

TOWN OF BOLTON HAZARD MITIGATION PLAN 2018 UPDATE

FINAL PLAN

Approved by FEMA
November 27, 2018

PREPARED FOR:

TOWN OF BOLTON
663 MAIN STREET
BOLTON, MASSACHUSETTS 01740

PREPARED BY:

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ACKNOWLEDGEMENTS & CREDITS

This plan was prepared for the Town of Bolton 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) Pre-Disaster Mitigation (PDM) Grant Program.

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Public Meeting Participants and Community Stakeholders

Special thanks to the public meeting participants and community stakeholders who provided feedback.



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Board of Selectmen Bolton, Massachusetts

Town Hall, 663 Main Street, Bolton, MA 01740
Phone 978-779-2297 Fax 978-779-5461

CERTIFICATE OF ADOPTION BOARD OF SELECTMEN TOWN OF BOLTON, Massachusetts

A RESOLUTION ADOPTING THE *TOWN OF BOLTON HAZARD MITIGATION PLAN 2018 UPDATE*

WHEREAS, the Town of Bolton established a Committee to prepare the *Town of Bolton Hazard Mitigation Plan 2018 Update*; and

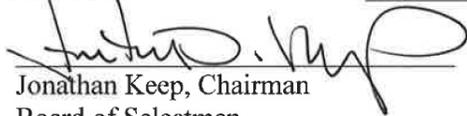
WHEREAS, the *Town of Bolton Hazard Mitigation Plan 2018 Update* contains several potential future projects to mitigate potential impacts from natural hazards in the Town of Bolton, and

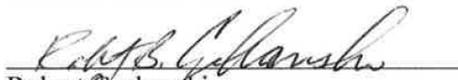
WHEREAS, duly-noticed public meetings were held by Board of Selectmen on March 22, 2018 and July 12, 2018.

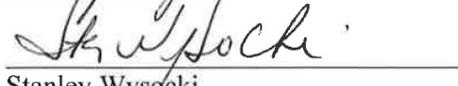
WHEREAS, the Town of Bolton authorizes responsible departments and/or agencies to execute their responsibilities demonstrated in the plan, and

NOW, THEREFORE BE IT RESOLVED that the Town of Bolton Board Of Selectmen adopts the *Town of Bolton Hazard Mitigation Plan 2018 Update*, in accordance with M.G.L. 40 §4 or the charter and bylaws of the Town of Bolton.

ADOPTED AND SIGNED this Date. 11-15-18


Jonathan Keep, Chairman
Board of Selectmen


Robert Czekanski


Stanley Wysocki

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 Bolton Hazard Mitigation Plan, which was approved by FEMA on February 05, 2010. Planning for the Hazard Mitigation Plan update was led by the Bolton Local Hazard Mitigation Planning Team, composed of staff from a number of different town departments. This team met on November 30, 2017, March 15, 2018 and May 30, 2018 and 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 Board of Selectmen hosted two public meetings, the first on March 22, 2018 and the second on July 12, 2018 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.

RISK ASSESSMENT

The Bolton Hazard Mitigation Plan assesses the potential impacts to the town from flooding, high winds, winter storms, brush fire, geologic hazards, extreme temperatures, and drