is typically measured using the Wind Chill Temperature Index, which is provided by the National Weather Service (NWS). The wind chill is the apparent temperature felt on exposed skin due to the combination of air temperature and wind speed. The index is provided in Figure 20. A Wind Chill warning is issued when the Wind Chill Index is forecast to fall below -25 degrees F for at least 3 hours. The coldest temperature recorded in Littleton, MA, is -16°F (-26.7°C) on January 15, 2004.

Figure 20: Wind Chill Temperature Index and Frostbite Risk



Source: National Weather Service

The best available data on past occurrences of extreme cold events are from NOAA's National Centers for Environmental Information (NCEI) for Middlesex County, which includes Littleton. There were three extreme cold events recorded by NCEI in the past ten years (Table 20), which caused no deaths, no injuries, or property damage.

Table 20: Middlesex County Extreme Cold and Wind Chill Occurrences

Date	Deaths	Injuries	Damages
2/15/2015	0	0	0
2/16/2015	0	0	0
2/14/2016	0	0	0
TOTAL	0	0	0

Source: NOAA, National Centers for Environmental Information

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Extreme cold is a dangerous situation that can result in health emergencies for susceptible people, such as those without shelter or who are stranded or who live in homes that are poorly insulated or without heat. The entire Town of Littleton is potentially vulnerable to the impacts of extreme cold. The greatest vulnerability to the Littleton would be a power outage during a winter storm, which could temporarily leave many residents without heat. In Littleton, 16.3% of residents are 65 years old and over, and 7% are living in poverty (US Census Bureau, 2021). Prolonged extreme cold temperatures may also cause water pipes to burst, which may cause flooding in buildings, leading to property damage. Extremely cold temperatures often accompany winter storms, which may also cause power failures and hazardous travel due to icy roads.

Probability of Future Occurrences

Extreme temperature events are projected to be medium frequency events based on past occurrences, as defined by the Massachusetts State Hazard Mitigation Plan. Both extreme cold and hot weather events occur between once in five years to once in 50 years, or a 2 percent to 20 percent chance of occurring each year.

INVASIVE SPECIES

The 2018 Massachusetts State Hazard Mitigation and Climate Adaptation Plan includes invasive species as a natural hazard for the first time. They are defined as “non-native species that cause or are likely to cause harm to ecosystems, economies, and/or public health”. In new habitats invasive species displace native species because they have competitive advantages including no biological controls from their native habitat.

Some of the more recognizable invasive plant species noted in the SHMCAP include Norway maple, garlic mustard, Japanese barberry, black swallowwort, buckthorn, purple loosestrife, water milfoil, Japanese knotweed, and phragmites. Invasive pests include emerald ash borer, hemlock wooly adelgid, and the Asian long-horned beetle.

Littleton is experiencing the loss of flood storage capacity and seeing a minor increase of fire danger from dead vegetation resulting from invasive species. The terrestrial invasive plant species of concern in Littleton are currently phragmites, oriental bittersweet, Japanese knotweed as well as the following insects, wooly adelgid, lanternfly, emerald ash borer, and the Asian long-horned beetle.

However, more recently the town has become much more concerned with aquatic invasive species. Last year (2023) there was an unprecedented amount of Fanwort, Water Milfoil and Curly Leaf Pondweed in Spectacle Pond and Lake Matawanakee. It was the first time in over 25 years that the Littleton Clean Lakes Committee (CLC) conducted summer invasive plant removal operations in Lake Matawanakee. Conditions are not much different so far this spring (2024). We anticipate needing to repeat the process again this year.

The CLC implemented a program of mechanical harvesting of aquatic invasives in Lake Matawanakee, Spectacle Pond and Long Lake. Annual herbicide treatments have been used for years in Spectacle Pond and Long Lake – usually with satisfactory results. But mechanical harvesting removes the invasive plants rather than killing them back to break down on the lake

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floor. Removal of the plant material begins to reduce the accumulated biomass in our waterbodies, eventually lowering the high level of nutrients that starve off oxygen and feed the weed growth.

All of Littleton's lakes are showing signs of age, primarily because of the neighborhoods that were built along their shores. Storm runoff flushes sediment, oils, detergents, pet waste and fertilizer from all over the watershed directly into our lakes and streams. Roadside storm drains keep streets clear but accelerate the destruction of our waterbodies. The resulting nutrient loading upsets the balance of aquatic ecosystems, threatening the suitability of the water to sustain the wildlife the town treasures.

The CLC emphasizes the need to interrupt that flow of runoff with swales and retention basins, rain gardens and recharging zones that can begin to return our lakes and streams to good health. Good work was done to this end at Long Lake 20 years ago, but it was just a start and it's time to do more. On the other hand, for the basins of Mill Pond, it might be too late. Maybe that's the Town's hazard in need of mitigation.

In the interest of planning at a regional scale, the CLC was a founding participant of the Stony Brook Flow Restoration Project (www.stonybrookflow.com). It seeks to recreate the natural flow of Stony Brook through Littleton and Westford to benefit aquatic life and improve water quality. There's an online dashboard that charts flows in real time and compares them to models of past conditions. This has been especially helpful during periods of drought.

Invasive Species and Climate Change

Climate change is predicted to increase the abundance of invasive species and expand their habitat ranges. Species hierarchies in ecosystems are also expected to change, and ecosystems that are stressed (due to climate-change associated drought, increased temperatures, wildfires, etc.) will be more susceptible to invasive species.

Probability of Future Occurrences

Based on the record of previous occurrences, invasive species in Littleton is a Very High frequency event as defined by the Resilient MA Plan. Invasive species are almost certain to occur multiple times a year.

WILDFIRE HAZARDS

A wildfire is a non-structure fire occurring in a forested, shrub, or grassland area. In the Boston Metro region these fires rarely grow to the size of a wildfire as seen more typically in the western U.S. As their name implies, these fires typically burn no more than the underbrush of a forested area. There are three different classes of wild fires:

- **Surface fires** are the most common type and burn along the floor of a forest, moving slowly and killing or damaging trees;
- **Ground fires** are usually started by lightning and burn on or below the forest floor;
- **Crown fires** spread rapidly by wind, jumping along the tops of trees.

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Wildfire season can begin in March and usually ends in late November. The majority of wildfires typically occur in April and May, when most vegetation is void of any appreciable moisture, making them highly flammable. Once "green-up" takes place in late May to early June, the fire danger usually is reduced somewhat.

A wildfire differs greatly from other fires by its extensive size, the speed at which it can spread out from its original source, its potential to unexpectedly change direction, and its ability to jump gaps such as roads, rivers and fire breaks.

The National Wildfire Coordinating Group (NWCG) classifies the severity of wildfires based on their acreage as follows:

- Class A - one-fourth acre or less;
- Class B - more than one-fourth 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 (NWCG, 2023).

The most susceptible fuels are pitch pine, scrub oak and oak forests. Topography can affect the behavior of fires, as fire spreads more easily uphill. Fires can present a hazard where there is the potential to spread into developed or inhabited areas, particularly residential areas where sufficient fuel materials might exist to allow the fire the spread into homes. Protecting structures from fire poses special problems and can stretch firefighting resources to the limit. The most common cause of wildfires is the careless disposal of smoking materials and unintended campfires.

If heavy rains follow a fire, other natural disasters can occur, including landslides, mudflows, and floods. If a wildfire destroys ground cover, erosion becomes one of several potential problems.

Wildfires in Massachusetts are measured by the number of fires and the sum of acres burned. The most recent data available for wildfires in Massachusetts, shown in Figure 20 below.

Potential Wildfire Hazard Areas

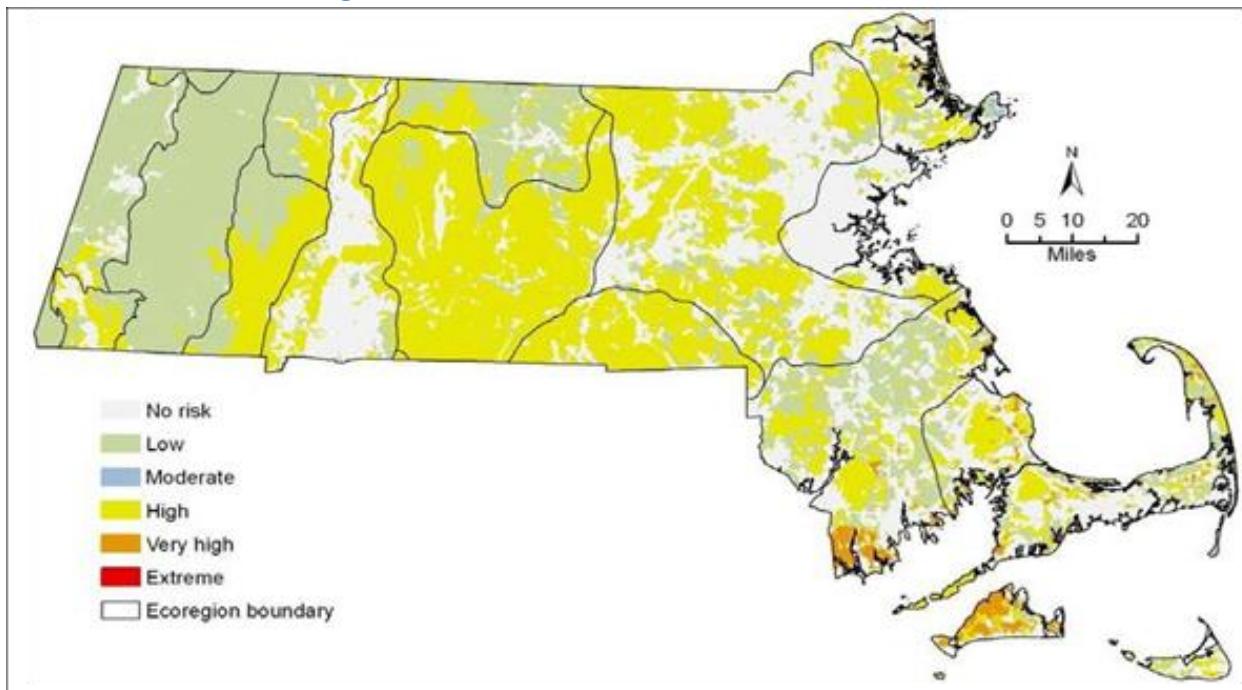
The 2018 SHMCAP includes a map that depicts statewide fire risk incorporating three risk components: fuel, wildland-urban interface, and topography (Figure 20). The wildland-urban interface reflects communities where housing and vegetation intermingle, and fire can spread from structures to vegetated areas.

Potential vulnerabilities to wildfires include damage to structures and other improvements, and impacts on natural resources such as wildlife habitat. Smoke and air pollution from wildfires can be a health hazard, especially for sensitive populations including children, the elderly, and those with respiratory and cardiovascular diseases. Should a wildfire occur in Littleton or in other nearby communities, the resulting smoke could have negative impacts on air quality. This could have public health impacts, particularly for those with respiratory conditions such as asthma. The Massachusetts Department of Public Health Bureau of Environmental Health states that Littleton

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has a lower pediatric asthma prevalence in K-8 students, and a lower rate of asthma emergency department visits, than the state average (MA Dept of Public Health, 2022). However, given the low extent of wildfires in the town and the immediate response times to reported fires in Littleton the likelihood of injuries and casualties is minimal. Since 2019, the Fire Department has responded to 3 brushfires in 2019, 6 in 2020, 11 in 2021, 9 in 2022 and 12 in 2023.

Figure 21: Wildfire Risk Areas in Massachusetts



Source: 2018 SHMCAP

Potential Brushfire Hazard Areas

The following areas of Town were identified as having the highest potential for brush fires based on the accumulation of dried vegetation growth. The numbers correspond to the numbers on Map 8, "Hazard Areas" in Appendix B.

8. Oak Hill Conservation Site, 200 acres.
9. Newtown Hill Conservation Area, 98 acres
10. Morgan Property/Forest Foundation, 50 acres
11. Frost and Whitcomb land off Newton Road, 103 acres
14. Smith Conservation land, Moore Lane/Wickham Lane
15. Cobb/Yapp Conservation land, by Newtown Road

Potential vulnerabilities to wildfires include damage to structures and other improvements, and impacts on natural resources such as town conservation land. Smoke and air pollution from wildfires can be a health hazard, especially for sensitive populations including children, the elderly, and those with respiratory and cardiovascular diseases.

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Probability of Future Occurrences

Potential damages from wildfires in Littleton would depend on the extent and type of land affected. Based on past occurrences and the Massachusetts Resilience Plan, brushfires are of Medium frequency, meaning that they are likely to occur at least once every 50 years (two or more occurrences this century).

Wildfire and Climate Change

As the climate warms, drought and warmer temperatures may increase the risk of wildfire as vegetation dries out and becomes more flammable. Increasing drought and increasing damage to trees from pests, can also lead to greater fire risk. The 2022 Assessment cites anticipated forest health degradation from increasing wildfire frequency for the Eastern Inland Region, where Littleton is located (Commonwealth of Massachusetts, 2022).

CLIMATE TRENDS: EXTREME WEATHER

Extreme weather includes wind-related hazards (such as hurricanes, tropical storms, tornadoes, and thunderstorms) as well as winter weather (such as Nor'easters, blizzards, and ice conditions). Following is a description of the types of natural hazards associated with extreme weather events.

WIND HAZARDS

Wind-related hazards include hurricanes, tropical storms, and tornadoes as well as high winds during Nor'easters and thunderstorms. As with many communities, falling trees that result in downed power lines and power outages are an issue in Littleton. Information on wind related hazards can be found on Map 5 in Appendix A, which indicates that the 100-year wind speed in Littleton is 110 miles per hour.

HURRICANES AND TROPICAL STORMS

A hurricane is a violent wind and rainstorm with wind speeds of 74-200 miles per hour. A hurricane is strongest as it travels over the ocean and is particularly destructive to coastal property as the storm hits the land. The Town's entire area is vulnerable to hurricanes. Hurricanes occur between June and November. A tropical storm has similar characteristics, but wind speeds are below 74 miles per hour.

Since 1900, Massachusetts has experienced approximately 32 tropical storms, nine Category 1 hurricanes, five Category 2 hurricanes and one Category 3 hurricane. A hurricane or storm track is the line that delineates the path of the eye of a hurricane or tropical storm.

As shown in Map 5 in Appendix A, the following storms tracked through Littleton:

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- Category 1 Hurricane in 1858
- Category 2 Hurricane in 1960
- Tropical Depression in 1988
- Tropical Storm in 1999

In addition, Littleton experiences the impacts of hurricanes and tropical storms regardless of whether the storm track passes directly through the Town, and numerous hurricanes have affected the communities of eastern Massachusetts (see Table 21).

Table 21: Hurricane Records for Massachusetts, 1938 - 2023

Hurricane Event	Date
Great New England Hurricane	September 21, 1938
Great Atlantic Hurricane	September 14-15, 1944
Hurricane Doug	September 11-12, 1950
Hurricane Carol	August 31, 1954
Hurricane Edna	September 11, 1954
Hurricane Diane	August 17-19, 1955
Hurricane Donna	September 12, 1960
Hurricane Gloria	September 27, 1985
Hurricane Bob	August 19, 1991
Hurricane Earl	September 4, 2010
Tropical Storm Irene	August 28, 2011
Hurricane Sandy	October 29-30, 2012

National Oceanic and Atmospheric Administration

Hurricane intensity is measured according to the Saffir/Simpson scale, which categorizes hurricane intensity linearly based upon maximum sustained winds, barometric pressure, and storm surge potential. These are combined to estimate potential damage. The following gives an overview of the wind speeds, surges, and range of damage caused by different hurricane categories:

Scale No. (Category)	Winds(mph) Storm	Surge (ft)	Potential Damage
1	74 – 95	4 - 5	Minimal
2	96 – 110	6 - 8	Moderate
3	111 – 130	9 - 12	Extensive
4	131 – 155	13 - 18	Extreme
5	> 155	>18	Catastrophic

Source: NOAA

Falling trees and branches are a significant problem because they can result in power outages when they fall on power lines or block traffic and emergency routes. Hurricanes are a town-wide hazard in Littleton. Potential hurricane damages to Littleton have been estimated using HAZUS-MH. Total damages are estimated at \$15 million for a 100 hurricane and \$53 Million for a 500 year hurricane.

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Based on records of previous occurrences, hurricanes in Littleton are a medium frequency event as defined by the Massachusetts Resilience Plan. This hazard is likely to occur every fifty years.

Probability of Future Occurrences

Based on records of previous occurrences, hurricanes in Littleton are a Medium frequency event as defined by the Resilient MA Plan. This hazard occurs from once in 5 years to once in 50 years, or a 2% to 20% chance per year.

Hurricanes and Climate Change

Climate models suggest that hurricanes and tropical storms will become more intense as warmer ocean waters provide more fuel for the storms. In addition, rainfall amounts associated with hurricanes are predicted to increase because warmer air can hold more water vapor.

SEVERE THUNDERSTORMS

While less severe than the other types of storms discussed, thunderstorms can lead to localized damage and represent a hazard risk for communities. Generally defined as a storm that includes thunder, which always accompanies lightning, a thunderstorm is a storm event featuring lightning, strong winds, and rain and/or hail. Thunderstorms sometime give rise to tornados. On average, these storms are only around 15 miles in diameter and last for about 30 minutes. A severe thunderstorm can include winds of close to 60 mph and rain sufficient to produce flooding. The severity of thunderstorms ranges from commonplace and of short duration to intense storms that cause damage due to high winds, flooding, or lightning strikes.

Eastern Massachusetts is at risk of one to two severe thunderstorms per year. The best available data on previous occurrences of thunderstorms in Littleton is through NOAA's National Centers for Environmental Information (NCEI). For the years 2010 to 2022, NCEI records show 84 thunderstorm wind events in Middlesex County (Table 22). These storms resulted in an estimate of \$3.47 million in property damage. There were seven injuries and no death reported.

Table 22: Middlesex County Thunderstorm Wind Events, 2010 to 2023

DATE	MAGNITUDE (knots)	DEATHS	INJURIES	PROPERTY DAMAGE \$
5/4/2010	50	0	0	30000
6/1/2010	50	0	0	5000
6/3/2010	50	0	0	20000
6/5/2010	50	0	0	40000
6/6/2010	50	0	1	100000
6/24/2010	50	0	0	30000
7/12/2010	50	0	0	50000
7/19/2010	50	0	0	25000
6/1/2011	50	0	0	5000
6/9/2011	50	0	0	15000
8/2/2011	50	0	0	1000
8/19/2011	50	0	0	15000

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6/8/2012	50	0	0	25000
6/23/2012	45	0	0	5000
7/4/2012	50	0	0	10000
7/18/2012	70	0	0	350000
9/7/2012	50	0	0	10000
9/8/2012	40	0	0	3000
6/17/2013	50	0	0	25000
6/18/2013	45	0	0	10000
6/24/2013	45	0	0	3000
7/23/2013	50	0	0	20000
7/29/2013	50	0	0	5000
7/3/2014	50	0	0	75000
7/7/2014	87	0	0	100000
7/15/2014	50	0	0	25000
7/28/2014	50	0	0	50000
9/6/2014	50	0	1	15000
5/28/2015	45	0	0	5000
8/4/2015	50	0	0	40000
8/15/2015	50	0	0	25000
2/25/2016	50	0	0	30000
3/17/2016	45	0	0	5000
7/22/2016	50	0	0	14,000
7/23/2016	50	0	0	0
8/22/2016	50	0	0	0
9/11/2016	50	0	0	10,000
5/18/2017	50	0	0	0
6/13/2017	52	0	0	0
6/23/2017	52	0	0	1000
6/27/2017	50	0	0	0
7/12/2017	50	0	0	0
8/2/2017	50	0	0	0
9/6/2017	50	0	0	0
5/15/2018	40	0	0	0
6/18/2018	50	0	0	0
6/25/2018	43	0	0	0
7/17/2018	50	0	0	3000
7/26/2018	50	0	0	5000
8/7/2018	50	0	0	3000
8/17/2018	50	0	0	4000
9/6/2018	50	0	0	2000

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10/23/2018	46	0	0	10,000
6/30/2019	50	0	0	800
7/17/2019	50	0	0	7250
7/31/2019	50	0	0	2500
8/7/2019	50	0	0	800
9/4/2019	55	0	0	26700
5/15/20	50	0	0	285,000
6/06/20	50	0	0	7000
6/21/20	50	0	0	38,200
6/28/20	55	0	0	6000
7/02/20	50	0	0	15300
7/05/20	50	0	0	12300
7/23/20	60	0	0	40600
7/30/20	50	0	0	3100
8/22/20	50	0	0	6000
8/23/20	50	0	0	25600
8/27/20	50	0	0	1600
10/07/20	61	0	5	6500
11/15/20	56	0	0	4000
5/6/21	50	0	0	800
6/30/21	50	0	0	500
7/6/21	50	0	0	18,500
7/7/21	55	0	0	7,600
7/27/21	52	0	0	33,800
8/19/21	50	0	0	1,300
9/13/21	50	0	0	400
3/7/22	56	0	0	19,000
7/2/22	50	0	0	800
7/21/22	50	0	0	500
8/5/22	50	0	0	9,900
8/7/22	60	0	0	30,300
8/26/22	50	0	0	7,800
9/13/22	50	0	0	3,000
6/2/23	52	0	0	20,000
TOTAL		0	7	\$3.48M

*Magnitude refers to maximum wind speed. Source: NOAA, National Climatic Data Center

The entire town of Littleton is potentially vulnerable to the impacts of thunderstorms, which are principally high winds and may include severe precipitation. The town's vulnerability to the winds associated with severe thunderstorms can include falling trees which cause power outages, as well as obstruction of key routes and emergency access. Heavy precipitation may also cause localized

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flooding, both riverine and urban drainage related. Severe localized flooding may also block key travel corridors and emergency access.

Probability of Future Occurrences

Based on the record of previous occurrences, severe thunderstorms in Littleton are high frequency events. This hazard occur more frequently than once in 5 years (greater than 20% per year).

Thunderstorms and Climate Change

As noted previously, the intensity of rainfall events has increased significantly, and those trends are expected to continue. Neither the 2018 SHMCAP, nor the 2022 Massachusetts Climate Change Assessment, specifically address whether climate will affect the intensity or frequency of thunderstorms.

HAIL

Hail events are frequently associated with thunderstorms and other severe storm events. Hail size typically refers to the diameter of the hailstones. Warnings may report hail size through comparisons with real-world objects that correspond to certain diameters as shown in Table 23.

Table 23: Hail Size Comparisons

Description	Diameter (inches)
Pea	0.25
Marble or mothball	0.50
Penny or dime	0.75
Nickel	0.88
Quarter	1.00
Half dollar	1.25
Walnut or ping pong ball	1.50
Golf ball	1.75
Hen's egg	2.00
Tennis ball	2.50
Baseball	2.75
Teacup	3.00
Grapefruit	4.00
Softball	4.50

Source: NOAA

The entire built environment of Littleton is potentially vulnerable to the impacts of hail. Potential damages from larger-size hail could include damage to vehicles, windows, roofs, and other structures, as well as some utility facilities. However, no significant hail damage has been reported in Littleton. Should solar energy facilitates be sited in Littleton in the future, they could be vulnerable to the impacts of hail.

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The best available data on previous hail events are recorded for Middlesex County through NOAA's National Centers for Environmental Information (NCEI) Storm Events Database. There were 9 hail events recorded from December 2012 through December 2022, as shown in Table 24. There was no property damage, injuries, or deaths reported for any of these hail events.

Table 24: Middlesex County Hail Events, 2012-2023

Date	Magnitude	Deaths	Injuries	Property Damage (\$)
5/4/2010	0.75	0	0	0
5/7/2011	0.75	0	0	0
6/1/2011	0.75	0	0	0
8/2/2011	0.75	0	0	0
8/19/2011	0.75	0	0	0
3/13/2012	1.25	0	0	0
3/14/2012	1	0	0	0
6/23/2012	0.75	0	0	0
7/18/2012	1	0	0	0
10/30/201	1	0	0	0
6/17/2013	0.75	0	0	0
5/25/2014	0.75	0	0	0
7/3/2014	1	0	0	0
8/7/2014	0.75	0	0	0
9/6/2014	0.88	0	0	0
8/4/2015	1	0	0	0
8/15/2015	0.75	0	0	0
7/23/2016	.75	0	0	0
6/27/2017	1.00	0	0	0
8/2/2017	.75	0	0	0
6/29/19	.75	0	0	0
6/06/20	1.00	0	0	0
6/28/20	1.00	0	0	0
7/30/20	.75	0	0	0
8/23/20	1.00	0	0	0
6/2/23	.75	0	0	0
TOTAL		0	0	0

Source: NOAA, National Centers for Environmental Information

*Magnitude refers to diameter of hail stones in inches

The town has not reported any local damages associated with hail. Should a significant hail event occur, the most likely damages would be to vehicles, both town-owned and privately owned, damage to vegetation which could cause power outages, and damage to some buildings. Hail events are a potential town-wide hazard in Littleton.

Probability of Future Occurrences

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Based on the record of previous occurrences in Middlesex County, hail events in Littleton are a Medium frequency event. This hazard may occur from once in 5 years to once in 50 years, or a 2% to 20% chance per year.

TORNADOES

A tornado is a violent windstorm characterized by a twisting, funnel-shaped cloud. These events are spawned by thunderstorms and occasionally by hurricanes, and may occur singularly or in multiples. They develop when cool air overrides a layer of warm air, causing the warm air to rise rapidly. Most vortices remain suspended in the atmosphere. Should they touch down, they become a force of destruction. Some ingredients for tornado formation include:

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

Tornadoes are most common in the summer, June through August and most form in the afternoon or evening. Tornadoes can be associated with strong thunderstorms.

Tornado damage severity is measured by the Fujita Tornado Scale, in which wind speed is not measured directly but rather estimated from the amount of damage. As of February 01, 2007, the National Weather Service began rating tornadoes using the Enhanced Fujita-scale (EF-scale), which allows surveyors to create more precise assessments of tornado severity. The EF-scale is summarized in the Table below:

The frequency of tornadoes in eastern Massachusetts is low; on average, there are six tornadoes that touchdown somewhere in the Northeast region every year. The strongest tornado in Massachusetts history was the Worcester Tornado in 1953 (NESEC).

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Table 25: Enhanced Fujita Scale

Scale	Wind speed		Relative frequency	Potential damage	
	mph	km/h			
EF0	65–85	105–137	53.5%	Minor damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over. Confirmed tornadoes with no reported damage (i.e., those that remain in open fields) are always rated EF0.	
EF1	86–110	138–178	31.6%	Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.	
EF2	111–135	179–218	10.7%	Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.	
EF3	136–165	219–266	3.4%	Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.	
EF4	166–200	267–322	0.7%	Extreme damage to near-total destruction. Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.	
EF5	>200	>322	<0.1%	Massive Damage. Strong frame houses leveled off foundations and swept away; steel-reinforced concrete structures critically damaged; high-rise buildings have severe structural deformation. Incredible phenomena will occur.	

Source: SHMCAP 2018

Recent tornado events in Massachusetts resulted in significant damage in Springfield in 2011 and in Revere in 2014. The Springfield tornado caused significant damage and resulted in four deaths in June of 2011. The Revere tornado touched down in Chelsea just south of Route 16, moved north into Revere's business district along Broadway, and ended near the intersection of Routes 1 and 60. The path was approximately two miles long and 3/8 mile wide, with wind speeds up to 120 miles per hour. Approximately 65 homes had substantial damage and 13 homes and businesses were rendered uninhabitable. And on August 22, 2016, an F1 tornado passed through part of nearby Concord. It impacted an area 0.85 miles long by 400 yards wide. According to the report from the National Centers for Environmental Information:

"This tornado touched down near the Cambridge Turnpike and headed northeast. Most of the damage was concentrated in an area beginning near the intersection of Lexington Road and Alcott Road and continuing up to the neighborhood of Alcott and Independence Roads. Numerous trees were uprooted or had the tops sheared off. These subsequently blocked roads, damaged homes, and downed power lines, cutting off power to the neighborhood. In addition, utility poles were downed either from the wind or from the downed power lines. Thirty-nine houses in this area were damaged to some degree.

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Only one house suffered significant structural damage. The tornado continued for a short distance beyond this neighborhood before lifting. The historical home of Louisa May Alcott and her family was right next to the tornado path but was not damaged.”

There has been one recorded tornado within the limits of the Town of Littleton on October 30, 1970. Since 1955 there have been 18 tornadoes in surrounding Middlesex County recorded by the National Center for Environmental Information. Two of these were F3 tornados, and four were F2. These 18 tornadoes resulted in a total of one fatality and six injuries and \$4.88 million in damages, as summarized in Table 26.

Table 26: Tornado Records for Middlesex County

Date	Fujita Scale	Fatalities	Injuries	Property Damage \$	Length (mile)	Width (yard)
10/24/1955	1	0	0	2.50K	10	0.1
6/19/1957	1	0	0	25.00K	17	1
6/19/1957	1	0	0	0.25K	100	0.5
7/11/1958	2	0	0	250.00K	17	1.5
8/25/1958	2	0	0	2.50K	50	1
7/3/1961	0	0	0	25.00K	10	0.5
7/18/1963	1	0	0	25.00K	50	1
8/28/1965	2	0	0	250.00K	10	2
7/11/1970	1	0	0	25.00K	50	0.1
10/3/1970	3	1	0	250.00K	60	35.4
7/1/1971	1	0	1	25.00K	10	25.2
11/7/1971	1	0	0	0.25K	10	0.1
7/21/1972	2	0	4	2.500M	37	7.6
9/29/1974	3	0	1	250.00K	33	0.1
7/18/1983	0	0	0	0.25K	20	0.4
9/27/1985	1	0	0	0.25K	40	0.1
8/7/1986	1	0	0	250.00K	73	4
8/22/2016	1	0	0	1.000M	400	.85
8/23/2021	0	0	0	10.00K		
TOTAL		1	6	4.88M		

Source: NOAA, National Center for Environmental Information

Buildings constructed prior to current building codes may be more vulnerable to damages caused by tornadoes. Evacuation of impacted areas may be required on short notice. Sheltering and mass feeding efforts may be required along with debris clearance, search and rescue, and emergency fire and medical services. Key routes may be blocked by downed trees and other debris, and widespread power outages are also typically associated with tornadoes. At this time, the Massachusetts State Building Code's provisions are the most cost-effective mitigation measure against tornadoes given the extremely low probability of occurrence.

Although tornadoes are a potential town-wide hazard in Littleton, tornado impacts are relatively localized compared to severe storms and hurricanes. Damages from any tornado in Littleton would greatly depend on the track of the tornado. Generally, the more densely developed areas including Littleton Common, Long Pond, and other residential clusters, would likely be subject to more damage in the event of a tornado.

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Based on the record of previous occurrences since 1950, Tornado events in Littleton are a Medium frequency event as defined by the 2013 Massachusetts State Hazard Mitigation Plan. This hazard may occur from once in 5 years to once in 50 years, or a 2% to 20% chance per year.

Probability of Future Occurrences

Based on the record of previous occurrences since 1950, Tornado events in Littleton are a Low frequency event as defined by the Resilient MA Plan. This hazard is likely to occur at least once by the end of the century; with some examples of historical occurrences.

Tornadoes and Climate Change

According to the SHMCAP, it is possible that severe thunderstorms which can include tornadoes may increase in frequency and intensity. However, scientists have less confidence in the models that seek to project future changes in tornado activity. Massachusetts' 2022 Climate Change Assessment does not include information related to tornadoes.

WINTER HAZARDS

Winter storms, including heavy snow, blizzards, and ice storms, are the most common and most familiar of the region's hazards that affect large geographic areas. The majority of blizzards and ice storms in the region cause more inconvenience than they do serious property damage, injuries, or deaths. However, periodically, a storm will occur which is a true disaster, and necessitates intense large-scale emergency response.

SEVERE WINTER STORM/NOR'EASTER

A northeast coastal storm, known as a nor'easter, is typically a large counter-clockwise wind circulation around a low-pressure center. Featuring strong northeasterly winds blowing in from the ocean over coastal areas, nor'easters are relatively common in the winter months in New England occurring one to two times a year. The storm radius of a nor'easter can be as much as 1,000 miles and these storms feature sustained winds of 20 to 40 mph with gusts of up to 70 mph. These storms are accompanied by heavy rains or snows, depending on temperatures. Nor'easters may also sit stationary for several days, affecting multiple tide cycles and extended heavy precipitation.

Many of the historic flood events identified in the previous section were precipitated by nor'easters, including the "Perfect Storm" event in 1991. More recently, blizzards in December 2010, October 2011, February 2013, and January 2015, and March 2018 were large nor'easters that caused significant snowfall amounts.

Previous occurrences of Nor'easters are listed in Table 27.

Table 27: Nor'easter Events for Massachusetts, 1978 - 2021

Date	Nor'easter Event
February 1978	Blizzard of 1978
October 1991	Severe Coastal Storm ("Perfect Storm")
December 1992	Great Nor'easter of 1992

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January 2005	Blizzard/Nor'easter
October 2005	Coastal Storm/Nor'easter
April 2007	Severe Storms, Inland & Coastal Flooding/Nor'easter
January 2011	Winter Storm/Nor'easter
October 2011	Severe Storm/Nor'easter
February 2013	Blizzard of 2013
January 2015	Blizzard of 2015
March 2015	March 2015 Nor'easters
January 2018	January 2018
March 2018	March 2018

Littleton is vulnerable to both the wind and precipitation that accompanies nor'easters. High winds can cause damage to structures, fallen trees, and downed power lines leading to power outages. Intense rainfall can overwhelm drainage systems causing localized flooding of rivers and streams as well as urban stormwater ponding and localized flooding. Fallen tree limbs as well as heavy snow accumulation and intense rainfall can impede local transportation corridors, and block access for emergency vehicles.

The entire Town of Littleton could be at risk from the wind, rain or snow impacts from a nor'easter, depending on the track and radius of the storm, but due to its inland location the town is not subject to coastal hazards.

Based on the record of previous occurrences, nor'easters in Littleton are high frequency events as defined by the 2013 Massachusetts State Hazard Mitigation Plan. This hazard may occur more frequently than once in 5 years (greater than 20% per year).

BLIZZARDS & HEAVY SNOW

A blizzard is a winter snow storm with sustained or frequent wind gusts to 35 mph or more, accompanied by falling or blowing snow reducing visibility to or below ¼ mile. 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. The hazard created by the combination of snow, wind and low visibility significantly increases, however, with temperatures below 20 degrees.

Winter storms are a combination hazard because they often involve wind, ice and heavy snow fall. The National Weather Service defines “heavy snow fall” as an event generating at least 4 inches of snowfall within a 12 hour period. Winter Storms are often associated with a Nor'easter event, a large counter-clockwise wind circulation around a low-pressure center often resulting in heavy snow, high winds, and rain. Blizzards and winter storms are often associated with a Nor'easter event (see Nor'easters section above).

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The Regional Snowfall Index (RSI) characterizes and ranks the severity of northeast snowstorms. RSI has five categories: Extreme, Crippling, Major, Significant, and Notable. RSI scores are a function of the area affected by the storm, the amount of snow, and the number of people living in the path of the storm. The largest RSI values result from storms producing heavy snowfall over large areas that include major metropolitan centers. The RSI categories are shown in Table 28.

Table 28: Regional Snowfall Index

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

Source: 2018 SHMCAP

The most significant winter storm in recent history was the “Blizzard of 1978,” which resulted in over 3 feet of snowfall and multiple day closures of roadways, businesses, and schools.

The best available data on previous occurrences and impacts of heavy snow events in Littleton is available for Middlesex County from the National Centers for Environmental Information (NCEI) records. From 2010 to 2022, Middlesex County experienced nearly 40 days with heavy snowfall events, resulting in no injuries, deaths, and property damage of \$142,500, as shown in Table 29.

Table 29: Heavy Snow Events in Middlesex County, 2010 to 2022

Date	Deaths	Injuries	Property Damage (\$)
1/18/2010	0	0	0
2/16/2010	0	0	15,000
2/23/2010	0	0	8,000
1/12/2011	0	0	0
10/29/2011	0	0	30,000
12/29/2012	0	0	0
2/8/2013	0	0	0
2/8/2013	0	0	0
2/23/2013	0	0	0
3/7/2013	0	0	0
3/18/2013	0	0	0
12/14/2013	0	0	0
12/17/2013	0	0	0
1/2/2014	0	0	0
1/18/2014	0	0	0
2/5/2014	0	0	0

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2/13/2014	0	0	0
2/18/2014	0	0	0
11/26/2014	0	0	10,000
1/24/2015	0	0	0
1/26/2015	0	0	0
2/2/2015	0	0	0
2/8/2015	0	0	0
2/14/2015	0	0	0
2/5/2016	0	0	75,000
3/21/2016	0	0	0
4/4/2016	0	0	0
12/29/2016	0	0	0
3/14/2017	0	0	0
11/15/2018	0	0	0
12/1/2019	0	0	4,000
1/18/20	0	0	0
3/23/20	0	0	0
10/30/20	0	0	500
12/05/20	0	0	0
12/16/20	0	0	0
2/1/21	0	0	0
1/28/22	0	0	0
TOTAL	0	0	\$142,500

Source: NOAA, National Climatic Data Center

An indication of previous severe winter events is the list of Presidentially-declared disasters for blizzards snowstorms. There have been 14 since 1978, as shown in Table 29. The most significant single winter storm was the “Blizzard of 1978,” which resulted in over three feet of snowfall and multiple day closures of roadways, businesses, and schools. The record snowfall of January 2015 resulted from a series of storms over that month. The most recent significant winter event was Winter Storm Kenan (January 29, 2022), which resulted in 30.9” of snow in Massachusetts (Stucker, 2022).

Table 30: Winter-Related Federal Disaster Declarations, 1978-2022

Disaster Name	Date of Event
Coastal Storms, Flood, Ice & Snow	February 1978
Winter Coastal Storm	December 1992
Blizzard	March 1993
Blizzard	January 1996
Snowstorm	March 2001
Snowstorm	February 2003

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Snowstorm	December 2003
Snowstorm	January 2005
Severe Winter Storm, Snowstorm	January 2011
Severe Winter Storm, Snowstorm, Flooding	February 2013
Severe winter storm, snowstorm, flooding	January 2015
Severe winter storm and Snowstorm	March 2018
Severe winter storm and flooding	March 2018
Severe winter storm and snowstorm	January 2022

Sources: OpenFEMA Dataset: *Disaster Declarations and FEMA Declared Disasters*

Winter storms are a potential town-wide hazard in Littleton. The average annual snowfall for Littleton is 48 - 72 inches (see Map 6 in Appendix B). The impacts of winter storms are often related to the weight of snow and ice, which can cause roof collapses and also causes tree limbs to fall which can in turn cause power outages, property damage, and injuries. The Town's vulnerability is primarily related to restrictions to travel on roadways, road closures, school closures, and potential restrictions on emergency vehicle access. The Town works to clear roads and carries out general snow removal operations, and bans on-street parking during snow removal to ensure that streets can be plowed and public safety vehicle access is maximized. Commuter rail operations may also be impacted, as they were in the 2015 blizzard which caused the closure of the MBTA system for one day and limited services on several commuter rail lines, including the Fitchburg line which serves Littleton, for several weeks. Another winter storm vulnerability is power outages due to fallen trees and utility lines.

Potential Snow Hazard Areas

One challenge the town faces is occasional snow drifting onto Nagog Hill Road (4) and Newtown Road (5) see locations on Map 6 in Appendix A). The Town has purchased portable barriers to prevent drifting on these roads.

Probability of Future Occurrences

Blizzards are considered to be high frequency events based on past occurrences. This hazard occurs more than once in five years, with a greater than 20 percent chance of occurring yearly.

ICE STORMS

The ice storm category covers a range of different weather phenomena that collectively involve rain or snow being converted to ice in the lower atmosphere leading to potentially hazardous conditions on the ground. 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. 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.

Sleet and hail are other forms of frozen precipitation. 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

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convective clouds (usually thunderstorms), often during the warm spring and summer months (a description of hail is included in a subsequent report section).

The best available data on previous ice storm events are recorded at the county level through NOAA's National Centers for Environmental Information (NCEI) Storm Events Database. Middlesex County, which includes the Town of Littleton, experienced three events from 1998 to 2023 which caused a total of \$3,155,000 in damages (Table 31).

Table 31: Middlesex County Ice Storm Events, 1998 –2023

BEGIN_DATE	EVENT_TYPE	DEATHS	INJURIES	DAMAGE
1/9/1998	Ice Storm	0	0	5,000
11/16/2002	Ice Storm	0	0	150,000
12/11/2008	Ice Storm	1	0	3,000,000
TOTAL		0	0	3,155,000

Source: NOAA, National Centers for Environmental Information.

The greatest hazard is created by freezing rain conditions, which is rain that freezes on contact with hard surfaces leading to a layer of ice on roads, walkways, trees, and other surfaces. The conditions created by freezing rain can make driving particularly dangerous and emergency response more difficult. The weight of ice on tree branches can also lead to falling branches causing power outages and blocking roadways. The impacts of winter storms may also include roof collapses and property damage and injuries related to the weight of snow and ice.

Probability of Future Occurrences

Ice storms are considered to be medium-frequency events based on past occurrences. This hazard occurs once in 5 years to once in 50 years, with 2% to 20% chance of occurring each year.

Winter Weather and Climate Change

As with hurricanes, warmer ocean water and air will provide more fuel for winter storms. According to the 2018 SHMCAP it appears that Atlantic coast nor'easters are increasing in frequency and intensity. Further, the SHMCAP notes that research suggests that warmer weather in the Arctic is producing changes to atmospheric circulation patterns that favor the development of winter storms in the Eastern United States. There is also some indication that as winters warm, temperatures may be more likely to produce icing conditions. Massachusetts' 2022 Climate Change Assessment predicts more mild winters, increased precipitation in the winter months, and multiple freeze-thaw cycles every winter due to warming temperatures (Commonwealth of Massachusetts, 2022).

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NON-CLIMATE-INFLUENCED HAZARDS

EARTHQUAKES

Earthquakes are the sole natural hazard for which there is no established correlation with climate impacts. Damage in an earthquake stems from ground motion, surface faulting, and ground failure in which weak or unstable soils, such as those composed primarily of saturated sand or silts, liquefy. The effects of an earthquake are mitigated by distance and ground materials between the epicenter and a given location. An earthquake in New England affects a much wider area than a similar earthquake in California due to New England's solid bedrock geology (NESEC). Earthquakes can also trigger landslides

Seismologists use a magnitude scale known as the Richter scale to express the seismic energy released by each earthquake. The typical effects of earthquakes in various ranges are summarized in Table 32.

Table 32: Richter Scale and Effects

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

Source: Nevada Seismological Library (NSL), 2005

According to the State Hazard Mitigation Plan, New England experiences an average of five earthquakes per year. From 1668 to 2016, 408 earthquakes were recorded in Massachusetts (NESEC). Most have originated from the La Malbaie fault in Quebec or from the Cape Anne fault located off the coast of Rockport. The region has experienced larger earthquakes in the distant past, including a magnitude 5.0 earthquake in 1727 and a 6.0 earthquake that struck in 1755 off the coast of Cape Anne. More recently, a pair of damaging earthquakes occurred near Ossipee, NH in 1940. A 4.0 earthquake centered in Hollis, Maine in October 2012 was felt in the Boston area. Historic records of some of the more significant earthquakes in the region are shown in Table 33.

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Table 33: Historic Earthquakes in Massachusetts or Surrounding Area

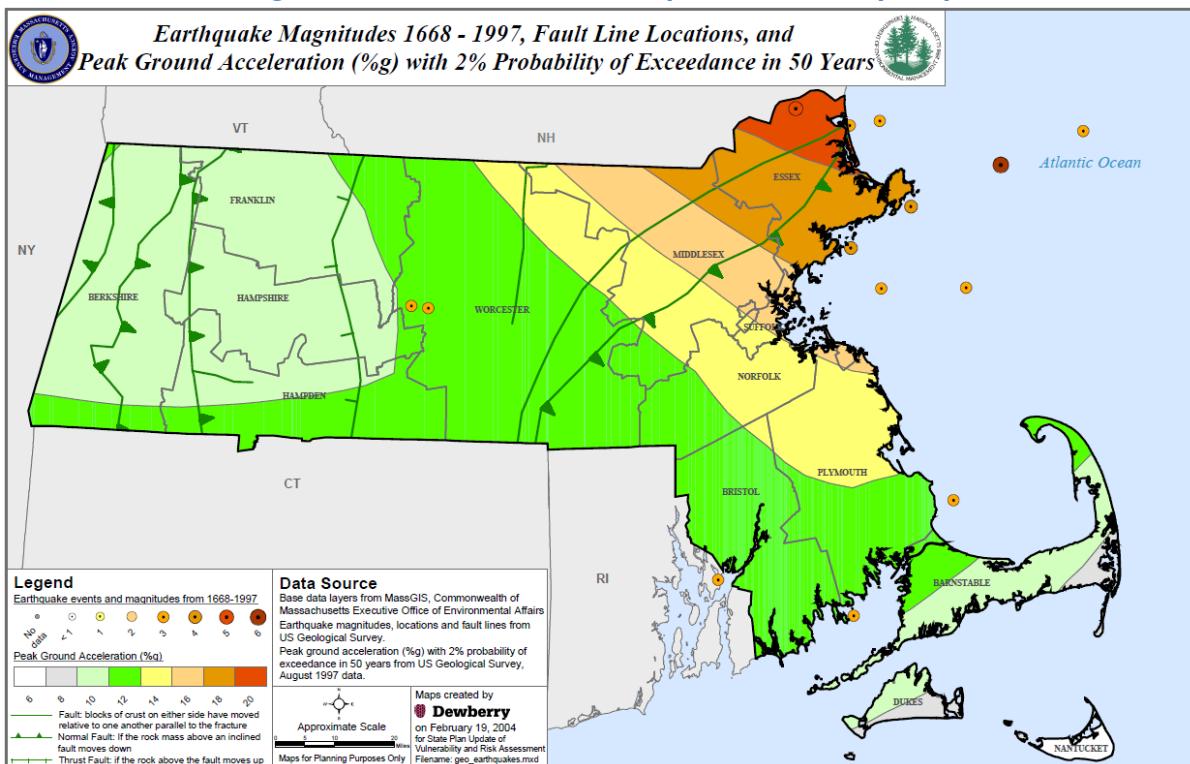
Location	Date	Magnitude
MA - Cape Ann	11/10/1727	5
MA - Cape Ann	12/29/1727	NA
MA - Cape Ann	2/10/1728	NA
MA - Cape Ann	3/30/1729	NA
MA - Cape Ann	12/9/1729	NA
MA - Cape Ann	2/20/1730	NA
MA - Cape Ann	3/9/1730	NA
MA – Boston	6/24/1741	NA
MA - Cape Ann	6/14/1744	4.7
MA – Salem	7/1/1744	NA
MA - Off Cape Ann	11/18/1755	6
MA - Off Cape Cod	11/23/1755	NA
MA – Boston	3/12/1761	4.6
MA - Off Cape Cod	2/2/1766	NA
MA – Offshore	1/2/1785	5.4
MA - Wareham/Taunton	12/25/1800	NA
MA – Woburn	10/5/1817	4.3
MA - Marblehead	8/25/1846	4.3
MA – Brewster	8/8/1847	4.2
MA – Boxford	5/12/1880	NA
MA – Newbury	11/7/1907	NA
MA - Wareham	4/25/1924	NA
MA - Cape Ann	1/7/1925	4
MA - Nantucket	10/25/1965	NA
MA – Boston	12/27/74	2.3
MA - Nantucket	4/12/12	4.5
ME – Hollis	10/17/12	4.0

Source: Boston HIRA

One measure of earthquake risk is ground motion, which is measured as maximum peak horizontal acceleration, expressed as a percentage of gravity (%g). The range of peak ground acceleration in Massachusetts is from 10 %g to 20 %g, with a 2% probability of exceedance in 50 years, as shown in Figure 22. Littleton is in the middle part of the range for Massachusetts, at 12-14g, making it a moderate area of earthquake risk relative to the state, although Massachusetts as a whole is considered to have a low risk of earthquakes compared to the rest of the country. There have been no recorded earthquake epicenters within Littleton.

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Figure 22: Massachusetts Earthquake Probability Map



Source: 2018 SHMCAP

Although New England has not experienced a damaging earthquake since 1755, seismologists state that a serious earthquake occurrence is possible. There are five seismological faults in Massachusetts, but there is no discernible pattern of previous earthquakes along these fault lines. Earthquakes occur without warning and may be followed by aftershocks. The majority of older buildings and infrastructure were constructed without specific earthquake resistant design features.

Earthquakes are a hazard with multiple impacts beyond the obvious building collapse. Buildings may suffer structural damage which may or may not be readily apparent. Earthquakes can cause major damage to roadways, making emergency response difficult. Water lines and gas lines can break, causing flooding and fires. Another potential vulnerability is equipment within structures. For example, a hospital may be structurally engineered to withstand an earthquake, but if the equipment inside the building is not properly secured, the operations at the hospital could be severely impacted during an earthquake.

Earthquakes are a potential town-wide hazard in Littleton. The town has many un-reinforced, older buildings which would be vulnerable in the event of a severe earthquake. Potential earthquake damage to Littleton have been estimated using HAZUS-MH. Total damages are estimated at \$353,400,000 for a 5.0 magnitude earthquake and \$2.7 billion in a magnitude 7 earthquake.

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Probability of Future Events

There are several ways the probability of future occurrences has been estimated. According to the Boston College Weston Observatory, in most parts of New England, there is a one in ten chance that a potentially damaging earthquake will occur in a 50-year time period. According to the SHMCAP there is a 10-15% chance of a magnitude 5 earthquake in a given ten-year period. The Massachusetts State Hazard Mitigation Plan classifies earthquakes as "very low" frequency events that occur less frequently than once in 100 years.

LAND USE AND DEVELOPMENT

EXISTING LAND USE

Table 34 shows the acreage and percentage of land in 15 categories. If the four residential categories are aggregated, residential uses make up 40.6% of the area of the town (4,553 acres). Open land, forest, agriculture, and recreation combined comprise a total of 28.2%, or 3,164 acres. Commercial and industrial combined make up 10.2% of the town, or 1,138 acres.

Table 34: Littleton Land Use 2016

Land Use Category	Acres	Percent (%)
Open land	2592	23.13
Commercial	307	2.74
Industrial	798	7.12
Forest	127	1.13
Agriculture	300	2.68
Recreation	145	1.29
Tax exempt	607	5.42
Mixed use, primarily residential	777	6.93
Residential - single family	3365	30.03
Residential - multi-family	278	2.48
Residential - other	133	1.19
Mixed use, other	193	1.73
Mixed use, primarily commercial	33	0.29
Right-of-way	978	8.73
Water	563	5.02
TOTAL	11,195	100%

Source: Massachusetts GIS, 2016 Land Use Inventory

For more information on how the land use statistics were developed and the definitions of the categories, please go to <http://www.mass.gov/mgis/lus.htm>.

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Economic Elements

Littleton has local economic centers located in multiple areas of the town. Business and industrial zones are concentrated in three areas including Littleton Common and the junction of routes 2A/110 and 119, the Route 2 and I-495 interchange, and the western end of Ayer Rd. (Rt. 110). There are approximately 422 businesses and 6755 jobs in Littleton.

Historic, Cultural, and Natural Resource Areas

According to the 2017 Littleton Master Plan, the Littleton Historical Commission has submitted more than 200 properties to MHC's Inventory of Historic and Archaeological Assets of the Commonwealth. The table below shows the town's inventory broken down by the three areas defined in MHC's MACRIS – Littleton, Littleton Common, and Littleton Depot.

Table 35: Littleton's Historical, Cultural, and Natural Resource Areas

Resource Type	Littleton	Littleton Common	Littleton Depot
All types	21	112	23
Areas	1	3	2
Buildings	17	89	21
Objects	0	7	0
Structures	3	12	0
Burial Grounds	0	1	0

Source: MACRIS database accessed July 1, 2017.

The Town of Littleton, hosts several arts and cultural institutions. These include the Nashoba Valley Chorale, the Littleton Lyceum (the oldest continuous Lyceum in the United States), The Cannon Theatre, and the Firehouse Coffeehouse. The Master Plan also identifies the Littleton Historical Commission, the Parks and Recreation Commission, the Council on Aging, and the Rueben Hoar Library as important cultural institutions.

Littleton covers about 16.5 square miles of gently rolling hills in northwest Middlesex County. The elevation above sea level ranges between 200 and 500 feet with the higher areas located mostly toward the western end of town. The eastern portion of the Town drains to the Concord River largely via the Nashoba and Fort Pond Brooks to the Assabet River and then to the Concord River. The western portion of Town drains to the Merrimack River via Beaver and Stony Brooks. Water resources, including aquifers and ponds, are shared with neighboring towns. Protection of water resources for drinking, recreation, and aesthetics, is the number one goal of the Town's 2016 Open Space and Recreation Plan. According to the 2016 Plan, nearly 15% of land in Littleton is permanently protected.

DEVELOPMENT TRENDS

Until the 1940's, agriculture and large land holdings were the predominant land uses. Residential uses have expanded creating a strong suburban component. Supported by improved transportation access, the commercial and industrial sectors have experienced strong growth in the past three decades. Littleton has experienced housing growth as well, due to the increase in job

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opportunities in the I-495 corridor, and convenient commuting options for those preferring suburban to urban settings. Development pressure is expected to continue.

Development trends throughout the metropolitan region are tracked by MAPC's Development Database, which provides an inventory of new development over the last decade. The database tracks both completed developments and those currently under construction. The database includes 16 developments in the Town of Littleton since 2017, of which 13 are completed and 3 were under construction or planned in 2024.

The database also includes several attributes of the new development, including site acreage, housing units, and commercial space. Almost of the projects are housing projects.. The 16 developments in Littleton include a total of 109 housing units, and are sited on over 244 acres. See the table below.

Table 36: Summary of Littleton Developments 2017-2023

DEVELOPMENTS COMPLETED	ACRES	HOUSING UNITS	PROJECT TYPE	Notes
Taylor Street	87.84	0	Amazon warehouse	Last-mile delivery warehouse completed 2022; included donation of 53-acre new well site parcel to the Water Department
Hobbyhorse Hills Subdivision	N/A		9-lot single family subdivision.	completed
Durkee	16.50	30	Open Space Subdivision	completed
Sanderson	22.60	30	Open Space Subdivision	completed
Chestnut Lane	40.31	6	Subdivision	completed
Russell Street	9.97	0	3,000 square foot retail development	Permits approved, but construction not started yet
Chase Farm	9.53	0	Retail development	Tire Barn completed and operating
537 Great Road	2.62	0	Adult use marijuana manufacturing facility	Adult Use Marijuana retail sales and manufacturing operational inside of existing warehouse building
24 Porter Road	5.19	0	Dirigible Brewing Company	Use approved operational within existing warehouse space
6 Spectacle Pond Road	3.15	0	Storage facility with office space	Minor revision approved Jan. 2024; construction not started yet
59 Porter Road	15.09	0	Co-location of Wireless Telecommunic	This was one of the early cell tower sites in Littleton and remains operational

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			ations on the cell tower	
Webber Village Development	4.40	19	Senior Residential Development	Complete, includes 2 Affordable units
100 Spectacle Pond Road	10.46	17	Jones Meadow Senior Residential Development	Complete, includes 2 Affordable units
265 Great Road (Includes 265, 277, 287, 289 Great Road and 25 Robinson Road)	3.02	0	Branch of Northern bank and commercial facilities	Permitting approved; construction not started yet
Kaye Property Subdivision	11.00		Conventional Subdivision	complete
The Homes at Croft Corner - 93 Foster Street	2.35	7	Open Space Development subdivision	complete
TOTAL	244.03	109		

Potential Future Development

MAPC consulted with town planning staff to determine areas that may be developed in the future, based on the Town's comprehensive planning efforts and current trends and projects. These areas are described below. In order to characterize any change in the town's vulnerability associated with new developments, a GIS mapping analysis was conducted which overlaid the development sites with the FEMA Flood Insurance Rate Map. The analysis shows that 11 developments are located partially within a flood zone.

DEVELOPMENT SITES IN HAZARD AREAS

Table 37 shows the relationship of these parcels to three of the mapped hazards. This information is provided so that planners can ensure that development proposals comply with flood plain zoning and that careful attention is paid to drainage issues.

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Table 37: Littleton New Developments in Relation to Hazard Areas

Site ID	Parcel	Land Slide Risk	Flood Zone	Brush Fire Risk
A	Ayer Road (West)	Low incidence		No
B	Taylor Street	Low incidence	2.0% in X: 0.2% Annual Chance of Flooding	No
C	Hobbyhorse Hills subdivision	Low incidence		No
E	245 Foster Street	Low incidence		No
F	Gutierrez, 225 Taylor St	Low incidence		No
G	Skyview Lane, 555 Newtown Rd	Low incidence		Yes
H	Durkee	Low incidence		No
I	Sanderson	Low incidence		No
J	Grey Farms	Low incidence	22.51% in X: 0.2% Annual Chance of Flooding	No
K	Chestnut Lane	Low incidence	0.03% in X: 0.2% Annual Chance of Flooding	No
L	Russell Street	Low incidence		No
M	Chase Farms	Low incidence	3.52% in X: 0.2% Annual Chance of Flooding	No
N	537 Great Road	Low incidence		No
O	24 Porter Road	Low incidence	6.47% in AE: 1% Annual Chance of Flooding, with BFE, and 0.37% in AE: Regulatory Floodway, and 9.59% in X: 0.2% Annual Chance of Flooding	No
P	6 Spectacle Pond Road	Low incidence	26.58% in AE: 1% Annual Chance of Flooding, with BFE	No
Q	59 Porter Road	Low incidence	41.46% in AE: 1% Annual Chance of Flooding, with BFE	No
R	Webber Village Development	Low incidence		No
S	100 Spectacle Pond Road	Low incidence		No
T	265 Great Road	Low incidence		No
U	Kaye Property Subdivision	Low incidence		No

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V	The Homes at Croft Corner - 93 Foster St	Low incidence		No
W	1 and 2 Monarch Drive	Low incidence	23.31% in AE: 1% Annual Chance of Flooding, with BFE , and 23.87% in X: 0.2% Annual Chance of Flooding	No
X	225 Taylor Street	Low incidence		No
Y	195 Tahattawan Road	Low incidence	15.1% in X: 0.2% Annual Chance of Flooding	Yes
Z	555 Newtown Road	Low incidence		Yes
AA	550 Newtown Road	Low incidence	61.98% in A: 1% Annual Chance of Flooding, no BFE	No
BB	410 Great Road	Low incidence		No
CC	254, 256, 260 Ayer Road	Low incidence		No
DD	336 and 338 King Street	Low incidence	0.08% in A: 1% Annual Chance of Flooding, no BFE , and 14.42% in AE: 1% Annual Chance of Flooding, with BFE , and 8.9% in X: 0.2% Annual Chance of Flooding	No
EE	King Street Commons, 550 King Street	Low incidence		No

CRITICAL INFRASTRUCTURE IN HAZARD AREAS

Critical infrastructure includes facilities that are important for disaster response and evacuation (such as emergency operations centers, fire stations, water pump stations, etc.) and facilities where additional assistance might be needed during an emergency (such as nursing homes, elderly housing, day care centers, etc.). There are 63 facilities identified in Littleton. These are listed in Table 38 and are shown on the maps in Appendix A.

Table 38: Critical Facilities and Relationship to Hazard Areas

ID	NAME	TYPE	LANDSLIDE	WITHIN FEMA FLOOD ZONE	WITHIN LOCALLY IDENTIFIED AREA OF FLOODING	AVERAGE ANNUAL SNOW FALL
1	Shaker Lane School	School	Low	No	No	High
2	Russell Street School	School	Low	No	No	High
3	Littleton Middle School	School/Primary Emergency Shelter	Low	No	No	High

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ID	NAME	TYPE	LANDSLIDE	WITHIN FEMA FLOOD ZONE	WITHIN LOCALLY IDENTIFIED AREA OF FLOODING	AVERAGE ANNUAL SNOW FALL
4	Littleton High School	School/Secondary Emergency Shelter	Low	No	No	High
5	Oak Meadow Montessori School	School	Low	No	No	High
6	Life Care Center	Nursing Home	Low	No	No	High
7	Police Station	Police Station	Low	No	Beaver Brook/Great Road	High
8	Fire Station	Fire Station	Low	No	No	High
9	Town Hall	Town Hall	Low	No	No	High
10	GFI Distribution Center	Industrial	Low	No	No	High
11	Shattuck Street Housing	Elderly Housing	Low	No	No	High
12	First Baptist Church	Place of Assembly	Low	No	No	High
13	Congregational Church	Place of Assembly	Low	No	No	High
14	Church of Latter Day Saints	Place of Assembly	Low	No	No	High
15	Unitarian Church	Place of Assembly	Low	No	No	High
17	Funeral Home	Funeral Home	Low	No	No	High
18	Public Water Supply (#1 & #3)	Water	Low	AE	No	High
19	Littleton Electric Light & Water Dept.	Emergency Operations Center	Low	No	No	High
22	St. Anne's Church	Place of Assembly	Low	No	No	High
23	Public Water Supply: Treatment Plant and Well #2	Water Treatment and Well	Low	No	No	High
24	Treatment Plant	Water Treatment	Low	No	No	High
25	Verizon Telephone Hub	Telephone Substation	Low	No	No	High
26	AT&T Tower and Underground Facility	Telephone Substation	Low	No	No	High
27	Water Tower (Newtown hill)	Water Tower	Low	No	No	High

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ID	NAME	TYPE	LANDSLIDE	WITHIN FEMA FLOOD ZONE	WITHIN LOCALLY IDENTIFIED AREA OF FLOODING	AVERAGE ANNUAL SNOW FALL
28	Water Tower (Oak Hill)	Water Tower	Low	No	No	High
29	Water Tower (Cedar Hill)	Water Tower	Low	No	No	High
30	Littleton Green Apartments	Elderly Housing	Low	No	No	High
31	Mill Pond Apartments	Elderly Housing	Low	No	No	High
32	Acton Medical Facility	Medical Office	Low	No	No	High
33	Sewer Lift Station School & Town Hall	Sewer Lift Station	Low	No	No	High
34	Minuteman Arc	Group Home	Low	No	Nashoba Road	High
35	Evergreen Center	Group Home	Low	No	No	High
36	DSS Group Home	Group Home	Low	No	No	High
38	Littleton Motor Court	55+ Trailer Park	Moderate Susceptibility	No	No	High
40	Littleton Pools	Hazardous Materials	Low	No	No	High
41	Great Road Garden Center	Hazardous Materials	Low	No	No	High
42	Aubuchon Hardware	Hardware Store	Low	No	No	High
43	Middlesex Corporation	Hazardous Materials	Low	No	No	High
44	Littleton Highway Department	Department of Public Works	Low	No	No	High
5	Well #5	Water Supply	Low	No	No	High
46	Littleton Power Substation	Electric Substation	Low	No	No	High
47	Aggregate Industries	Hazardous Materials	Low	.2% Annual Chance of Flooding	No	High
49	Cataldo's (now closed)	Hazardous Materials	Low	No	No	High
50	Cupp and Cupp Nursery (now closed)	Hazardous Materials	Low	No	No	High
52	Mill Pond Dam	Dam	Low	AE	No	High

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ID	NAME	TYPE	LANDSLIDE	WITHIN FEMA FLOOD ZONE	WITHIN LOCALLY IDENTIFIED AREA OF FLOODING	AVERAGE ANNUAL SNOW FALL
53	Boston Minuteman Campground	Campground	Moderate Susceptibility	No	No	High
54	The Little Gym	Childcare Facility	Low	No	No	High
55	MetroWest Bible Church	Place of Worship	Low	No	No	High
56	Learning Experience	Children's Facility	Low	No	No	High
57	Fiba Technologies	Hazardous Materials	Low	No	No	High
58	Horace Mann Group Home	Group Home	Low	AE	No	High
59	New Group Home	Group Home	Low	No	No	High
60	Bates Finishing	Hazardous Materials	Low	No	No	High
61	R&R Pool & Spa	Hazardous Materials	Low	No	No	High
62	Private Treatment Plant	Treatment Plant	Low	No	No	High
63	Private Sewage Treatment	Treatment Facility	Low	No	No	High
64	Indian Hill Music School, King Street	Town-owned site to be redeveloped	Low	No	No	High
65	Water treatment #3, Whitcomb Ave.	Water treatment	Low	No	No	High
66	New Wastewater treatment plant to be completed in 2025, 242 King Street	Water treatment	Low	0.2% Annual Chance of Flooding	No	High
67	Emerson Health Urgent Care, 830 Constitution Street	Urgent Care	Low	No	No	High
68	Fiba, 67 Ayer Road	Industrial	Low	No	No	High
69	PGI Warehouse, Ayer Road	Warehouse	Low	No	No	High
70	Amazon warehouse, 151 Taylor Road	Warehouse	Low	No	No	High
71	Reuben Hoar Library	Library	Low	No	No	High

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VULNERABILITY ASSESSMENT

The purpose of the vulnerability assessment is to estimate the extent of potential damages from natural hazards of varying types and intensities. A vulnerability assessment and estimation of damages was performed for hurricanes, earthquakes, and flooding. The methodology used for hurricanes and earthquakes was the HAZUS-MH software. The methodology for flooding was developed specifically to address the issue in many of the communities where flooding was not solely related to location within a floodplain.

Introduction to HAZUS-MH

HAZUS- MH (multiple-hazards) is a computer program developed by FEMA to estimate losses due to a variety of natural hazards. The following overview of HAZUS-MH is taken from the FEMA website. For more information on the HAZUS-MH software, go to <http://www.fema.gov/plan/prevent/hazus/index.shtm>

“HAZUS-MH is a nationally applicable standardized methodology and software program that contains models for estimating potential losses from earthquakes, floods, and hurricane winds. HAZUS-MH was developed by the Federal Emergency Management Agency (FEMA) under contract with the National Institute of Building Sciences (NIBS). Loss estimates produced by HAZUS-MH are based on current scientific and engineering knowledge of the effects of hurricane winds, floods and earthquakes. Estimating losses is essential to decision-making at all levels of government, providing a basis for developing and evaluating mitigation plans and policies as well as emergency preparedness, response and recovery planning.

HAZUS-MH uses state-of-the-art geographic information system (GIS) software to map and display hazard data and the results of damage and economic loss estimates for buildings and infrastructure. It also allows users to estimate the impacts of hurricane winds, floods and earthquakes on populations.”

There are three modules included with the HAZUS-MH software: hurricane wind, flooding, and earthquakes. There are also three levels at which HAZUS-MH can be run. Level 1 uses national baseline data and is the quickest way to begin the risk assessment process. The analysis that follows was completed using Level 1 data. Level 1 relies upon default data on building types, utilities, transportation, etc. from national databases as well as census data. While the databases include a wealth of information on the Town of Littleton, it does not capture all relevant information. In fact, the HAZUS training manual notes that the default data is “subject to a great deal of uncertainty.”

However, for the purposes of this plan, the analysis is useful. This plan is attempting to generally indicate the possible extent of damages due to certain types of natural disasters and to allow for a comparison between different types of disasters. Therefore, this analysis should be considered to be a starting point for understanding potential damages from the hazards.

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ESTIMATED DAMAGES FROM HURRICANES

The HAZUS-MH software was used to model potential damages to the community from a 100 year and 500 year hurricane event; storms that are 1% and .02% likely to happen in a given year, and roughly equivalent to a Category 2 and Category 4 hurricane. The damages caused by these hypothetical storms were modeled as if the storm track passed directly through the Town, bringing the strongest winds and greatest damage potential.

Though there are no recorded instances of a hurricane equivalent to a 500 year storm passing through Massachusetts, this model was included in order to present a reasonable “worst case scenario” that would help planners and emergency personnel evaluate the impacts of storms that might be more likely in the future, as we enter into a period of more intense and frequent storms.

Table 39 - Estimated Damages from Hurricanes

	100 Year	500 Year
Building Characteristics		
Estimated total number of buildings	3,873	
Estimated total building replacement value (2006 \$)	\$2,578,000,000	
Building Damages		
# of buildings sustaining minor damage	167	648
# of buildings sustaining moderate damage	12	102
# of buildings sustaining severe damage	0	7
# of buildings destroyed	0	8
Population Needs		
# of households displaced	0	1
# of people seeking public shelter	0	0
Debris		
Building debris generated (tons)	657	2,916
Tree debris generated (tons)	1,175	2,329
# of truckloads to clear building debris	26	117
Value of Damages		
Property damage (buildings and content)	\$14,570,400	\$49,782,600
Losses due to business interruption	\$510,220	\$3,876,900
Total	\$15,080,620	\$53,659,500

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ESTIMATED DAMAGES FROM EARTHQUAKES

The HAZUS-MH earthquake module allows users to define an earthquake magnitude and model the potential damages caused by that earthquake as if its epicenter had been at the geographic center of the study area. For the purposes of this plan, two earthquakes were selected: magnitude 5.0 and magnitude 7.0. Historically, major earthquakes are rare in New England, though a magnitude 5 event occurred in 1963.

Table 40 - Estimated Damages from Earthquakes

	Magnitude 5.0	Magnitude 7.0
Building Characteristics		
Estimated total number of buildings	3,873	
Estimated total building replacement value (2006 \$)	\$2,578,000,000	
Building Damages		
# of buildings sustaining slight damage	1,159	109
# of buildings sustaining moderate damage	588	786
# of buildings sustaining extensive damage	136	1,148
# of buildings completely damaged	30	1,823
Population Needs		
# of households displaced	67	1,766
# of people seeking public shelter	28	723
Debris		
Building debris generated (tons)	47,000	458,000
# of truckloads to clear debris (@ 25 tons/truck)	1,880	18,320
Value of Damages		
Property damage	\$311,499,200	\$2,408,452,600
Losses due to business interruption	\$41,897,000	\$325,743,300
Total	\$353,400,000	\$2,734,200,000

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ESTIMATED DAMAGES FROM FLOODING

The HAZUS-MH flood risk module was used to estimate damages to the municipality at the 100 and 500 return periods. These return periods correspond to flooding events that have a 1% and a 0.2% likelihood of occurring in any given year.

Table 41: Estimated Damages from Flooding

	100 Year	500 Year
Building Characteristics		
Estimated total number of buildings	3,873	
Estimated total building replacement value (2006 \$)	\$2,578,000,000	
Building Damages		
# of buildings sustaining slight damage (<10%)	6	2
# of buildings sustaining moderate damage (10-50%)	4	4
# of buildings sustaining substantial damage (>50%)	0	0
Population Needs		
# of households displaced	38	48
# of people seeking public shelter	12	13
Debris		
Building debris generated (tons)	49	109
# of truckloads to clear building debris	2	5
Value of Damages		
Property damage (buildings and content)	\$5,060,000	\$8,400,000
Losses due to business interruption	\$8,580,000	\$11,380,000
Total:	\$13,640,000	\$19,780,000

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CLIMATE CHANGE RISK ASSESSMENT SUMMARY

Table 42: Summary of Hazard Risks for Society, Built Environment, and Natural Resources

CLIMATE CHANGE	NATURAL HAZARD	KEY CONCERNS SOCIETY	KEY CONCERNS BUILT ENVIRONMENT	KEY CONCERNS NATURAL RESOURCES
Changes in Precipitation 	Inland Flooding	Elderly residents and environmental justice populations; property damage. Impacts on businesses	Roadway closures, damage to buildings; impacts on infrastructure	Pollutants, erosion, scouring, damage to habitat
	Drought	Increases costs for irrigation, drinking water supply	Impacts on landscaped areas, parks, playing fields, etc.	Impacts on streams, wetlands, vegetation
	Landslide	Private property damage	Damage to buildings and infrastructure	Erosion, sedimentation
Sea Level Rise 	Coastal Flooding	Property damage, impacts on businesses	Roadway closures, damage to buildings; impacts on infrastructure	Damage to coastal habitat
Rising Temperatures 	Average and Extreme Temperatures	Elderly populations if no access to cooling or financial resources to buy an AC		Increasing invasives, stress on aquatic and terrestrial habitats
	Wildfires	Air Quality - Smoke	Damage to buildings	Damage to resources
	Invasive species	Potential health impacts of pests	Impaired use of park and open space	Loss of biodiversity
Extreme Weather 	Hurricanes / Tropical Storms	Power outages; property damage, impacts to businesses	Street closures, house flooding, emergency access, wind damage to buildings, power outages	Tree damage
	Severe Winter Storms	Power outages, elderly, or isolated residents	Damage to public buildings with snow loads, power outages that can affect municipal operations, road blockages.	Tree damage
	Tornadoes	Property damage, impacts on businesses	Damage to buildings and infrastructure	Tree damage
	Thunderstorms/ Microbursts	Power outages, property damage	Power loss, road closures (same as above)	Tree damage
Non-Climate Hazard	Earthquake	Property damage, impacts on businesses	Damage to buildings and infrastructure	Landslides

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SECTION 5: HAZARD MITIGATION GOALS

The Littleton Local Hazard Mitigation Planning Team reviewed and discussed the goals from the 2017 Hazard Mitigation Plan for the Town of Littleton. All of the goals were found to continue to be reflective of the Town's priorities and concerns relative to natural hazard mitigation. An 11th goal was added to reflect need further mitigate invasive species. All of the goals are considered critical for the Town and they are not listed in order of importance.

Goal 1: Prevent and reduce the loss of life, injury, public health impacts and property damages resulting from all major natural hazards.

Goal 2: Identify and seek funding for measures to mitigate or eliminate each known significant flood hazard area.

Goal 3: Integrate hazard mitigation planning as an integral factor in all relevant municipal departments, committees and boards.

Goal 4: Prevent and reduce the damage to public infrastructure resulting from all hazards.

Goal 5: Encourage the business community, major institutions and non-profits to work with the Town to develop, review and implement the hazard mitigation plan.

Goal 6: Work with surrounding communities, state, regional and federal agencies to ensure regional cooperation and solutions for hazards affecting multiple communities.

Goal 7: Ensure that future development meets federal, state and local standards for preventing and reducing the impacts of natural hazards.

Goal 8: Take maximum advantage of resources from FEMA and MEMA to educate Town staff and the public about hazard mitigation.

Goal 9: Consider the potential impacts of future climate change. Incorporate climate sustainability and resiliency in hazard mitigation planning.

Goal 10: Address priority populations in the hazard mitigation process, including outreach and engagement, analysis of hazard impacts, and development and implementation of mitigation measures.

Goal 11: Take proactive measures to manage trees, and invasive species and their impacts on public and private properties.

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SECTION 6: EXISTING MITIGATION MEASURES

The existing protections in the Town of Littleton are a combination of zoning, land use, and environmental regulations, infrastructure maintenance and drainage infrastructure improvement projects. Infrastructure maintenance generally addresses localized drainage clogging problems, while large scale capacity problems may require pipe replacement or invert elevation modifications. These more expensive projects are subject to the capital budget process and lack of funding is one of the biggest obstacles to completion of some of these.

The Town's existing mitigation measures, which were in place prior to the original 2017 Plan, are listed by hazard type here and are summarized in Table 42 below.

Mitigation Measures Relating to Multiple Hazards

There are several mitigation measures that impact more than one hazard. These include the Comprehensive Emergency Management Plan (CEMP), the Massachusetts State Building Code and participation in a local Emergency Planning Committee.

Comprehensive Emergency Management Plan (CEMP)

Every community in Massachusetts is required to have a Comprehensive Emergency Management Plan. These plans address mitigation, preparedness, response and recovery from a variety of natural and man-made emergencies. Littleton's CEMP is currently being updated.

Massachusetts State Building Code

The Massachusetts State Building Code contains many detailed regulations regarding wind loads, earthquake resistant design, flood-proofing and snow loads. The Town of Littleton has adopted the "Stretch Code." For enhanced energy efficiency.

Participation in the Local Emergency Planning Committee (LEPC)

Flood Related Hazards

National Flood Insurance Program (NFIP)

Littleton participates in the NFIP with 11 policies in force as of May 1, 2023. The reporting period covers from 1978 to the present day. The following information is provided for the Town of Littleton.

The following information is provided for the Town of Littleton:

Flood insurance policies in force (as of May 1, 2023)	11
Coverage amount of flood insurance policies	\$4,324,000
Substantial Damage Claims Since 1978	0
Total losses (all losses submitted regardless of the status)	14
Total payments (Total amount paid on losses)	\$101,007

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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.

The town meets the minimum NFIP compliance requirements to regulate development in the floodplain through its adopted floodplain regulations (Chapter 173 Zoning, Article XVI Wetlands and Floodplain Regulations) that restrict certain activities and require a special permit for activities located within a flood zone. This meets FEMA's requirements as specified in the Massachusetts Model Floodplain Bylaw prepared by the Department of Conservation and Recreation's Flood Hazard Program. The Zoning Enforcement Officer enforces the requirements of the floodplain regulations under the National Flood Insurance Program.

The Zoning Enforcement Officer enforces the requirements of the floodplain regulations under the National Flood Insurance Program.

Since 1978 there have been no claims paid for substantial damage in Littleton (see table above). The Town implements the Substantial Improvements/Substantial Damages provisions of the floodplain management regulations as required per the NFIP (CFR Title 44, Parts 59 through 65) and Massachusetts State Building Code (780CMR). 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 Substantial Improvements/Substantial Damages provisions.

Other Flood Mitigation Measures

- a) All streets are swept twice per year. The Highway Department begins as soon as possible in the spring. The Department has sufficient equipment for sweeping and does the sweeping in-house, although a small portion was contracted out in past years.
- b) The Highway Department does sand the roads in the winter, but not in excessive amounts. They mix magnesium chloride with salt to work faster at colder temperatures. All 1300 catch basins are cleaned yearly.
- c) The Highway Department is mapping stormwater outlets with GPS.
- d) The town uses a trapper to mitigate beaver activity as necessary. A permit to do so is required by state law through the local Board of Health.
- e) The town has a wetlands protection bylaw (Chapter 171) to protect resource areas in and around wetlands.
- f) The Massachusetts Stormwater Policy is applied to developments within the jurisdiction of the Conservation Commission.
- g) The subdivision regulations encourage a preliminary submission to discuss development issues up-front with the Planning Board prior to a significant investment in design efforts. Runoff from subdivision developments may not increase in proposed conditions more than in existing conditions for the 25-year storm. Pipes and detention basins must be designed for the 25-year storm and culverts must be designed for the 50-year storm event.
- h) The town has Site Plan review requirements (Chapter 173 Zoning, Article IV Site Plan Requirements). The drainage requirements for site plans must meet those stated in the subdivision regulations.
- i) The Aquifer Protection District (Chap. 173 Zoning, Article XIV Aquifer and Water Resource District) requires a permit for any development with 15% or greater impervious coverage. Recharge is required in the aquifer protection district where feasible.

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- j)* A consultant prepared a Low-Impact Development (LID) guide for the Water Department and Town Meeting in 2007 approved to include usage of the recommended LID techniques to the maximum extent practicable for all developments within the aquifer protection district. This is now required for all development.
- k)* The town has acquired land for open space protection. The Water Department has a land acquisition fund. The Town recently purchased 87 acres of Hartwell property and a conservation restriction on 85 acres of Prouty Woods. The Conservation Commission and Littleton Conservation Trust also purchase and/or oversee conservation areas in the town.
- l)* The town adopted the Community Preservation Act with a 1% surcharge in May of 2007.
- m)* The town continues to implement its MS 4 which includes public education programs. The Water Department provides education on stormwater such as: a stormwater media campaign, articles in the Watts and Drops newsletter, information posted on the Water Department website, and a traveling stormwater display posted around town.
- n)* The May 7, 2024, Annual Town Meeting voted to purchase the 36.49 acre Webster Property for conservation purposes from CPA funds

Flooding: Existing Site-Specific Mitigation

The following sites were identified by Town staff as areas that have experienced more significant flooding in the past. The numbers in parentheses refer to the Areas of Concern on Map 8 in Appendix A.

Beaver Brook/Great Road (1)

Beaver Brook at Great Road (a state highway) has not overtopped in heavy rains. At times there will be high water in the brook, but overtopping does not occur (Jeff Patterson, Police Dept, has never seen it overtopped. The cause of the flooding is due more to the fact that it is within a floodplain area than it does with inadequate drainage infrastructure.

King Street (2)

The stream located near a floodplain at this King Street location has caused surface flooding in the past. Cupp and Cupp installed two undersized culverts on a private driveway off of King Street that caused some flooding. Note that King Street is a state highway.

Nashoba Road (3)

Nashoba Road had routinely flooded, often due to beaver activity. This site is also located near a floodplain. The town raised the road approximately 2.5 feet at its lowest point by installing retaining walls and fill slopes for a total length of 2400 feet, and the road was repaved in the Fall of 2022. This solution has appeared to alleviate the problem. Water still comes up on to the edge of the road, but doesn't flood the road.

Gilson Road (12)

Gilson road by the train tracks has been having issues with beaver problems, this has required drains to be cleaned. This has not overtopped the road but it's an area that needs to be checked.

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Dam Failures

- a) DCR dam safety regulations – All dams are subject to the Division of Conservation and Recreation's dam safety regulations. The dams must be inspected regularly and reports filed with the DCR Office of Dam Safety.
- b) Permits required for construction – State law requires a permit for the construction of any dam.

Wind-Related Hazards

- a) A contracting agency acts as town's Tree Warden. They do minimal trimming around town and concentrate mostly on dead tree removals. They remove approximately 75 to 125 trees per year. They also have a roadside mower to keep vegetation back from the edge of pavement.
- b) The Light Department helps with the larger tree removals and trims around the wires. They have a multi-year plan trimming program (approximately a 5 year cycle) to go over their whole system.
- c) The Highway Department also has a brush chipper and access to two additional brush chippers from the Light Department. They do not have in-house capability for stump grinding, but contract out yearly for stump grinding needs.

Winter-Related Hazards

- a) The Highway Department provides standard snow plowing operations, including salting and sanding. They are in the process of using a liquid deicer (Magnesium Chloride) in order to minimize sand usage. Currently in the process of exploring a salt brine preapplication that would require no sand.
- b) They have enough storage space for the snow, including the parking area of a town-owned field that has a parking area at 57 Russell Street, and town-owned land located at 500 Great Road. Additional space at the Littleton Transfer Station, 38 Spectacle Pond Road and the intersection of Pickard Lane and Great Road has been identified.

Brush Fire-Related Hazards

- a) Town bylaws allow controlled open burning in accordance with state regulations, but a permit is required from the Fire Chief for each day of intended burning.
- b) The Fire department reviews all subdivision and site plans for compliance with site access, water supply needs, and all other applicable regulations.
- c) The Fire Department maintains a website with substantial public education on fire prevention at:
<http://www.littletonma.org/content/19735/19465/26710/26714/default.aspx>

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Geologic Hazards

Earthquakes

- a) The middle school and high school are new buildings with backup power that could act as shelters if necessary.
- b) The town does have an evacuation plan as specified in its Comprehensive Emergency Management Plan (CEMP).
- c) Rivers and ponds in town are available to be tapped into for water supply if necessary.
- d) A tanker task force is available through State Fire mobilization. FEMA has 8-12 tankers that can be deployed anywhere in the US within 72 hours.
- e) The El Paso gas company monitors provides educational information and training on hazard mitigation for its Tennessee Gas Pipeline.

Landslides

- a) The subdivision regulations do have maximum slope requirements for new roads. Chapter 147 of the Town Code, Soil Removal, states a permit is required for moving large amounts of soil to or from a site.

MULTIHAZARD MITIGATION MEASURES

The Town of Littleton has several mitigation measures in place that address more than one hazard. Major issues in preventing natural hazards in Littleton are the ability of the Fire and Police departments to operate efficiently, or at all, in outdated facilities in the event of a significant natural hazard.

- a) *Multi-Department Review of Developments* – Multiple departments, such as Planning, Zoning, Health, Highway, Fire, Police, and Conservation, review all subdivision and site plans prior to approval.
- b) *Comprehensive Emergency Management Plan (CEMP)* – Every community in Massachusetts is required to have a Comprehensive Emergency Management Plan. These plans address mitigation, preparedness, response and recovery from a variety of natural and man-made emergencies. These plans contain important information regarding flooding, dam failures and winter storms. Therefore, the CEMP is a mitigation measure that is relevant to many of the hazards discussed in this plan. The CEMP is available online through secure access for town personnel.
- c) *Enforcement of the State Building Code* – The Massachusetts State Building Code contains many detailed regulations regarding wind loads, earthquake resistant design, flood-proofing and snow loads.
- d) *Local Emergency Management Planning Committee (LEPC)*

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- e) The middle school and high school are new buildings with backup power that could act as shelters if necessary.
- f) The town has a backup 911 system in Ayer, and redundant emergency communications systems. The Police Department recently updated its communications network with new radio consoles and towers. The main antenna is at the water tower and the backup antennas are at the Fire and Police Stations.

Existing mitigation measures are summarized in Table 43 below.

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Table 43: Existing Mitigation Measures

Mitigation Measure	Area Covered	Effectiveness / Comments	Updates and or Improvements since 2017 Plan
FLOOD RELATED HAZARDS			
A) Participation in the National Flood Insurance Program	Town-Wide	Effective/11 policies in force	
B) Annual street sweeping	Flood Mitigation	Effective	Sweep twice a year
C) Annual catch basin cleaning	Town-Wide	Effective	
D) Ongoing drainage system upgrades and maintenance	Flood Mitigation	Effective, six drainage projects completed since the 2010 update	
E) Stormwater system mapped in GIS	Town-Wide	Effective	
F) Beaver mitigation	Flood Mitigation	Effective	Concord water is handling the beavers that bother Nagog Reservoir. All being managed by the Board of Health.
G) Wetlands and Flood Plain Regulations	Town-Wide	Effective	Will need to change with the new FEMA maps in 2025.
H) Wetlands Protection Bylaw	Town-Wide	Effective	
I) Massachusetts Stormwater Policy	Town-Wide	Effective, expanded town-wide	
J) Stormwater Requirements in Subdivision Regulations	Town-Wide	Effective, expanded town-wide	These regs are set to change in the coming year.
K) Stormwater Requirements in Site Plan Review	Town-Wide	Effective	These regs are set to change in the coming year.
L) Aquifer Protection District	Town-Wide	Effective	Updated the boundaries of the district, to better protect ground water beaver brook wells.

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Mitigation Measure	Area Covered	Effectiveness / Comments	Updates and or Improvements since 2017 Plan
M) LID Guidebook produced for the Water Department	Town-Wide	Effective, now required for all development	
N) Land Acquisition:	Town-Wide	Effective	The Town acquired Williams Property-35 acres. The Town acquired Browns Woods through MVP Action Grant- about 22 acres. The May 7, 2024, Annual Town Meeting voted to purchase the 36.49 acre Webster Property for conservation purposes from CPA funds
O) Community Preservation Act	Town-Wide	Effective	On going discussion about if the 1% should change.
P) Public Education on stormwater through the NPDES Phase II program	Town-Wide	Effective	Renamed MS 4
Q) Culvert upgraded by the Town.	King Street (2)	Effective	
R) Road raised by the Town.	Nashoba Road (3)	Effective	
S) New culvert installed by the Town.	Newtown Road (7)	Reduced flooding	
DAM HAZARDS			
T) DCR Dam Safety Regulations	Town-Wide	Effective	
U) Construction permits required	Town-Wide	Effective	

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Mitigation Measure	Area Covered	Effectiveness / Comments	Updates and or Improvements since 2017 Plan
WIND HAZARDS			
V) Tree Maintenance Program by the Highway Dept.	Town-Wide	Effective	Gone from contractors to a tree crew now
W) Tree Maintenance Program by the Light Dept.	Town-Wide	Effective	
X) Highway Department has access to brush chippers	Town-Wide	Effective	
WINTER HAZARDS			
Y) Snow removal operations, liquid deicer (magnesium chloride); reduce sand usage	Town-Wide	Generally effective, extreme snow in 2015 was a challenge	Starting to look at Salt Brine preapplication, no sand
Z) Sufficient snow storage space	Town-Wide	Generally effective, extreme snow in 2015 was a challenge	
GEOLOGIC HAZARDS			
AA) Middle and High school are new buildings with backup power that can act as shelters	Town-wide	Effective	
BB) Evacuation plan in CEMP	Town-Wide	Effective	
CC) Rivers and ponds can be tapped into for firefighting if necessary	Town-Wide	Effective	
DD) Tanker task force available through State Fire mobilization.	Town-Wide	Effective	
EE) El Paso gas company monitors and provides training for its gas pipeline.	Town-Wide	Effective	
FF) Maximum slopes for subdivision roads	Town-Wide	Effective	

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Mitigation Measure	Area Covered	Effectiveness / Comments	Updates and or Improvements since 2017 Plan
GG) Soil removal permits required	Town-Wide	Effective	Selectboard updated this law.
HH) Massachusetts Building code enforced by the Town	Town-Wide	Effective for new construction and major renovations	
BRUSHFIRE HAZARDS			
II) Burning Permits -- Open Burning Permits required by the Fire Department	Town-wide	Effective	
JJ) Development Review – the Fire Department reviews all development plans for fire safety	Town-wide	Effective	
KK) Fire Department provides public education on its website	Town-Wide	Effective	
MULTI-HAZARDS			
LL) Multi-department review of developments	Town-Wide	Effective	
MM) Comprehensive Emergency Management Plan (CEMP)	Town-Wide	Effective	
NN) Enforcement of State Building Code	Town-Wide	Effective	
OO) Local Emergency Management Planning Committee (LEPC)	Town-Wide	Effective	
PP) Middle and High school are new buildings with backup power that can act as shelters	Town-Wide	Effective	

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Mitigation Measure	Area Covered	Effectiveness / Comments	Updates and or Improvements since 2017 Plan
QQ) Back-up 911 system in Ayer, redundant emergency communications systems, and recent upgrades to the Police Department communications network	Town-Wide	Effective	All radio systems for police are digital and all new
DROUGHT HAZARDS			
SS) A new well is currently being built for redundancy.	Town-wide	Not yet completed	
EXTREME TEMPERATURE HAZARDS			
TT) Community room at fire station is used for short term emergency temps and middle school is used for long term extreme temps and they use the Littleton volunteer Corp for these things.	Town-wide	Effective	

Local Capabilities for Implementation

Under the Massachusetts system of “Home Rule,” the Town of Littleton is authorized to adopt and from time to time amend a number of local bylaws and regulations that support the town’s capabilities to mitigate natural hazards. These include Zoning Bylaws, Subdivision and Site Plan Review Regulations, Wetlands Bylaws, Health Regulations, Public Works regulations, and local enforcement of the State Building Code. Local Bylaws may be amended each year at the annual Town Meeting to improve the town’s capabilities, and changes to most regulations simply require a public hearing and a vote of the authorized board or commission. The Town of Littleton has recognized several existing mitigation measures that require implementation or improvements, and has the capacity based on these Home Rule powers within its local boards and departments to address these.

The new zoning and regulatory measures identified in this plan include adopting cluster-by-right, flexible development zoning provisions, alternative design requirements to reduce impervious surfaces, adding slope stabilization requirements to site plan review, and adopting binding operation and maintenance agreements for private drainage facilities. The Littleton Department of Public Works will address the needs for catch basin cleaning, repairs and upgrades to drainage infrastructure. The town’s Planning Board will address the updates to the Master Plan and implementation of the Zoning Ordinance, Floodplain District, and Subdivision Rules and Regulations. The Conservation Commission will oversee implementation of the Wetlands Bylaw and the Open Space Plan. The Dept. of Public Works together with the Planning Board and Conservation Commission will coordinate implementation and enforcement of the Stormwater Bylaw.

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SECTION 7: MITIGATION MEASURES FROM THE 2017 PLAN

IMPLEMENTATION PROGRESS OF THE PREVIOUS PLAN

At a meeting of the Littleton Hazard Mitigation Planning Committee, Town staff reviewed the mitigation measures identified in the 2017 Littleton Hazard Mitigation Plan and determined whether each measure had been implemented or deferred. Of those measures that had been deferred, the committee evaluated whether the measure should be deleted or carried forward into this Hazard Mitigation Plan 2025 Update. The decision on whether to delete or retain a particular measure was based on the committee's assessment of the continued relevance or effectiveness of the measure and whether the deferral of action on the measure was due to the inability of the Town to take action on the measure. Table 44 summarizes the status of mitigation measures, and mitigation projects completed are described in more detail below.

Table 44: Status of Mitigation Measures

Mitigation Measure	Priority in 2017 Plan	CURRENT STATUS	FOR THE 2025 PLAN UPDATE
FLOODNG MITIGATION			
Pursue Open Space purchases of Joyce Williams property, surplus Mass DOT property, Boxborough Rd Area	High	Completed. The Town purchased the Joyce Williams property and the MassDOT property – both are located in the Boxborough Road area. In addition, the Town purchased approximately 36 acres known as the “Webster” property off Bulkeley Road near Crane Road in May 2024 in part to mitigate future flooding concerns	Keep in plan update. A continuing goal for the Town is to continue to consider flood hazard mitigation in review of open space areas for potential purchase.
Revise Open Space Development bylaw, adopt cluster-by-right	High	Partially completed The Town has not adopted cluster by right by law	Keep in plan update Adopt open space development by right
Adopt flexible development zoning provisions	High	Partially completed. The Town adopted village common mixed-used district and King Street Common mixed-use district	Keep in plan update Continue to develop updated zoning
Provide alternative design requirements for impervious surfaces	High	Completed. Storm water bylaw was adopted	Delete from plan update

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Require binding operation and maintenance plans for impervious surfaces	High	Completed Storm water by law covers this	Delete from plan update
Include slope stabilization requirements in site planning	High	Completed	Delete from plan update
Drainage Improvements: New Estate Rd., Nagog Hill Rd.	High	Completed The drainage has been fully reconstructed with new basins.	Delete from plan update
Implement beaver control measures.	High	Partially completed A few beaver deceivers installed at greatest culvert crossing	Keep in plan update and add development of a beaver management plan

WINTER HAZARDS MITIGATION

Locate additional snow storage areas for back-up use during significant snowfall events.	Medium	Completed	Delete from plan update
Locate storage for one year of salt usage	Medium	Not Completed No longer a priority. The Town has adequate facilities.	Delete from plan update

BRUSHFIRE MITIGATION

Maintain fire access roads at Oak Hill, Long Lake, Yapp Conservation Land, and NE Forestry Foundation Property	High	Partially Completed Oak Hill Road was done but the others were not.	Keep in plan update; The Town will continue these endeavors
Public Education on Brush Fire Prevention	High	Partially Completed Yearly public education is done for residents who obtain an open-air burning permit.	Keep in plan update; continue and expand upon these efforts

EARTHQUAKE MITIGATION

Conduct feasibility study on how to make town facilities earthquake resistant.	Medium	Not completed. Earthquake hazard is a lower priority in	Keep in plan update
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		Littleton due to lower likelihood of an earthquake.	
EXTREME TEMPERATURE MITIGATION			
Promote green roofs and cool roofs Town-wide	Medium	Partially completed Several buildings are currently being installed with green roofs, including the emergency management building, the library, and the senior center.	Keep in plan update; the town will continue to add green roofs to future municipal buildings.
DROUGHT MITIGATION			
Include drought tolerant landscaping in site plan review	High	Not completed. Littleton reconsidered this measure and have decided to focus resources on grass seed	Keep in plan update; consider drought resistant grass seed.
Provide education on drought and water use	High	Partially completed The Littleton Water District works with Boxboro on initiative to educate on water conservation.	Keep in plan update; enhance the Boxboro and Littleton water conservation project region wide
DAM MITIGATION			
Implement beaver management as required.	High	Not completed. The town identified the need to develop a townwide beaver management plan	Keep in plan update; create Beaver Management Plan as mentioned in the flooding mitigation section
WIND MITIGATION MEASURES			
Install fiber back-up to radio system between Police and Cedar Hill tower	High	Completed	Remove from plan
CLIMATE RESILIENCE/ADAPTATION			
Include sustainability in planning efforts	High	Partially completed. Town has worked to include sustainability in the Master Plan and Open Space Recreation Plan.	Keep in plan update; The town will continue to make climate considerations and sustainability a priority in the budgeting and capitol investment plans.

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Include climate consideration in master plan process.	High	Partially complete This has been included in the Master Plan.	Keep in plan update; explore producing a Climate Action Plan using the Town's climate action committee.
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As indicated on Table 43, Littleton made good progress on implementing mitigation measures identified in the 2017 Hazard Mitigation Plan. Several projects have been completed, including drainage improvements at New Estate Road and Nagog Hill Road, installation of a fiber back-up to the radio system, site plan review regulations on slope stabilization; adoption of a stormwater bylaw with operation and maintenance plans for impervious surfaces and alternative designs for impervious surfaces, and with location of additional snow storage areas. Several longer-term measures were partially completed, including purchase of a major open space parcel, revision of the Open Space Development bylaw, adoption of flexible zoning measures, beaver control measures, management of fire access roads, public education on wildfire hazards, installation of Green Roofs, public education on water use and drought, and inclusion of sustainability in the Master Plan and Open Space Recreation Plan.

Moving forward into the next five-year plan implementation period there will be many more opportunities to incorporate hazard mitigation into the Town's decision-making processes. The challenges the Town faces in implementing these measures are primarily due to limited funding and available staff time. This plan should help the Town prioritize the best use of its limited resources for enhanced mitigation of natural hazards.

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SECTION 8: HAZARD MITIGATION STRATEGY

WHAT IS HAZARD MITIGATION?

Hazard mitigation means to permanently reduce or alleviate the losses of life, injuries and property resulting from natural hazards through long-term strategies. These long-term strategies include planning, policy changes, education programs, infrastructure projects and other activities. FEMA currently has three mitigation grant programs: the Hazards Mitigation Grant Program (HGMG), the Building Resilient Infrastructure and Communities (BRIC) grant, and the Flood Mitigation Assistance (FMA) program. The three links below provide additional information on these programs.

- <https://www.fema.gov/hazard-mitigation-grant-program>
- <https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities>
- <https://www.fema.gov/flood-mitigation-assistance-grant-program>

According to FEMA Local Multi-Hazard Mitigation Planning Guidance, identified measures can generally be sorted into the following groups:

- **Prevention:** Government administrative or regulatory actions or processes that influence the way land and buildings are developed and built. These actions also include public activities to reduce hazard losses. Examples include planning and zoning, building codes, capital improvement programs, open space preservation, and stormwater management regulations.
- **Property Protection:** Actions that involve the modification of existing buildings or infrastructure to protect them from a hazard or removal from the hazard area. Examples include acquisition, elevation, relocation, structural retrofits, flood proofing, storm shutters, and shatter resistant glass.
- **Public Education & Awareness:** Actions to inform and educate citizens, elected officials, and property owners about the potential risks from hazards and potential ways to mitigate them. Such actions include outreach projects, real estate disclosure, hazard information centers, and school-age and adult education programs.
- **Natural Resource Protection:** Actions that, in addition to minimizing hazard losses, also preserve or restore the functions of natural systems. These actions include sediment and erosion control, stream corridor restoration, watershed management, forest and vegetation management, and wetland restoration and preservation.
- **Structural Projects:** Actions that involve the construction of structures to reduce the impact of a hazard. Such structures include storm water controls (e.g., culverts), floodwalls, seawalls, retaining walls, and safe rooms.
- **Emergency Services Protection:** Actions that will protect emergency services before, during, and immediately after an occurrence. Examples of these actions include protection of warning system capability, protection of critical facilities, and protection of emergency response infrastructure.

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REGIONAL AND INTER-COMMUNITY CONSIDERATIONS

Some hazard mitigation issues are strictly local. The problem originates primarily within the municipality and can be solved at the municipal level. Other issues are inter-community and require cooperation between two or more municipalities. There is a third level of mitigation which is regional and may involve a state, regional or federal agency or three or more municipalities.

REGIONAL PARTNERS

In many communities, mitigating natural hazards is more than a local issue. The facilities that serve these communities are complex systems owned and operated by a wide array of agencies, government, and private entities. In Littleton, this includes but is not limited to the Town of Littleton, Massachusetts Dept of Transportation (MassDOT), and the Massachusetts Bay Transportation Authority (MBTA). The planning, construction, operations and maintenance of these facilities are integral to the hazard mitigation efforts of communities. These agencies must be considered the communities' regional partners in hazard mitigation. These agencies also operate under the same constraints as communities do, including budgetary and staffing constraints and numerous competing priorities. In the sections that follow, the plan includes recommendations for activities to be undertaken by these other agencies. Implementation of these recommendations will require that all parties work together to develop solutions.

REGIONAL ISSUES

Major facilities owned, operated and maintained by federal, state, regional or private entities in Littleton include Routes 2, 2A, 110, 119 and 495 (MassDOT); MBTA Commuter Rail Service to Boston (MBTA); and Natural Gas Line.

NEW DEVELOPMENT AND INFRASTRUCTURE

As part of the process of developing recommendations for new mitigation measures for this plan update, the Town considered the issues related to new development, redevelopment, and infrastructure needs in order limit future risks. Taking into consideration the town's expansion of LID and stormwater requirements town-wide, the Wetlands Bylaw enforced by the Conservation Commission, the Comprehensive Plan, and the Open Space Plan, the town determined that existing regulatory measures are taking good advantage of local Home Rule land use regulatory authority to minimize natural hazard impacts of development. Priorities for the future include further regulatory changes and public education efforts toward ensuring that future development occurs in a sustainable manner. Beaver control measures and drainage upgrades are also priorities in this plan.

PROCESS FOR SETTING PRIORITIES FOR MITIGATION MEASURES

The last step in developing the Town's mitigation strategy is to assign a level of priority to each mitigation measure so as to guide the focus of the Town's limited resources towards those actions with the greatest potential benefit. At this stage in the process, the Local Hazard Mitigation Planning Team had limited access to detailed analyses of the cost and benefits of any given mitigation measure, so prioritization is based on the local team members' understanding of

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existing and potential hazard impacts and an approximate sense of the costs associated with pursuing any given mitigation measure.

Priority setting was based on local knowledge of the hazard areas, including impacts of hazard events, the extent of the area impacted, and the relation of a given mitigation measure to the Town's goals. In addition, the local Hazard Mitigation Planning Team also took into consideration factors such as the number of homes and businesses affected, whether or not road closures occurred and what impact closures had on delivery of emergency services and the local economy, anticipated project costs, whether any environmental constraints existed, and whether the Town would be able to justify the costs relative to the anticipated benefits.

Table 44 below demonstrates the prioritization of the Town's potential hazard mitigation measures. For each mitigation measure, the geographic extent of the potential benefiting area is identified as is an estimate of the overall benefit and cost of the measures. The benefits, costs, and overall priority were evaluated in terms of:

Estimated Benefits	
High	Action will result in a significant reduction of hazard risk to people and/or property from a hazard event
Medium	Action will likely result in a moderate reduction of hazard risk to people and/or property from a hazard event
Low	Action will result in a low reduction of hazard risk to people and/or property from a hazard event
Estimated Costs	
High	Estimated costs greater than \$250,000
Medium	Estimated costs between \$100,000 to \$250,000
Low	Estimated costs less than \$100,000 and/or staff time
Mitigation Priority	
High	Action very likely to have political and public support and necessary maintenance can occur following the project, and the costs seem reasonable considering likely benefits from the measure
Medium	Action may have political and public support and necessary maintenance has potential to occur following the project. Medium priority measures would address a hazard of concern to the town, but costs may not be in proportion to the benefits achieved.
Low	Not clear if action has political and public support and not certain that necessary maintenance can occur following the project. Low priority measures would not address significant or high priority hazards and/or the cost would not be in proportion to the benefits

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Table 45: Mitigation Measure Prioritization

Mitigation Action	Geographic Coverage	Estimated Benefit	Estimated Cost	Overall Priority
Flood Hazard Mitigation				
1. Create criteria for future parcels such as including flood mitigation for purchase of open space parcels and interconnected and diverse open space land. This measure will also serve to mitigate climate impacts such as heat and invasive species.	Town-wide	High	Low	High
2. Zoning diagnostics by the Town of Littleton which will include a review of the Open Space Residential Development bylaw and cluster by right provision	Town-wide	High	Low	High
3. Concentrate development in existing areas of development	Town-wide	High	Low	High
4. Beaver control measures- Create beaver mitigation plan	Town-wide	Medium	Low	Medium
5. Review options for extending wetlands buffer zones	Town-wide	Medium	Low	Medium
6. Conduct hydraulic analysis of flow and flooding issues in the Mill Pond Area	Mill-Pond Area	High	Medium	High
7. Identifying more rain gardens and water retention basins on steep slopes	Town-wide	Medium	Low	Medium
8. Educate and make public aware of watershed sub-basins with signate at water divides	Town-wide	Low	Low	Low
Extreme Weather (Wind/Hail/Thunderstorms)				
9. Installing wind resistant windows in public buildings	Town-wide	Medium	High	High
10. Enhance tree trimming to protect from severe	Town-wide	Medium	Medium	Medium

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Table 45: Mitigation Measure Prioritization

Mitigation Action	Geographic Coverage	Estimated Benefit	Estimated Cost	Overall Priority
weather events such as thunderstorms and hail				
Wildfire Mitigation				
11. Develop a comprehensive strategy for wildland fires that incorporates the natural fire cycle. This would include working to maintain fire access roads at Oak Hill, Long Lake, Yapp Conservation Land, and NE Forestry Foundation Property	Local	High	Low	High
12. Public Education on Brush Fire Prevention	Town-wide	High	Low	High
Winter Storm Hazard Mitigation				
13. Assess the ability of municipal buildings roofs to sustain snow loads and ice buildup on flat building roofs.	Town-wide	Low	Low	Low
Earthquake Mitigation				
144. Conduct feasibility study on how to make town facilities earthquake resistant.	Local	Medium	Medium	Medium
Extreme Temperature Mitigation				
15. The town will add green roofs and solar canopies to future municipal properties.	Town-wide	Medium	Low	Medium
16. Update site plan requirements to eliminate heat islands in parking lots and to increase shade.	Town-wide	Medium	Low	Medium
Drought Mitigation				
17. Include drought tolerant landscaping in site plan review, put an emphasis on utilizing native plants with considerations for drought resistant grass seed	Town-wide	High	Low	High
18. Provide education on drought and water use, continue and enhance the	Town-wide	High	Low	High

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Table 45: Mitigation Measure Prioritization

Mitigation Action	Geographic Coverage	Estimated Benefit	Estimated Cost	Overall Priority
Boxborough and Littleton water conservation project regionwide				
19. Include rain barrels and drought resistant grass seeds in future projects	Town-wide	Medium	Medium	Medium
20. Public Education on reducing water consumption specifically regarding large area water consuming lawns	Town-wide	Low	Low	Low
Climate Resilience/Adaptation				
21. Will make climate considerations and sustainability a priority in the budgeting and capital investment plans.	Town-wide	High	Low	High
22. Explore producing a climate action plan/municipal sustainable action plan using the sustainability committee	Town-wide	High	Low	High
INVASIVE SPECIES HAZARDS				
23. Strategically reduce invasive plants (e.g. garlic mustard pull) and combine with town-wide week-long clean-up effort as is done successfully in abutting towns)	Town-wide	Medium	Low	Medium
Landslide Hazards				
24. The town should review new developments with high slopes or unstable soil to ensure that landslide risks are mitigated	Town-wide	Low	Low	Low
Dam Hazards				
25. The town will coordinate with the Massachusetts Department of Transportation to ensure that the Mill Pond Dam is	Mill Pond Dam	Low	Low	Low

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Table 45: Mitigation Measure Prioritization

Mitigation Action	Geographic Coverage	Estimated Benefit	Estimated Cost	Overall Priority
regularly inspected and maintained as needed.				

Recommended Mitigation Strategy

The recommended mitigation strategy is summarized in Table 45, which provides the following information about each recommended mitigation measure:

Description of the Mitigation Measure – The description of each mitigation measure is brief and cost information is given only if cost data were already available from the community. The cost data represent a point in time and would need to be adjusted for inflation and for any changes or refinements in the design of a particular mitigation measure.

Priority – As described above and summarized in Table 44, the designation of high, medium, or low priority was done considering potential benefits and estimated project costs, as well as other factors in the STAPLEE analysis.

Implementation Responsibility – The designation of implementation responsibility was done based on a general knowledge of what each municipal department is responsible for. It is likely that most mitigation measures will require that several departments work together and assigning staff is the sole responsibility of the governing body of each community.

Time Frame – The time frame was based on a combination of the priority for that measure, the complexity of the measure and whether or not the measure is conceptual, in design, or already designed and awaiting funding. Because the time frame for this plan is five years, the timing for all mitigation measures has been kept within this framework. The identification of a likely time frame is not meant to constrain a community from taking advantage of funding opportunities as they arise.

Potential Funding Sources – This column attempts to identify the most likely sources of funding for a specific measure. The information on potential funding sources in this table is preliminary and varies depending on a number of factors. These factors include whether or not a mitigation measure has been studied, evaluated or designed, or if it is still in the conceptual stages. MEMA and DCR assisted MAPC in reviewing the potential eligibility for hazard mitigation funding. Each grant program and agency has specific eligibility requirements that would need to be taken into consideration. In most instances, the measure will require a number of different funding sources. Identification of a potential funding source in this table does not guarantee that a project will be eligible for, or selected for funding. Upon adoption of this plan, the local team responsible for its implementation should begin to explore the funding sources in more detail.

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Additional information on funding sources – The best way to determine eligibility for a particular funding source is to review the project with a staff person at the funding agency. The following websites provide an overview of programs and funding sources.

Army Corps of Engineers (ACOE) – The website for the North Atlantic district office is <http://www.nae.usace.army.mil/>. The ACOE provides assistance in a number of types of projects including shoreline/streambank protection, flood damage reduction, flood plain management services and planning services.

Massachusetts Emergency Management Agency (MEMA) – The grants page <http://www.mass.gov/dem/programs/mitigate/grants.htm> has a useful table that compares eligible projects for the Hazard Mitigation Grant Program and the Flood Mitigation Assistance Program.

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Table 46: Recommended Mitigation Strategy

Mitigation Measure	Priority	Lead Agency	Estimated Cost*	Estimated Timeframe 2025-30	Potential Funding Sources
FLOOD HAZARDS					
1. Create criteria for future parcels such as including flood mitigation for purchase of open space parcels and interconnected and diverse open space land. This measure will also serve to mitigate climate impacts such as heat and invasive species.	High	Conservation Commission /Planning Department with support from NGOs such as Littleton Conservation Trust, Sudbury Valley Trustees, and New England Forestry Foundation	Low	2025/27	Town/ Local Acquisitions for Natural Diversity (LAND) Grant Program Municipal Vulnerability Preparedness 6grant program
2. Zoning diagnostics by the Town of Littleton which will include a review of the Open Space Residential Development bylaw and cluster by right provision	High	Planning	Low	2027-29	Littleton General Fund- Planning Department

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Mitigation Measure	Priority	Lead Agency	Estimated Cost*	Estimated Timeframe 2025-30	Potential Funding Sources
3. Concentrate development in existing areas of development	High	Planning	Low	2025-30	Metropolitain Area Planning Council Technical Assistance Program/ Littleton General Fund- Planning Department
4. Beaver control measures-Create beaver mitigation plan	High	Water/Clean Lakes Committee	Low	2025-2030	Littleton General Fund- Water Department
5. Review options for extending wetlands buffer zones	Medium	Conservation Commission	Low	2028	Littleton General Fund- Conservation Commission
6. Conduct hydraulic analysis of flow and flooding issues in the Mill Pond Area	Medium	Department of Public Works	Medium	2029	Littleton General Fund- Department of Public Works
7. Identifying more rain gardens and water retention basins on steep slopes	Medium	Water/Conservation	Medium	2026-27	Climate Resiliency Grant/Department of Environmental Protection MS4 Storm Water Grant

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Mitigation Measure	Priority	Lead Agency	Estimated Cost*	Estimated Timeframe 2025-30	Potential Funding Sources
8. Educate and make public aware of watershed sub-basins with signate at water divides	Medium	Water	Low	2027	Littleton General Fund-Water Department
EXTREME WEATHER (WIND/HAIL/THUNDERSTORMS)					
9. Installing wind resistant windows in public buildings	Medium	Facilities	Medium	2029/30	Littleton General Fund-Facilities Department
10. Enhance tree trimming to protect from severe weather events such as thunderstorms and hail	Medium	Department of Public Works and Littleton Electric Light and Water Departments	Medium	2025-2030	Littleton General Fund-Department of Public Works and Littleton Electric Light and Water Departments
WILDFIRE HAZARDS					
11. Develop a comprehensive strategy for wildland fires that incorporates the natural fire cycle. This would include working	High	Fire in partnership with Sustainability/Conservation	Low	2025-2030	Littleton General Fund- Fire Department

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Mitigation Measure	Priority	Lead Agency	Estimated Cost*	Estimated Timeframe 2025-30	Potential Funding Sources
to maintain fire access roads at Oak Hill, Long Lake, Yapp Conservation Land, and NE Forestry Foundation Property					
12. Public Education on Brush Fire Prevention	High	Fire	Low	2025-2030	Student Awareness of Fire Education (SAFE) Grant
WINTER HAZARDS					
13. Assessing snow loads and ice buildup on flat building roofs.	Medium	Facilities	Low	2028	Littleton General Fund-Facilities Department
GEOLOGIC HAZARDS					
14. Conduct feasibility study on how to make town facilities earthquake resistant	Medium	Facilities	Medium	2027	Littleton General Fund-Facilities Department
EXTREME TEMPERATURE HAZARDS					
15. The town will continue to add green roofs and solar canopies to future municipal properties.	Medium	Select Board	Low	2025-2030	Littleton General Fund-Sustainability Committee

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Mitigation Measure	Priority	Lead Agency	Estimated Cost*	Estimated Timeframe 2025-30	Potential Funding Sources
16. Update site plan requirements to eliminate heat islands in parking lots and to increase shade.	High	Planning	Low	2027	Littleton General Fund- Planning Department
DROUGHT HAZARDS					
17. Include drought tolerant landscaping in site plan review, put an emphasis on utilizing native plants with considerations for drought resistant grass seed	High	Planning/Conservation	Low	2027	Littleton General Fund- Planning Department
18. Continue and enhance the Boxboro and Littleton water conservation project region wide	High	Water	Low	2025-2030	Littleton General Fund- Water Department
19. Include rain barrels in future projects, the town shall require these during the site plan review process, and be	Medium	Water	Medium	2028	Littleton General Fund- Water Department

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Mitigation Measure	Priority	Lead Agency	Estimated Cost*	Estimated Timeframe 2025-30	Potential Funding Sources
encouraged in other developments					
20. Public Education on reducing water consumption specifically regarding large area water consuming lawns 21.	Medium	Water	Low	2026-27	Littleton General Fund- Water Department
CLIMATE RESILIENCE/ADAPTATION					
22. Will continue to make climate considerations and sustainability a priority in budgeting and capital investment plans. 23.	High	Office of Town Administrator	Low	2025-2030	Littleton General Fund- Office of Town Administrator
24. Explore producing a climate action plan/municipal sustainable action plan using the sustainability committee	High	Select Board/ Planning/ Sustainability	Low	2026	Littleton General Fund- Planning Department Littleton General Fund- Sustainability Committee, Department of Energy Resources Grant

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Mitigation Measure	Priority	Lead Agency	Estimated Cost*	Estimated Timeframe 2025-30	Potential Funding Sources
INVASIVE SPECIES HAZARDS					
25. Strategically reduce invasive plants (e.g. garlic mustard pull) and combine with town-wide week-long clean-up effort as is done successfully in abutting towns)	High	Conservation	Medium	2025-2030	Cooperative Invasive Species Management Areas CISMA Grant
LANDSLIDE HAZARDS					
24. The town should review new developments with high slopes or unstable soil to ensure that landslide risks are mitigated	Low	Planning	Low	2025-2030	General Fund- Planning
DAM HAZARDS					
25. The town will coordinate with the Massachusetts Department of Transportation to ensure that the Mill Pond Dam is regularly inspected and maintained as needed.	Low	Department of Public Works	Low	2025-2030	Littleton General Fund- Department of Public Works and Littleton Electric Light and Water Departments

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SECTION 9: PLAN ADOPTION AND MAINTENANCE

Plan Adoption

The Littleton Hazard Mitigation Plan 2025 Update was adopted by the Select Board on [ADD DATE]. See Appendix D for documentation. The plan was approved by FEMA on [ADD DATE] for a five-year period that will expire on [ADD DATE].

Plan Maintenance

MAPC worked with the Littleton Hazard Mitigation Team to prepare this plan. After approval of the plan by FEMA, the local Team will meet on a regular basis to oversee implementation of the plan and prepare for the next plan update. Additional members could be added to the local implementation team from other town departments, local businesses, non-profits, and institutions.

The town will encourage public participation during the next 5-year planning cycle. As updates and a review of the plan are conducted by the local Team, these will be placed on the project's website, and any meetings of the Local Team will be publicly noticed in accordance with the town and state open meeting laws. The posting will include a mechanism for citizen feedback such as an e-mail address to send comments.

Implementation Schedule

Mid-Term Survey on Progress— The coordinator of the Hazard Mitigation Implementation Team will prepare and distribute a survey in year three of the plan. The survey will be distributed to all of the local implementation group members and other interested local stakeholders. The survey will poll the members on any changes or revisions to the plan that may be needed, progress and accomplishments for implementation, and any new hazards or problem areas that have been identified.

This information will be used to prepare a report or addendum to the local hazard mitigation plan in order to evaluate its effectiveness in meeting the plan's goals and identify areas that need to be updated in the next plan. The Hazard Mitigation Implementation Team, coordinated by the Commissioner of Public Works, will have primary responsibility for tracking progress, evaluating, and updating the plan.

Begin to Prepare for the next Plan Update -- FEMA's approval of this plan is valid for five years, by which time an updated plan must be approved by FEMA in order to maintain the town's approved plan status and its eligibility for FEMA mitigation grants. Given the lead time needed to secure funding and conduct the planning process, the Hazard Mitigation Implementation Team will begin to prepare for an update of the plan in year three. This will help the Town avoid a lapse in its approved plan status and grant eligibility when the current plan expires.

The Hazard Mitigation Implementation Team will use the information from the Mid-Term progress review to identify the needs and priorities for the plan update and seek funding for the plan update process. Potential sources of funding may include FEMA Pre-Disaster Mitigation grants and the Hazard Mitigation Grant Program. Both grant programs can pay for 75% of a planning project, with a 25% local cost share required.

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Prepare and Adopt an Updated Local Hazard Mitigation Plan —Once the resources have been secured to update the plan, the Hazard Mitigation Implementation Team may decide to undertake the update themselves, contract with the Metropolitan Area Planning Council to update the plan or to hire another consultant. However the Hazard Mitigation Implementation Team decides to update the plan, the group will need to review the current FEMA hazard mitigation plan guidelines for any changes. The Littleton Hazard Mitigation Plan Update will be forwarded to MEMA and DCR for review and to FEMA for approval.

Integration of the Plans with Other Planning Initiatives

Upon approval of the Littleton Hazard Mitigation Plan 2017 Update by FEMA, the Local Hazard Mitigation Team will provide all interested parties and implementing departments with a copy of the plan and will initiate a discussion regarding how the plan can be integrated into that department's ongoing work. At a minimum, the plan will be reviewed and discussed with the following departments:

- Fire
- Emergency Management
- Police
- Highway
- Light and Water
- Planning
- Conservation
- Parks, Recreation, and Community Education
- Health
- Building

Other stakeholders that will be coordinated will include land conservation organizations, watershed groups, business groups, and nonprofit institutions.

Moving forward, the Hazard Mitigation Plan 2023 Update will be integrated into other town plans and policies as they are updated and renewed, including the Master Plan, Open Space and Recreation Plan, Capital Investment Program and Comprehensive Emergency Management Plan

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SECTION 10: LIST OF REFERENCES

Town of Littleton, Annual Report 2022

Code of the Town of Littleton

Town of Littleton Master Plan 2017

Town of Littleton Plan for 2030 (public input)

Town of Littleton Open Space and Recreation Plan, 2016

Town of Littleton Capital Plan 2017 Review of Requests

Environment America Research and Policy Center, *When It Rains It Pours – Global Warming and the Increase in Extreme Precipitation*, July 2012

FEMA, Flood Risk Report, Concord River Watershed, 2/27/2013

FEMA, Flood Insurance Rate Maps for Middlesex County, MA, 2012

FEMA, Local Mitigation Plan Review Guide; October 1, 2011.

MA Emergency Management Agency, *State Hazard Mitigation Plan*, 2013

MA Geographic Information System, *McConnell Land Use Statistics*, 2005

MA Office of Dam Safety, *Inventory of Massachusetts Dams*

Metropolitan Area Planning Council, *Geographic Information Systems Lab*

New England Seismic Network, Weston Observatory

Northeast States Emergency Consortium, website

NOAA, National Climatic Data Center, website

Union of Concerned Scientists, *Confronting Climate Change in the U.S. Northeast*, 2007

U. S. Census, 2020, *American Community Survey*

USGS, National Water Information Center, website

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APPENDIX A: HAZARD MAP SERIES

The MAPC GIS (Geographic Information Systems) Lab produced a series of maps for each community. Some of the data came from the Northeast States Emergency Consortium (NESEC). More information on NESEC can be found at <http://www.serve.com/NESEC/>. Due to the various sources for the data and varying levels of accuracy, the identification of an area as being in one of the hazard categories must be considered as a general classification that should always be supplemented with more local knowledge.

The map series consists of twelve map panels displaying the following information:

Map 1.	Population Density
Map 1a.	Environmental Justice
Map 2.	Land Use
Map 3.	Flood Zones
Map 3b.	Flood Claims from March 2010 Disaster Declaration
Map 4.	Earthquakes and Landslides
Map 5.	Hurricanes and Tornadoes
Map 6.	Average Snowfall
Map 7.	Composite Natural Hazards
Map 8.	Local Hazard Areas
Map 9	Land Surface Temperature
Map 10	Wildfires

Map 1: Population Density – This map uses the US Census block data for 2020 and shows population density as the number of people per acre in seven categories with 60 or more people per acre representing the highest density areas.

Map 1b: Environmental Justice – This map shows Environmental Justice (EJ) populations using 2020 data. EJ designations from the State include English isolation, income, and minority residents.

Map 2: Land Use – This map shows land cover and land use from MassGIS' 2016 [Land Cover/Land Use](#) dataset.

Map 3: Flood Zones – The map of flood zones used the FEMA NFIP Flood Zones for Middlesex County as its source. For more information, refer to the FEMA Map Service Center website <http://www.msfc.fema.gov>. The definitions of the flood zones are described in detail on this site as well. The flood zone map for each community also shows critical infrastructure and municipally owned and protected open space.

Map 3b: Flood Claims – This map shows flood insurance and disaster claim records from March 2010. The March 29, 2010 federal disaster declaration associated with severe rainfall and flooding triggered the launch of the Federal Emergency Management Agency's (FEMA's) Individual Assistance Program through which residential property owners, businesses, and institutions without flood insurance were eligible to apply for relief to pay for storm-related expenditures and repairs.

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Map 4: Earthquakes and Landslides (Regional) – This map depicts landslide risk and recorded earthquake epicenters in the community and surrounding region. This information came from NESEC. For most communities, there was no data for earthquakes because only the epicenters of an earthquake are mapped.

The landslide information shows areas with either a low susceptibility or a moderate susceptibility to landslides based on mapping of geological formations. This mapping is highly general in nature. For more information on how landslide susceptibility was mapped, refer to <http://pubs.usgs.gov/pp/p1183/pp1183.html>.

Map 5: Hurricanes and Tornadoes (Regional) – This map shows the spatial characteristics of several different meteorological properties and past events in the community and surrounding region. The map includes the storm tracks for both hurricanes and tropical storms. This information must be viewed in context. A storm track only shows where the eye of the storm passed through. In most cases, the effects of the wind and rain from these storms were felt in other communities even if the track was not within that community. This map also shows the location of tornadoes with a classification as to the level of damages. What appears on the map varies by community since not all communities experience the same wind-related events. These maps also show the 100-year wind speed and areas that could be inundated by storm surge during a hurricane, if any.

Map 6: Average Snowfall (Regional) - This map shows the average snowfall in the community and the surrounding region.

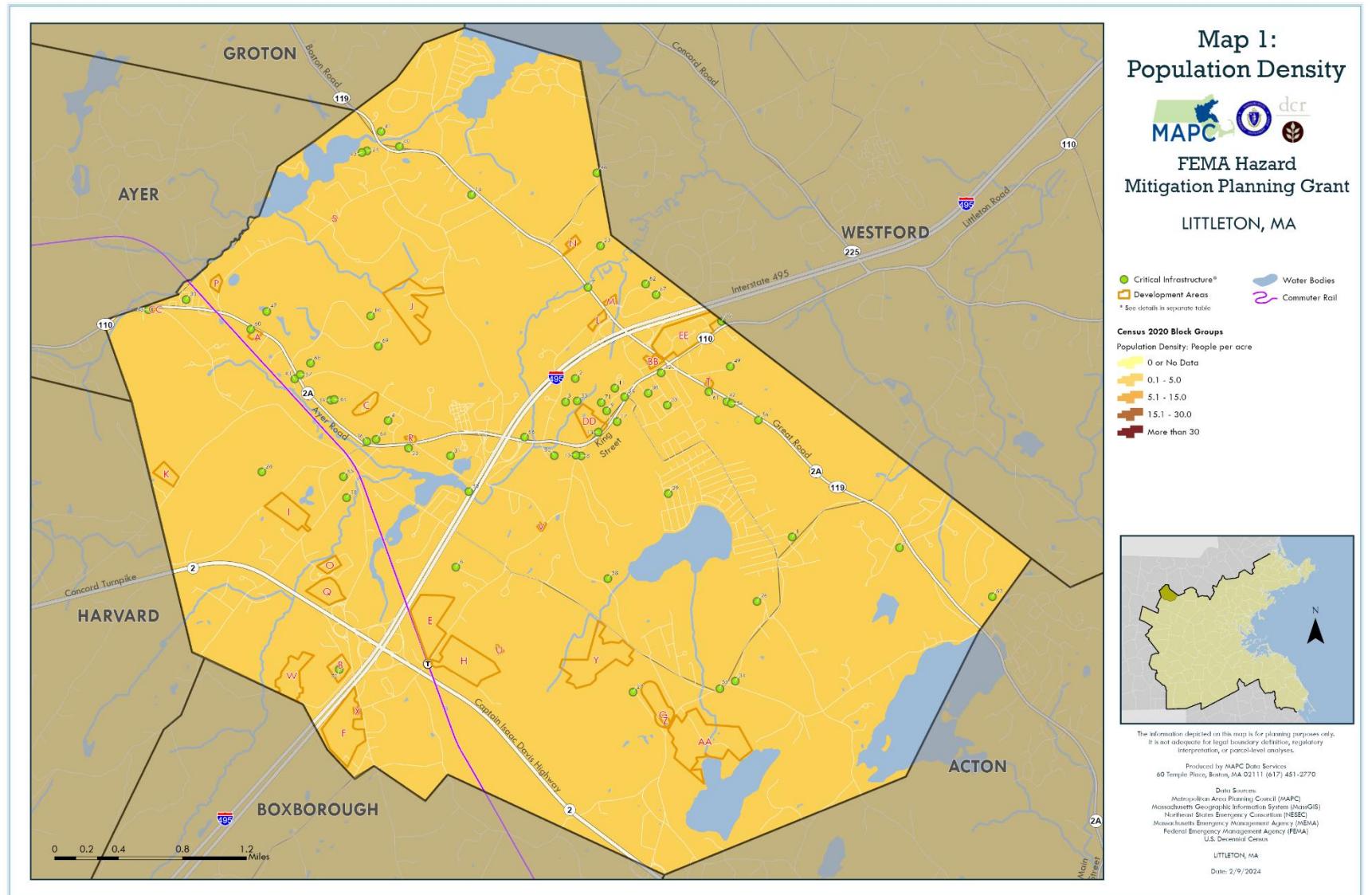
Map 7: Composite Natural Hazards (Regional) - This map shows four categories of composite natural hazards. The hazards included in this map are 100-year wind speeds of 110 mph or higher, low, and moderate landslide risk, FEMA Q3 flood zones (100 year and 500 year) and hurricane surge inundation areas. Areas with only one hazard were considered to be low hazard areas. Moderate areas have two of the hazards present. High hazard areas have three hazards present and severe hazard areas have four hazards present.

Map 8: Local Hazard Areas – For each community, locally identified hazard areas are overlaid on an aerial photograph. The critical infrastructure sites and planned development areas are also shown. The source of the aerial photograph is Mass GIS.

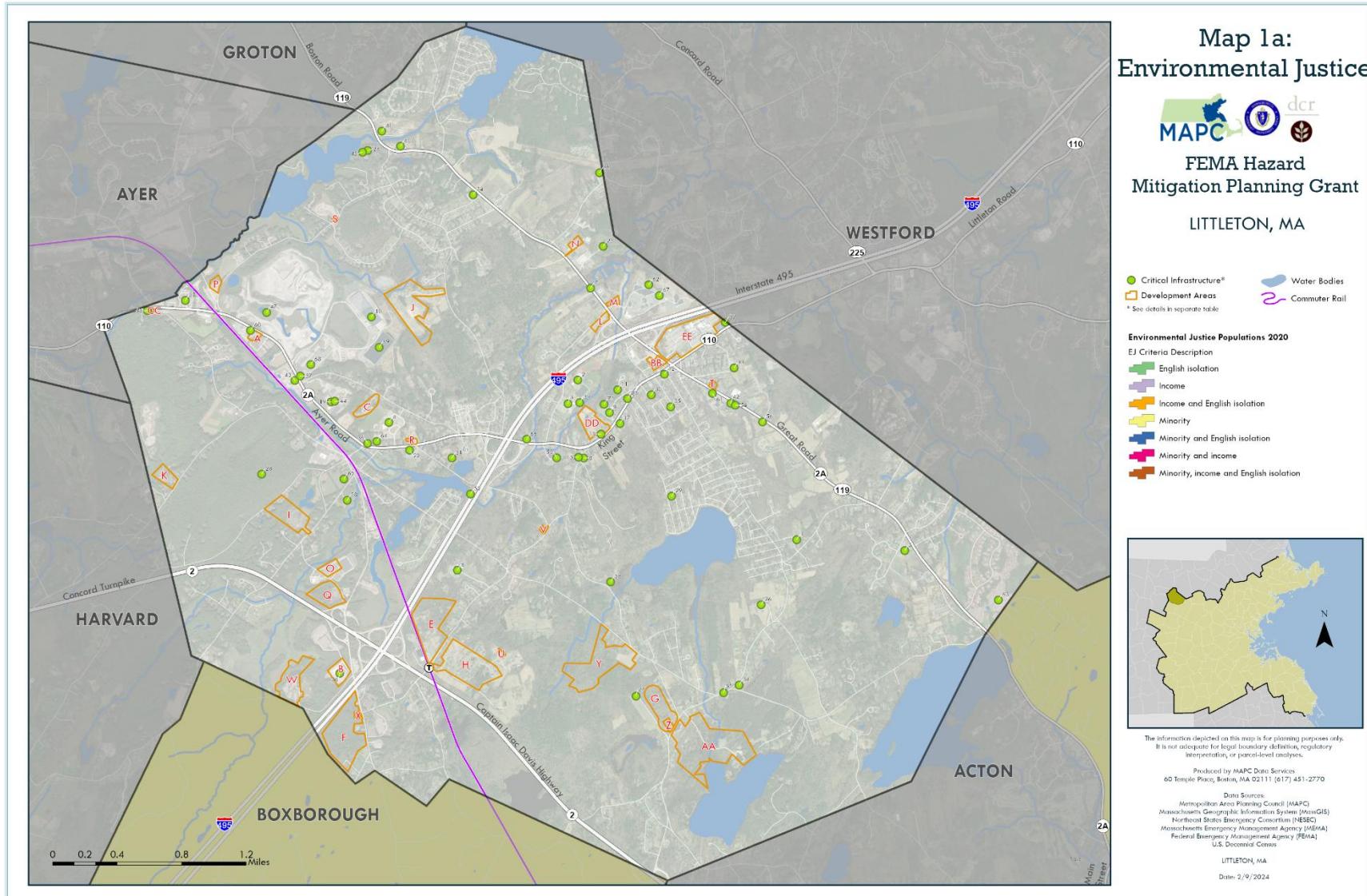
Map 9: Land Surface Temperature- MAPC's Statewide Land Surface Temperature (LST) Index was created by combining estimates of surface temperature from days in 2018, 2019, and 2020 where the daily air temperature maximum exceeded 70 degrees Fahrenheit. The Statewide LST Index “Hot Spots” data depicts the 5% highest LST index areas in each Regional Planning Agency (RPA) region. The data was generated by identifying pixels whose LST index values are equal to or greater than 95% of LST index values in the region, and then delineating cohesive regions where pixels meet this criterion as polygons. Map 9 represents the “Hot Spots” relative to the MAPC region, mapped on top of the National Land Cover Database’s [2016 30-m tree canopy data](#).

Map 10: Wildfires – This map shows wildfire risk to the community using USDA data. Wildfire risk is classified as very low, low, moderate, high, and very high.

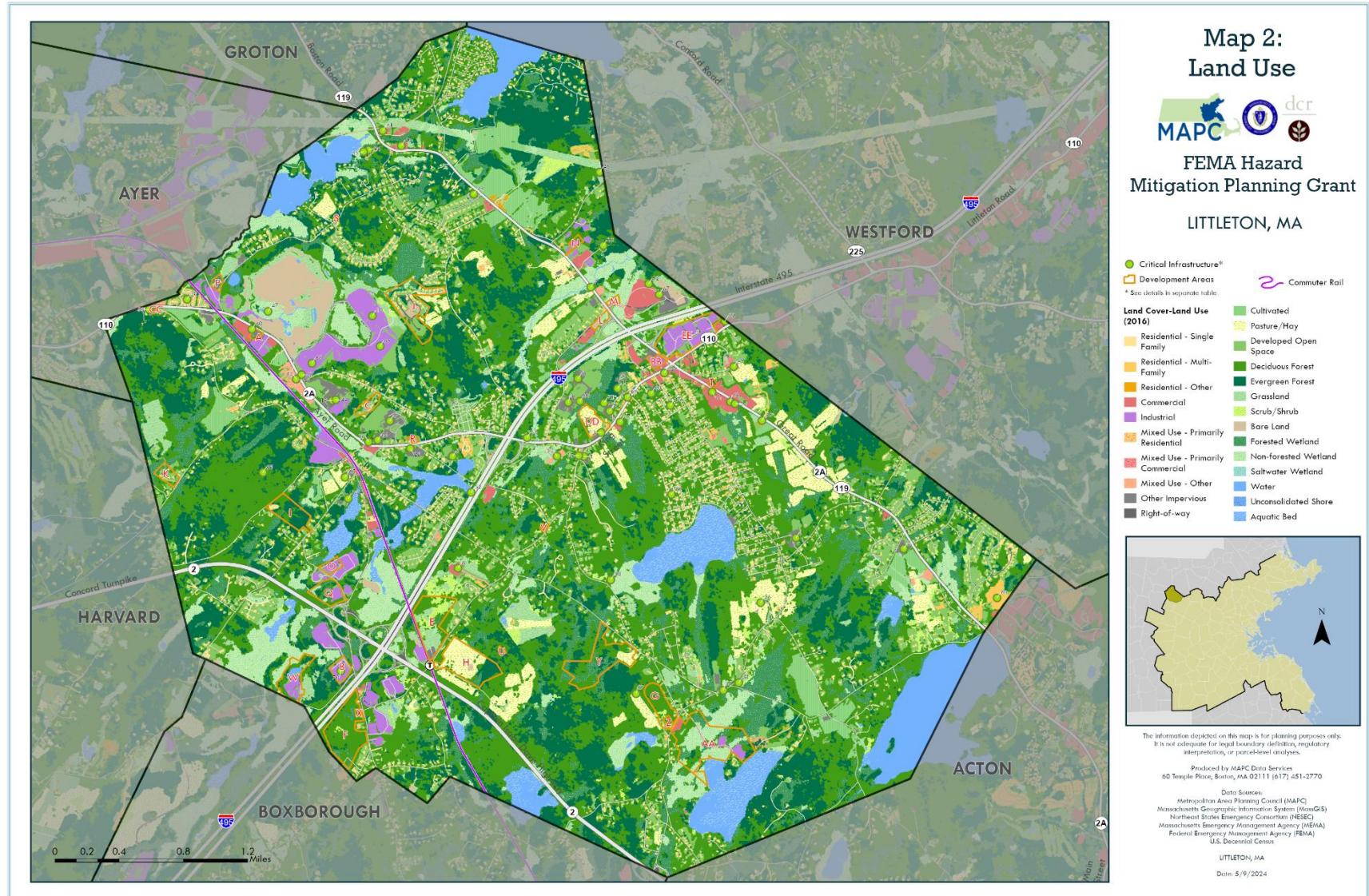
TOWN OF LITTLETON HAZARD MITIGATION PLAN 2025 UPDATE



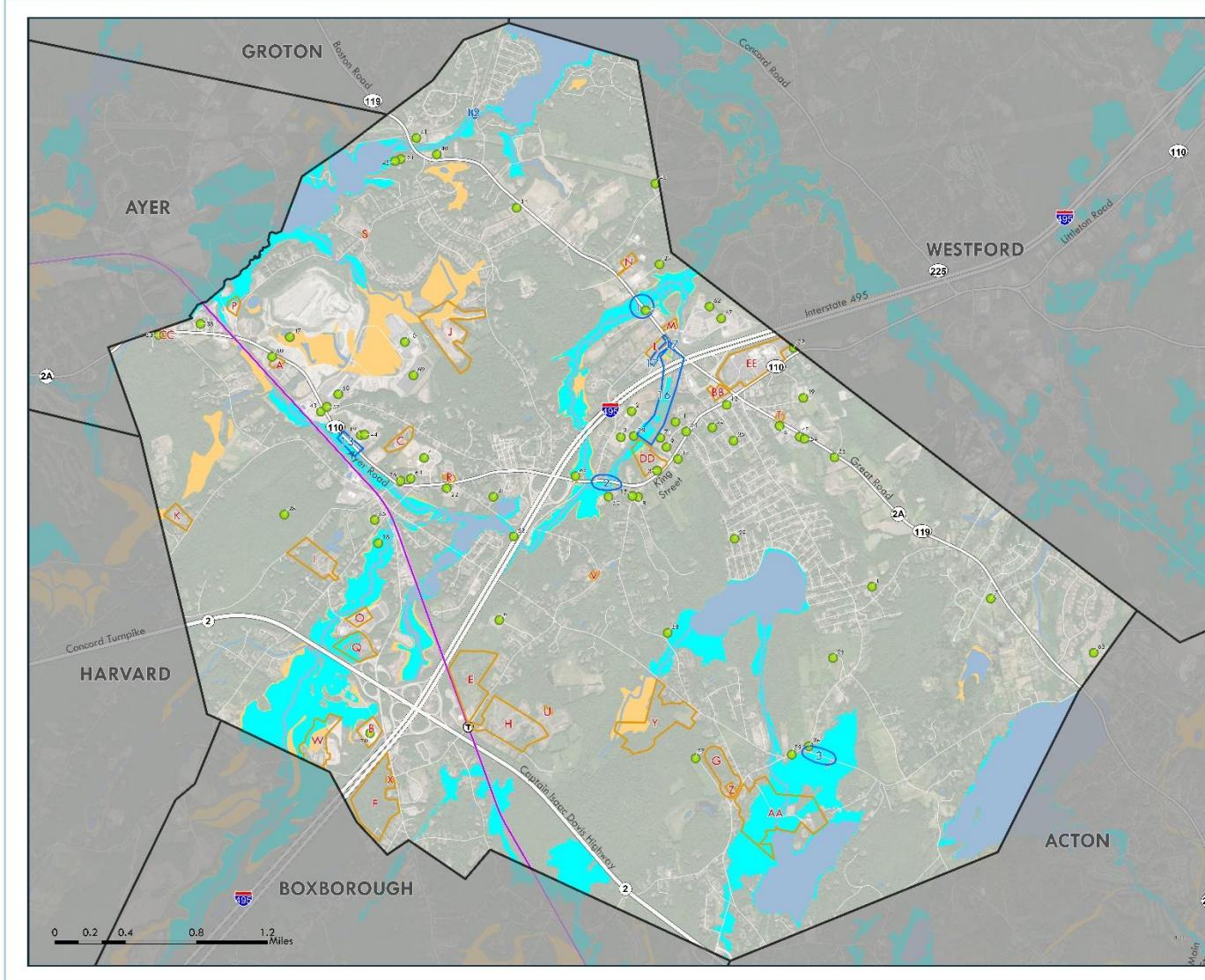
TOWN OF LITTLETON HAZARD MITIGATION PLAN 2025 UPDATE



TOWN OF LITTLETON HAZARD MITIGATION PLAN 2025 UPDATE



TOWN OF LITTLETON HAZARD MITIGATION PLAN 2025 UPDATE



**Map 3:
Flood Zones**

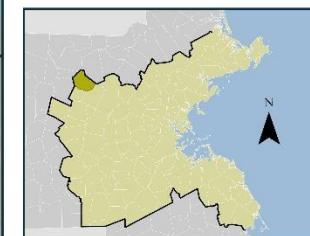
**FEMA Hazard
Mitigation Planning Grant**

LITTLETON, MA

Water Bodies
Commuter Rail

FEMA Flood Zones, 2017 (Annual Chance):

- Zone A: 1%
- Zone AE: 1%
- Zone AH: 1%
- Zone AO: 1%
- Zone VE: 1% with Velocity Hazard
- 0.2% Annual Chance



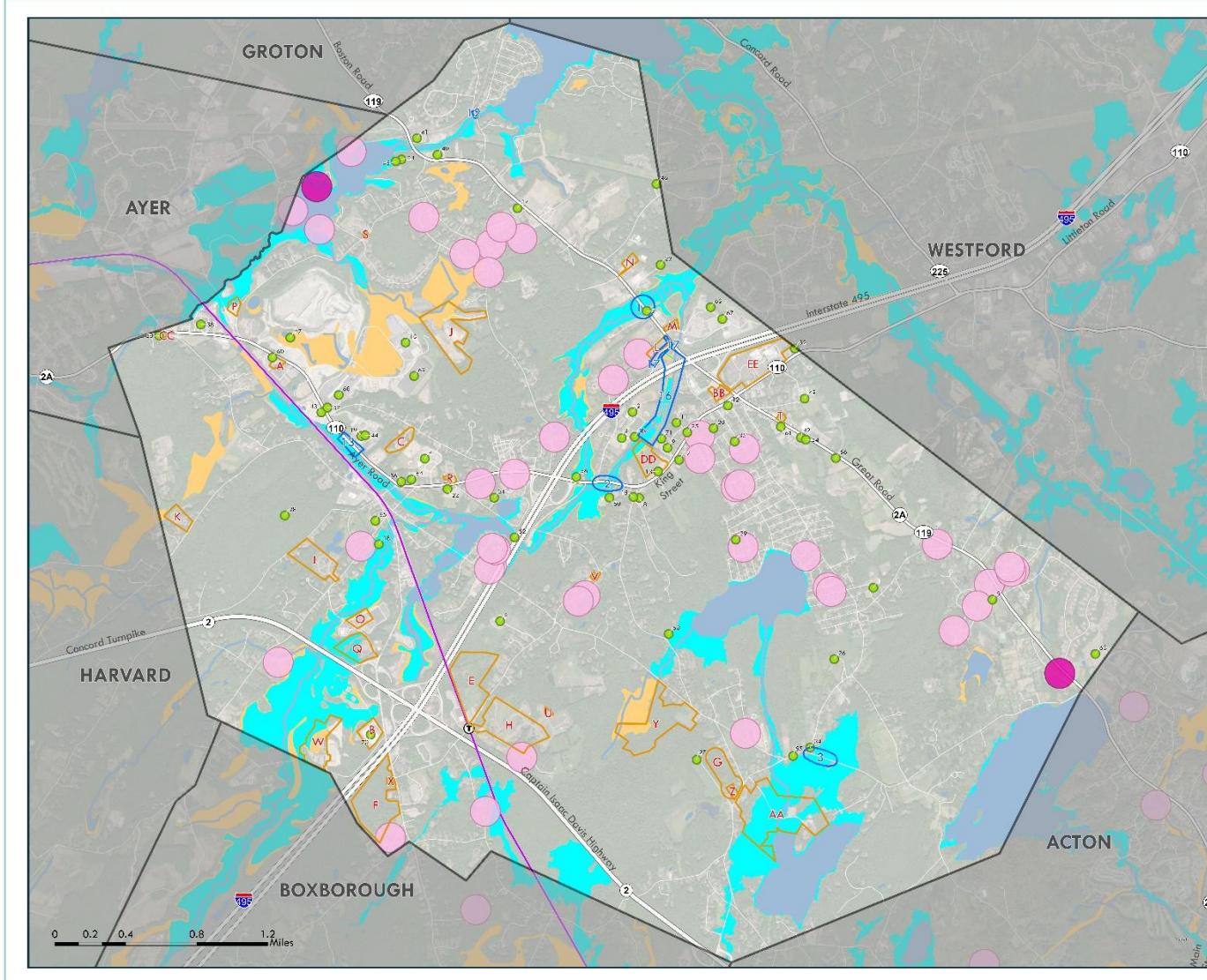
The information depicted on this map is for planning purposes only. It is not accurate for legal boundary definition, regulatory line interpretation, or parcel-level analysis.

Produced by MAPC Data Services
60 Temple Place, Boston, MA 02111 (617) 451-2770

Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
U.S. Decennial Census

LITTLETON, MA
Date: 1/30/2025

TOWN OF LITTLETON HAZARD MITIGATION PLAN 2025 UPDATE



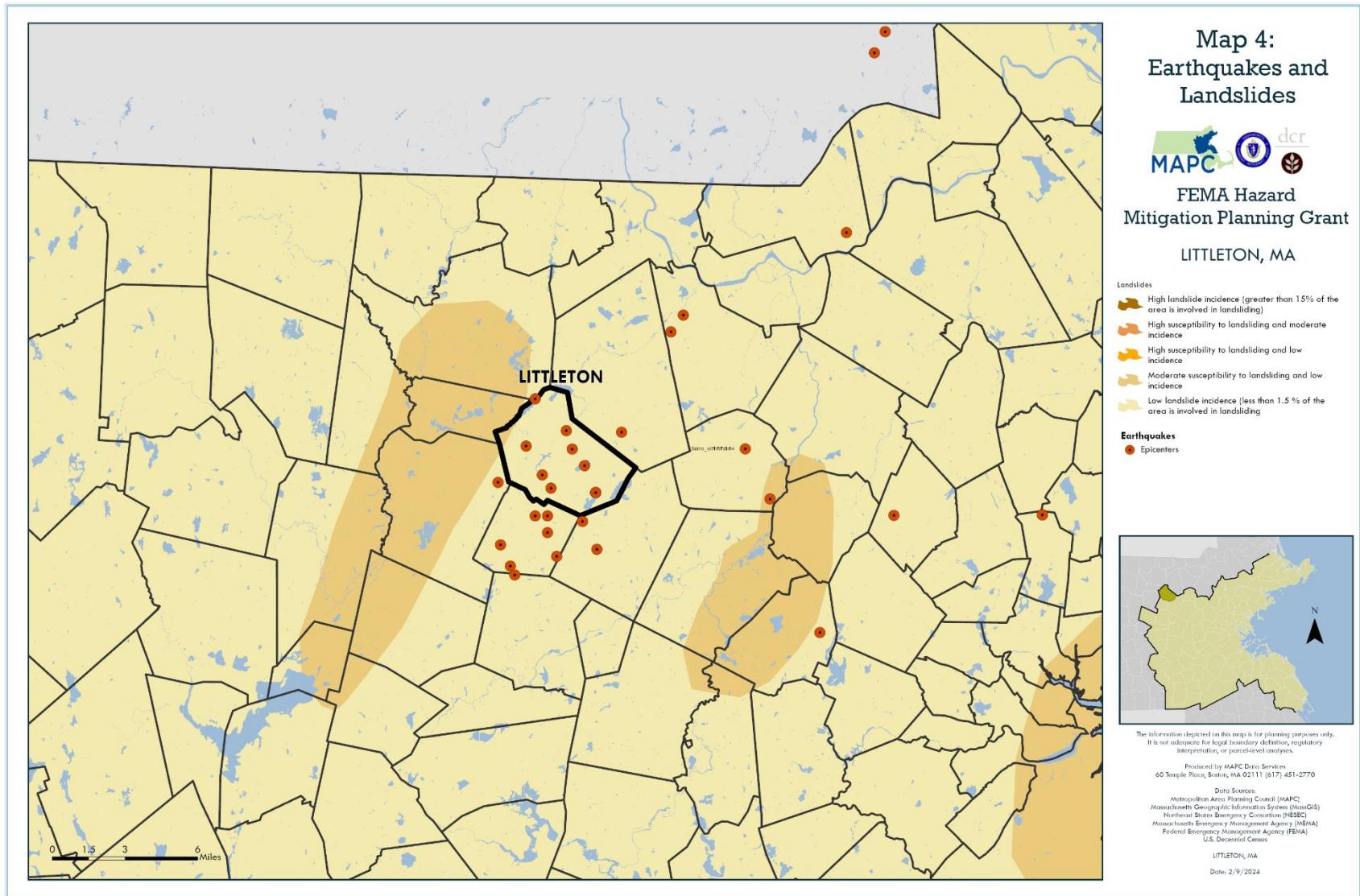
Map 3b:
Flood Zones and
2010 Flood Claims



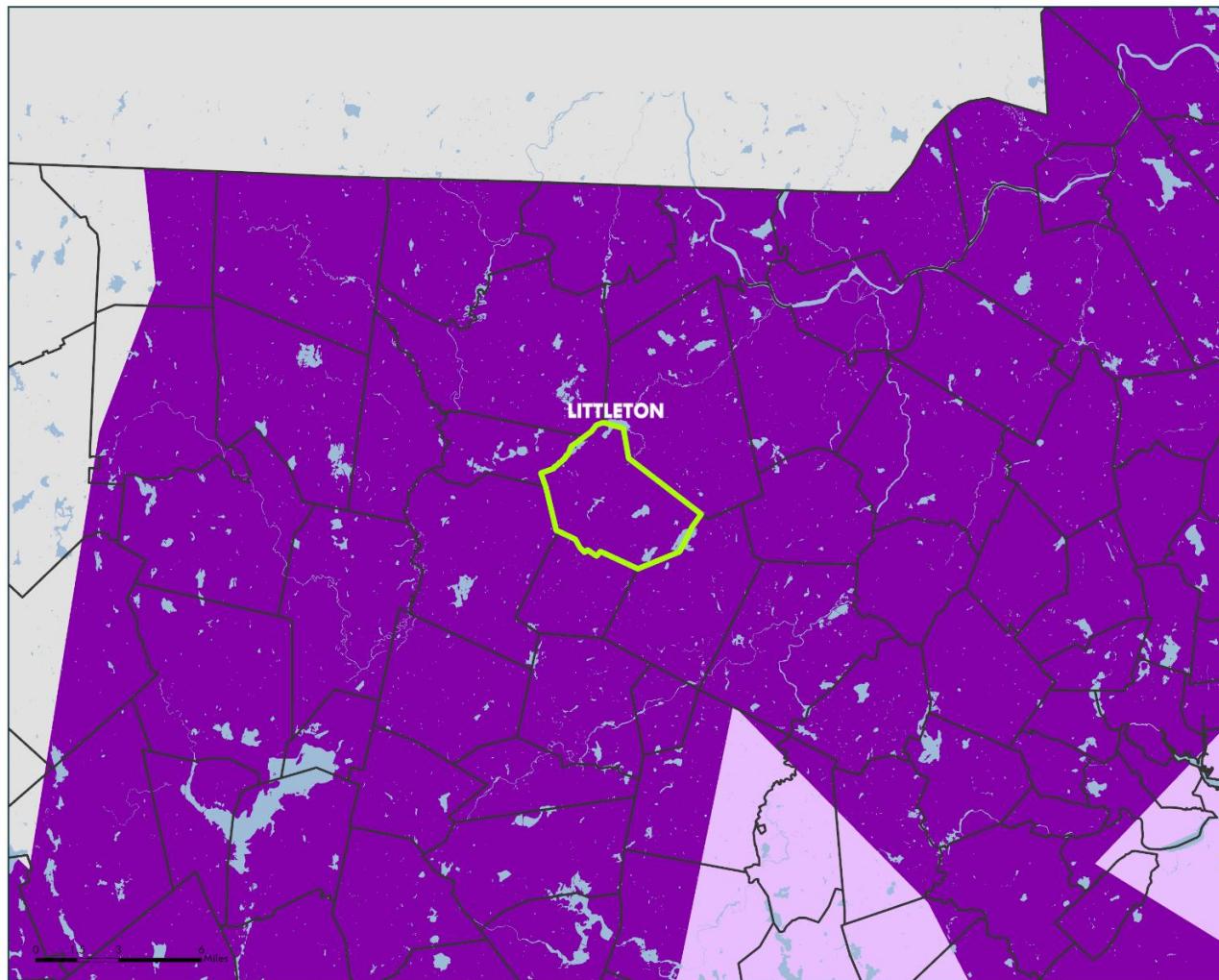
**FEMA Hazard
Mitigation Planning Grant**

LITTLETON, MA

TOWN OF LITTLETON HAZARD MITIGATION PLAN 2025 UPDATE



**TOWN OF LITTLETON HAZARD MITIGATION PLAN
2025 UPDATE**



**Map 6:
Average Snowfall**



FEMA Hazard
Mitigation Planning Grant

LITTLETON, MA

Average Annual Snowfall
Inches
G 36.1 - 48.0
H 48.1 - 72.0



The information depicted on this map is for planning purposes only.
It is not appropriate for legal boundary defining, regulatory
interpretation, or parcel-level analyses.

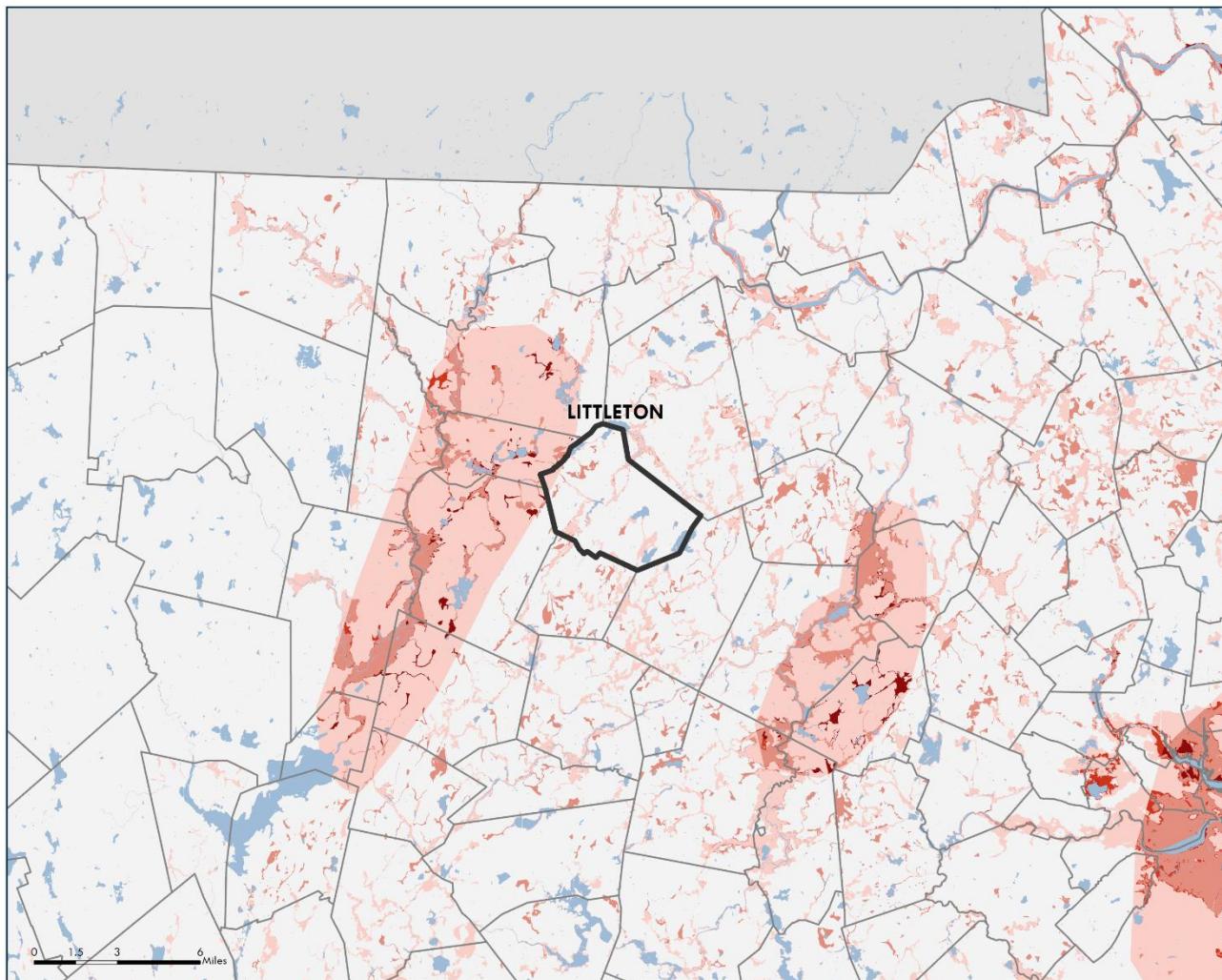
Produced by MAPC Data Services
60 Temple Place, Boston, MA 02111 | 617.481.2770

Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NSEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
U.S. Decennial Census

LITTLETON, MA
Date: 2/9/2024

Path: K:\DataServices\Projects\Current_Project\Environment\PDH\project_files\ArcPro\03_PDH_ExportMaps\PDH_AveSnowf

TOWN OF LITTLETON HAZARD MITIGATION PLAN 2025 UPDATE



Map 7:
Composite
Natural Hazards



FEMA Hazard
Mitigation Planning Grant

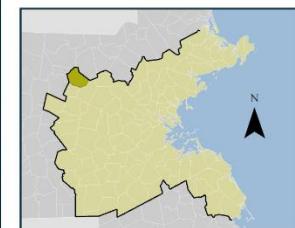
LITTLETON, MA

Composite Natural Hazards

- Low (2 Hazards)
- Moderate (3 Hazards)
- High (4 Hazards)
- Very High (5 Hazards)

Composite natural hazards shown for areas of existing development. Hazards include:

- 100 year wind speed of 110 MPH or higher
- Moderate landslide risk
- FEMA flood zones (100 year and 500 year)
- Average snowfall of 36.1" or more
- Hurricane surge inundation areas



The information depicted on this map is for planning purposes only.
It is not adequate for legal boundary definition, Regulatory
interpretation, or precise land uses.

Produced by MAPC Data Services
60 Temple Place, Boston, MA 02111 (617) 451-2770

Data Sources:

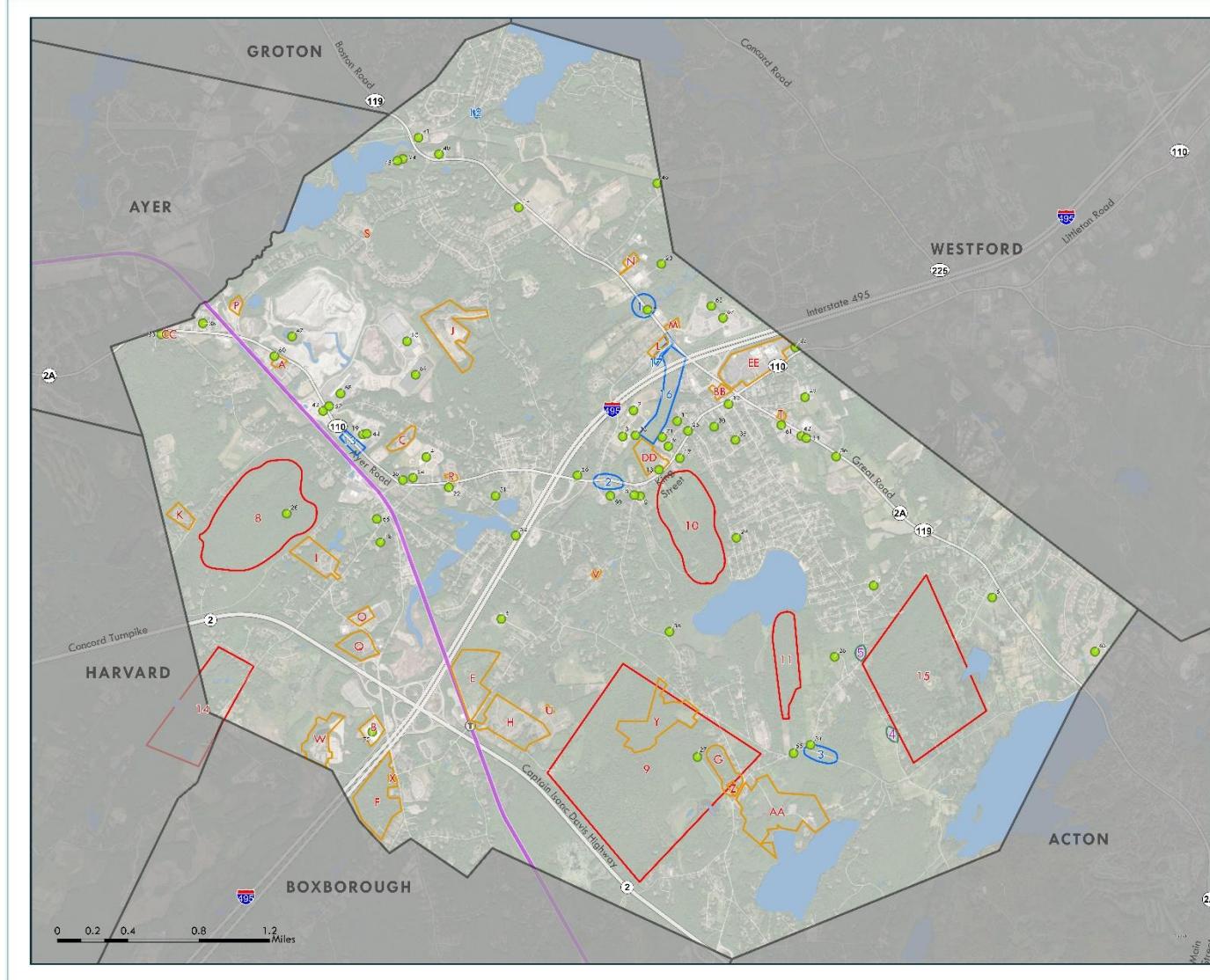
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
U.S. Decennial Census

LITTLETON, MA

Date: 2/9/2024

Path: K:\DataServices\Projects\Current_Projects\Environment\PDMA\project_files\ArcProj\03_PDM_Export\Map\PDMA_ArcProj.mpr

TOWN OF LITTLETON HAZARD MITIGATION PLAN 2025 UPDATE



Map 8: Local Hazard Areas



FEMA Hazard
Mitigation Planning Grant

LITTLETON, MA

-  Critical Infrastructure*
-  Development Areas
-  Water Bodies
-  Commuter Rail

* See details in separate table

- Hazard Areas
- Type
 - Brush Fire
 - Flooding
 - Other

The information depicted on this map is for planning purposes only.
It is not adequate for legal boundary definition, regulatory
interpretation, or parcel-level analyses.

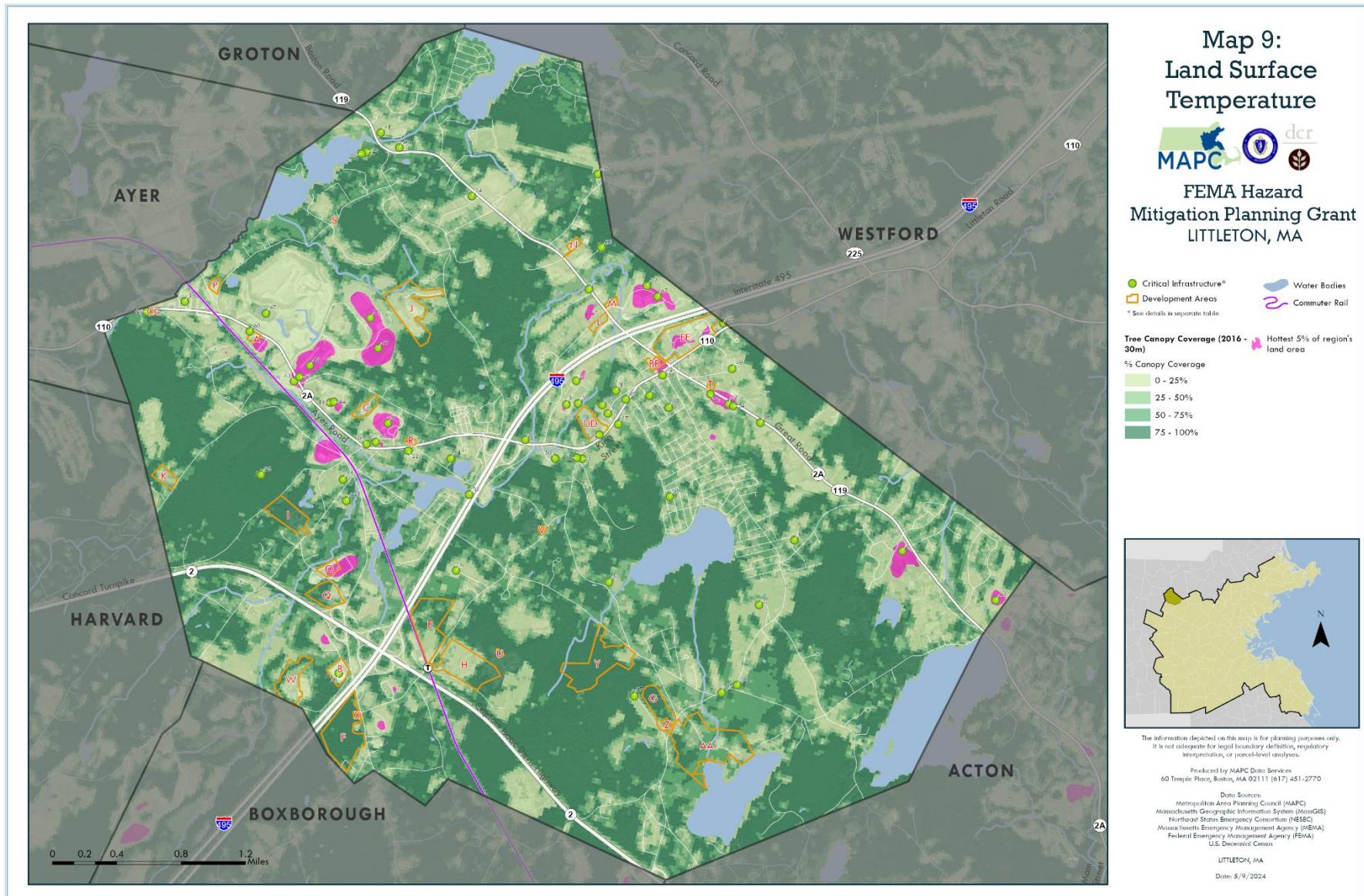
Produced by MAPC Data Services
60 Temple Place, Boston, MA 02111 (617) 451-2770

Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
U.S. Census

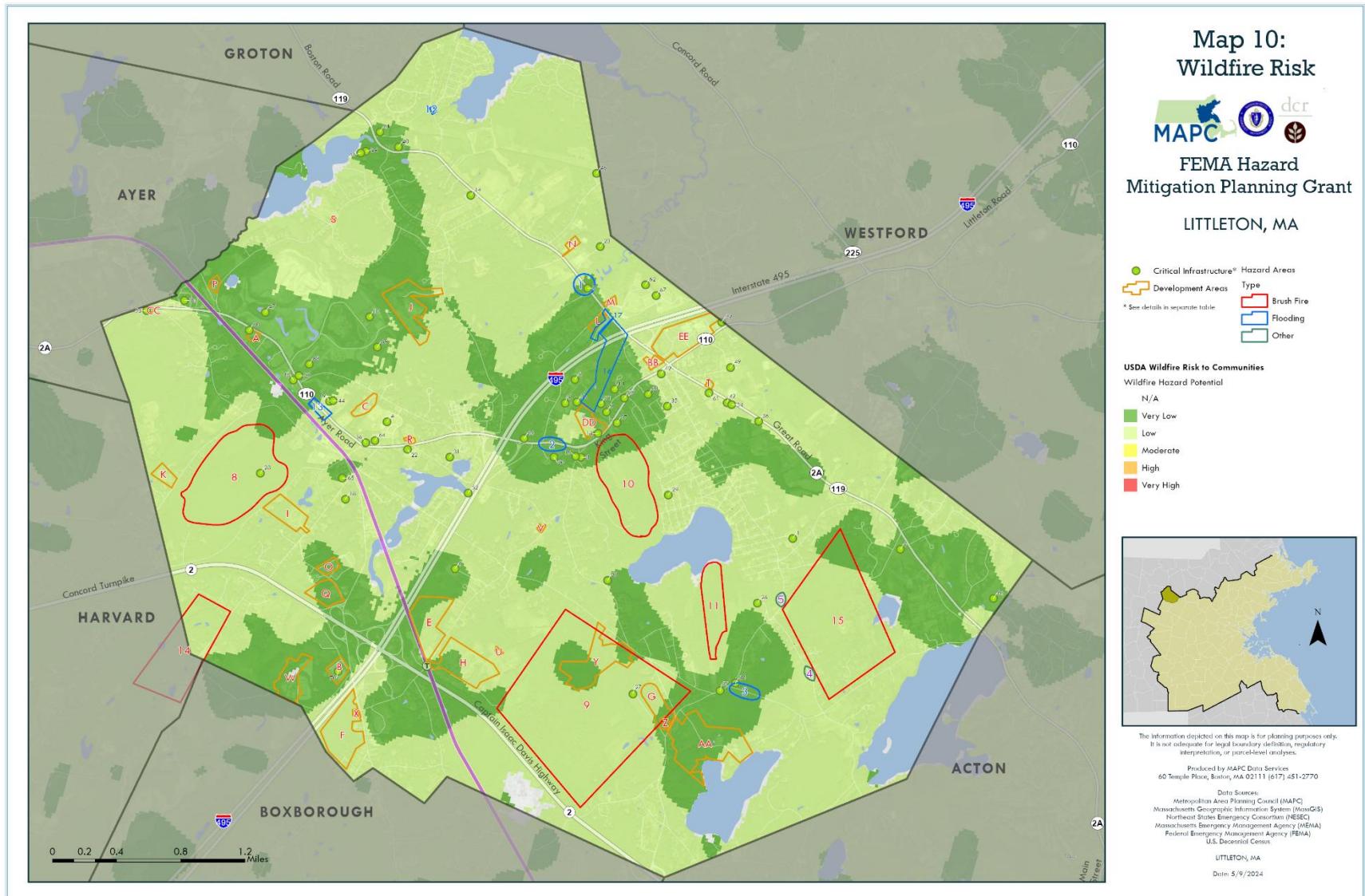
LITTLETON, MA

Date: 1/30/2025

TOWN OF LITTLETON HAZARD MITIGATION PLAN 2025 UPDATE



TOWN OF LITTLETON HAZARD MITIGATION PLAN 2025 UPDATE



**TOWN OF LITTLETON HAZARD MITIGATION PLAN
2025 UPDATE**

APPENDIX B: HAZARD MITIGATION TEAM MEETINGS

**Littleton Hazard Mitigation Plan Update 2023
Local Team Meeting #1**

**Monday, July 10, 2023
2:00 – 3:30 PM**

AGENDA

1. Welcome and Introductions

2. Overview of the HMP Project

- Overview of the FEMA Hazard Mitigation Plans
- Project tasks and schedule (see attached Summary of the Process)

3. Getting Started: Local Data Updates from the 2017 Plan

- *We will update the following 3 types of local data from the 2017 plan (see attached worksheets for updating each of the 3 data types):*
 - Local Hazard Areas of Concern (Flooding & Wildfire)
 - Critical Facilities
 - New Development sites
- *MAPC's GIS Planner will join via Zoom to map new or revised sites using the online platform Google MyMaps*

4. Next steps: Prepare for Public Meetings and Outreach

- Two Public Meetings: during planning process, and review draft plan
- Identify local stakeholders to invite (review MVP Workshop invitees)

**TOWN OF LITTLETON HAZARD MITIGATION PLAN
2025 UPDATE**

APPENDIX B: HAZARD MITIGATION TEAM MEETINGS

**Littleton Hazard Mitigation Plan Update
Summary of the Planning Process**

1) Littleton Team Meeting #1: Overview / Data & Map Update July 2023

- Review project tasks and timeline
- Update: **Critical Facilities**: Inventory and Map
- Update: **Local Hazard Areas** and Map
- Update: **Development Sites** and Map
- Public Meetings, outreach to stakeholders

2) Littleton Team Meeting #2: Update of Existing Mitigation Oct. 2023

- Update: **Hazard Mitigation Goals** for the Plan
- Update: **Existing Mitigation Measures**
- Prepare for **Public Meeting #1**

3) Littleton Public Meeting #1: Plan Overview/Public Input Nov. 2023

4) Littleton Team Meeting #3: Develop Mitigation Strategy Jan. 2024

- Review status of **Recommended Mitigation Strategies** from the Previous Plan
- Discuss possible changes to mitigation strategies and need for new strategies

5) Littleton Team Meeting #4: Develop Mitigation Strategy Apr. 2024

- Develop Recommended Mitigation Measures and Prioritize
- Designate Implementing agencies, Timeframes, Estimated Costs, Funding Sources
- Prepare for 2nd Public Meeting and outreach to stakeholders

6) Littleton Public Meeting #2: Presentation of Draft HMP May 2024

7) Draft HMP: submitted to MEMA & FEMA May 2024

**TOWN OF LITTLETON HAZARD MITIGATION PLAN
2025 UPDATE**

APPENDIX B: HAZARD MITIGATION TEAM MEETINGS

**LITTLETON HAZARD MITIGATION PLAN UPDATE 2023
LOCAL TEAM MEETING #2**

**Wednesday, September 27, 2023
10:00 – 11:30 AM**

Zoom Meeting
<https://us06web.zoom.us/j/88631566663>

Dial-In numbers
+1 646 931 3860 US or +1 301 715 8592 US
Meeting ID: 886 3156 6663

AGENDA

1. Welcome and Project Update

2. Review and Update of Mitigation Goals for the Plan

See Worksheet #4 Mitigation Goals from the 2017 plan attached

3. Review Status of Existing Mitigation Measures

See Worksheet #5 Existing Mitigation from the 2017 Plan attached

- Note any Changes for 2023
- Update any Improvements Needed
- Add any New Measures adopted since 2017

4. Prepare for First Public Meeting and Community Survey

- Meeting date and host board/commission (target November)
- Meeting Invitation/outreach:
 - Identify local stakeholders to invite (refer to MVP invitees)
 - Community groups, businesses, NGO's, etc.
 - Public outreach on Town website, social media, etc.
 - MAPC to prepare flyer, social media card, press advisory

**TOWN OF LITTLETON HAZARD MITIGATION PLAN
2025 UPDATE**

APPENDIX B: HAZARD MITIGATION TEAM MEETINGS

**Littleton Hazard Mitigation Plan Update
Local Team Meeting #3**

**Thursday, January 4, 2024
10:00 – 11:30 AM**

Virtual Meeting

<https://us06web.zoom.us/j/89310279917>

AGENDA

- 1. Welcome and Project Update**
- 2. Review Status of Mitigation Strategies from the 2017 Plan**

The Team will review the recommended mitigation measures from the 2017 plan and note those that have been implemented, are in progress, or have not been implemented.

See the attached worksheet to note the status of mitigation recommendations.

- 3. Next Steps**

- **Final Team Meeting – April**
 - To be Scheduled in April 2024
 - Finalize mitigation recommendations for the 2024 plan
- **Second Public Meeting – May**
 - Presentation of the draft plan and public questions/comments
 - Draft plan to be posted on the Town's website for public review
- **Draft Plan to be submitted for MEMA & FEMA review – May**
 - Revisions to the draft plan if required by MEMA or FEMA
 - FEMA will issue "Approval Pending Adoption" notice
- **Adoption of the Final Plan by the Town**
 - FEMA will issue "Approval Pending Adoption" notice
- **FEMA will issue a formal Letter of Plan Approval**
 - The new plan will be in effect for 5 years, until 2029
 - The Town will be eligible to apply for BRIC grants for mitigation projects

**TOWN OF LITTLETON HAZARD MITIGATION PLAN
2025 UPDATE**

APPENDIX B: HAZARD MITIGATION TEAM MEETINGS

**LITTLETON HAZARD MITIGATION PLAN UPDATE
LOCAL TEAM MEETING #4 (FINAL MEETING)**

**Thursday, April 4, 2024
10:00 – 12:00**

**Zoom
Passcode: 387455**

AGENDA

1. Welcome and Project Update

2. Finalize the Mitigation Strategies for 2024 Plan

- The Team will review the draft recommended mitigation measures for the 2024 plan
- We will confirm the recommendations, lead agencies, timeframes, and costs
- *See the attached worksheet.*

3. Next Steps

• Second Public Meeting / Review of Draft Plan

- **Need to Schedule Public Meeting for May**
- Meeting notice and social media outreach, please advise on public engagement
- Presentation of the draft plan and public questions/comments
- Draft plan to be posted on the Town's website for public review

• Draft Plan to be submitted for MEMA & FEMA review

- Revisions to the draft plan if required by MEMA or FEMA
- FEMA will issue "Approval Pending Adoption" notice

• Adoption of the Final Plan by the Town

- FEMA will issue "Approval Pending Adoption" notice
- The Select Board will vote to adopt the plan

• FEMA will issue a formal Letter of Plan Approval

- The new plan will be in effect for 5 years, until 2029
- The Town will be eligible to apply for BRIC grants for mitigation projects

TOWN OF LITTLETON HAZARD MITIGATION PLAN 2025 UPDATE

APPENDIX C: PUBLIC PARTICIPATION



PLANNING BOARD

P.O. Box 1305
Littleton, Massachusetts 01460



PLANNING BOARD MEETING
THURSDAY, November 16, 2023 at 6:00 p.m.
Room 103
Shattuck Street Town Offices at 37 Shattuck Street

This LIVE meeting may be viewed online at LCTV On-Demand at
<https://littleton.vod.castus.tv/vod>

Public meetings may be broadcast live, recorded live, or recorded for later playback on LCTV and/or the Internet. PARTICIPANTS/ATTENDEES ARE REMINDED THAT BY JOINING THIS MEETING THAT YOU CONSENT TO YOUR LIVENESS AND AUDIO BEING USED AND REBROADCAST BY LCTV. If attending virtually, please identify your screen name with your full name. This will protect the integrity of the meeting. Attendees of all public meetings should be aware of Massachusetts Recording Law M.G.L. Ch. 20A §20 (f) if they are personally considering recording any part of a meeting or a meeting in its entirety.

Proposed Agenda – items may be taken out of order or at times other than listed

1. 6:00 Littleton's Hazard Mitigation Plan – First Public Meeting – Metropolitan Area Planning Council (MAPC)
 - A. Overview
 - B. Process
 - C. Input Needed
 - D. Next Steps
2. 6:30 Board Business
 - A. Introduce Assistant Town Planner
 - B. Minutes of prior meetings: Sept. 14, 2023
 - C. Bills
 - D. Town Meeting Follow-Up
 1. Article 18 Firearms Business Zoning Bylaw Update
 2. Article 19 MBTA Communities Zoning Bylaw
 3. Article 20 Webster Parcel
 - E. Member Input and Member Update on Projects:
 1. Northern Bank (25 Robinson Road and 265-289 Great Rd)
 2. Hager Homestead (336 and 338 King Street)
 3. Bicycle and Pedestrian Plan
 - F. Public Input: *Public Input will last for no more than 10 minutes and speakers are allowed to speak for no longer than 2 minutes. Speakers addressing the meeting are required to do so from the podium, provide name and address for the record, and all comments must be through the Chair. Public Input on a posted public hearing agenda item will be taken during that public hearing.*
3. 6:45 Stormwater Permit Review – Taylor Street Wells and Water Main Extension – LELWD



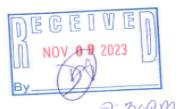
PLANNING BOARD

P.O. Box 1305
Littleton, Massachusetts 01460

4. 7:00 Continued Public Hearing – 234 Taylor Street – Adult Use Marijuana Establishment and Water Resource District Special Permit – Sanctuary Medicinals Inc.
The Public Hearing for 234 Taylor Street will be continued to a future meeting.
5. 7:05 550 King Street Definitive Subdivision –
 - A. Endorse Mylars
 - B. Endorse Covenant
6. 7:10 160 Ayer Road – Littleton Apothecary – Board Discussion regarding determination of "good cause" – Adult Use Marijuana Special Permit for Retail Establishment
7. 7:15 Continued Public Hearing - 550 Newtown Road – Major Commercial/Industrial Use Special Permit, Site Plan Amendment, and Stormwater Permit – add self-storage building to existing site – Storage Rentals of America
The Public Hearing for 550 Newtown Road will be continued to a future meeting.
8. 7:20 Executive Session to Discuss Pending Litigation – Town Counsel Chris Heep – Regarding Homelit Realty appeal of Glevay Family Trust "Healy Corner" Subdivision

ADJOURN

*If, after notifying the chair of the public body, any person may make a video or audio recording of an open session of a meeting of a public body, or may transmit the meeting through any medium, subject to reasonable requirements of the chair as to the number, placement and operation of equipment used so as not to interfere with the conduct of the meeting. At the beginning of the meeting, the chair shall inform other attendees of any recordings.



TOWN OF LITTLETON HAZARD MITIGATION PLAN
2025 UPDATE

APPENDIX C: PUBLIC PARTICIPATION



Floods? Blizzards? Nor'easters?

*Are you concerned about Natural Hazards
impacting Littleton residents and businesses?*

The Town is updating its plan for Natural Hazards!

**Please Join us for a
Public Presentation**

Questions, comments, suggestions?

Email MToohill@littletonma.org

Tuesday, May 28, 6:35 PM
Littleton Select Board
Sturtz Meeting Room-
Rueben Hoar Library
35 Shattuck St, Littleton

**TOWN OF LITTLETON HAZARD MITIGATION PLAN
2025 UPDATE**

APPENDIX C: PUBLIC PARTICIPATION



When: Tuesday, May 28, 2024, 6:35 PM

Where: Littleton Select Board (Live in-person meeting)
Sturtz Meeting Room- Reuben Hoar Library
35 Shattuck Street, Littleton
May be viewed online
at <https://cloud.castus.tv/vod/littleton/?page=HOME>

Littleton experiences natural hazards that can impact residents and businesses, including flooding, severe winter storms, and drought.

The Town has prepared a draft 2024 Hazard Mitigation Plan to assess its vulnerability to natural hazards and identify strategies to increase the resilience of our community, infrastructure, and natural resources.

**Please join us for a presentation on the plan
hosted by the Select Board on May 28!**

If you have questions or comments,
please email Maren Toohill
Town Planner
MToohill@littletonma.org

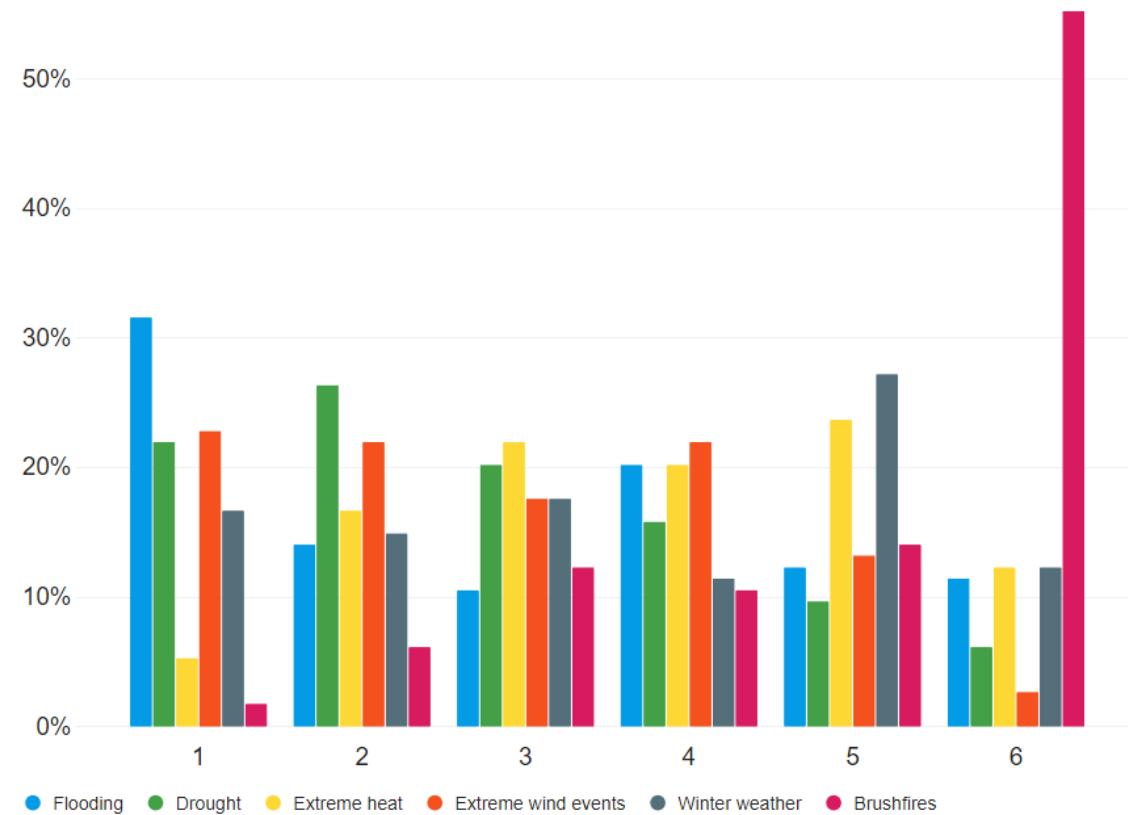


**TOWN OF LITTLETON HAZARD MITIGATION PLAN
2025 UPDATE**

APPENDIX C: PUBLIC PARTICIPATION

What natural hazards are you most concerned about? 1 being of the utmost concern, 6 being the least.

114 Responses

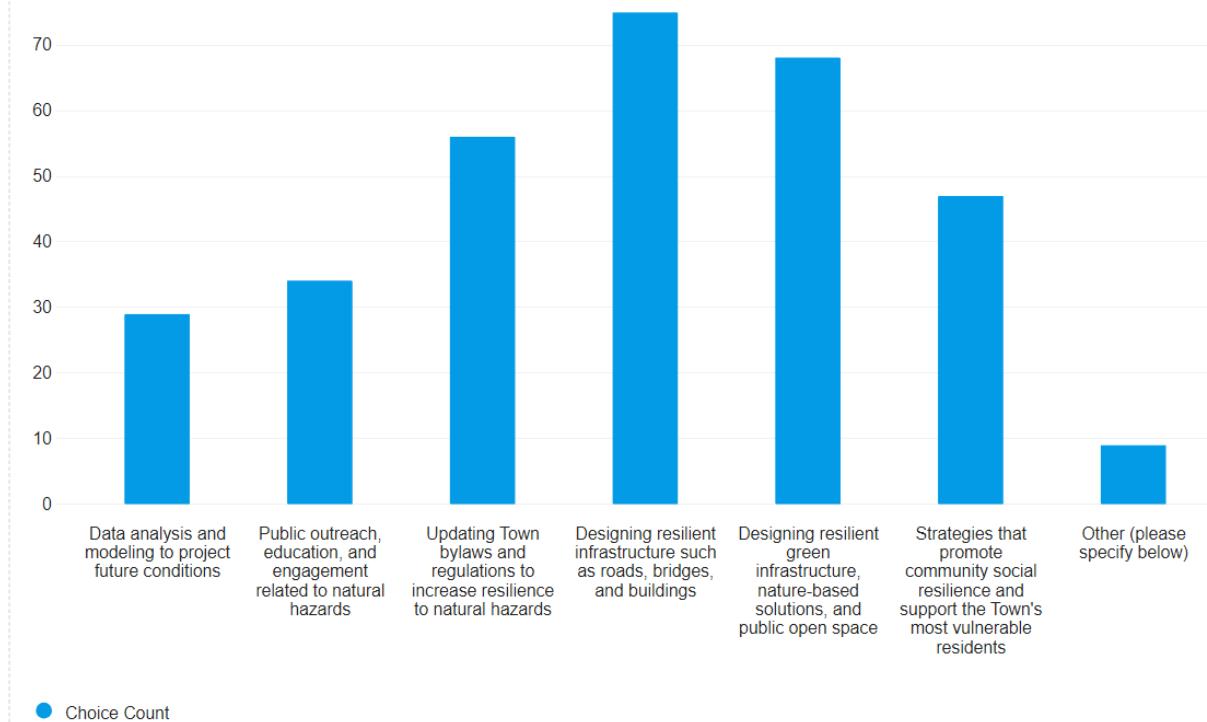


**TOWN OF LITTLETON HAZARD MITIGATION PLAN
2025 UPDATE**

APPENDIX C: PUBLIC PARTICIPATION

Which hazard mitigation strategies are most important to you? Please select your top three (3) priorities.

114 Responses



**TOWN OF LITTLETON HAZARD MITIGATION PLAN
2025 UPDATE**

Comments sent about the plan

Following are comments received from the public on the draft plan, and responses from the Town in red text.

- There is flooding at the RR crossing at King Street by the old depot (King/Hardwoord/MBTA)
 - The town is aware that there has been beaver activity that occasionally backs up water to that short section of King Street between Ayer Road traffic light toward the RR Crossing before Taylor Street.
- There was flooding at 119 and Russell Street by the police station. This might have been because of a blocked/closed storm grate
 - The town is aware, as this is due to the closed stormwater gate at Constitution Avenue that caused the backup/flooding near the Russell Street/Route 119 (Great Road)/Constitution Avenue intersection – just down the street from the police station at 500 Great Road. (Town has keys to operate this gate.)
- There is mention of land based invasive species but no mention of aquatic invasives in our ponds. These aquatic invasives are a navigational hazard, swimming hazard and contribute to the eutrophication of our ponds.
 - This has now been included in the plan.
- Spectacle Pond's watershed is upstream along Bennett's Brook in Harvard and Ayer. There is a private road in Harvard at the headwaters of the Bennett's Brook watershed that is impounding several hundred acres of water. The owner of this road has placed successively higher and higher and higher culverts under this road when flood events occurred to prevent his road from being washed out. Problem is the road is actually a dam and the water in back of this dam just gets higher with each installation of a higher up culvert. This has increased the impoundment volume of water. When heavy rains occur the volume of water from this impounded area exceeds the capacity of culverts under this road. The culverts under this road are frequently blocked by beaver. The road effectively acts as a dam when the culverts are blocked. When the road is overtopped and gouged out during heavy rains a very high pulse of water can be sent downstream and may cause flooding on Spectacle Pond. The gouges in the road are essentially extra culverts but they are placed higher up than the real culverts. There are downstream beaver blockages from this private road as well and they can sometimes be breached due to the volume of water from the impoundment upstream. The beaver dams also impound water. We've seen situations where there can be a cascading effect of the road being overtopped, beaver dams breached downstream and the cumulative effect of multiple impoundments being released in a short period of time can cause a very large flow of water downstream into Spectacle Pond resulting in flooding.
 - The Town is aware that this is a situation in the neighboring town of Harvard on private property and that any resolution of the issue will require coordination with the town of Harvard.

**TOWN OF LITTLETON HAZARD MITIGATION PLAN
2025 UPDATE**

APPENDIX C: PUBLIC PARTICIPATION

This is an example of the email that was sent and included the flyer for the May 28th meeting. In addition to this being sent to FIBA Technologies, it was also sent to Amazon, Oak Meadow Montessori, Camp Nashoba and the list of neighboring communities. Other local businesses received the flyers directly. No feedback was received.

From: Cooper Mathews
Sent: Thursday, May 23, 2024 1:27 PM
To: info@fibatech.com
Subject: MAPC Hazard Mitigation Plan Meeting - May 28, 2024

Hello all -

This email is to let FIBA Technology know that MAPC (Metropolitan Area Planning Council) will be presenting the **Draft Hazard Mitigation Plan** at the **May 28, 2024**, Select Board Meeting in the Sturtz Meeting Room of the Reuben Hoar Library, 35 Shattuck Street at **6:35 P.M.** Please share with employees and anyone else that may be interested.

MAPC's flyer is attached. Hope to see you there!

Cooper

Cooper Mathews
Assistant Town Planner
Town of Littleton
CMathews@Littletonma.org

**TOWN OF LITTLETON HAZARD MITIGATION PLAN
2025 UPDATE**

APPENDIX D: PLAN ADOPTION CERTIFICATE



TOWN OF LITTLETON

P.O. Box 1305
Littleton, Massachusetts 01460

**CERTIFICATE OF ADOPTION
SELECTBOARD
TOWN OF LITTLETON, MASSACHUSETTS**

**A RESOLUTION ADOPTING THE
TOWN OF LITTLETON HAZARD MITIGATION PLAN 2025 UPDATE**

WHEREAS, the Town of Littleton established a Committee to prepare the Town of Littleton Hazard Mitigation Plan 2025 Update; and

WHEREAS, the Town of Littleton Hazard Mitigation Plan 2025 Update contains several potential future projects to mitigate potential impacts from natural hazards in the Town of Littleton, and

WHEREAS, duly-noticed public meetings were held by the Selectboard on November 16, 2024, and May 23, 2025, and

WHEREAS, the Town of Littleton authorizes responsible departments and/or agencies to execute their responsibilities demonstrated in the plan, and

NOW, THEREFORE BE IT RESOLVED that the Town of Littleton Selectboard adopts the Town of Littleton Hazard Mitigation Plan 2025 Update, in accordance with M.G.L. 40 §4 or the charter and bylaws of the Town of Littleton.

ADOPTED AND SIGNED this Date, June 23, 2025

Karen Morrison, Chair:

A handwritten signature of Karen Morrison in black ink.

Matthew Nordhaus, Vice-Chair:

A handwritten signature of Matthew Nordhaus in black ink.

Gary Wilson, Clerk:

A handwritten signature of Gary Wilson in black ink.

Charles DeCoste, Member:

A handwritten signature of Charles DeCoste in black ink.

Mark Rambacher, Member:

A handwritten signature of Mark Rambacher in black ink.

ATTEST

A handwritten signature of the Clerk, Karen Morrison, in black ink, including the title "Town Clerk" and the date "June 23, 2025".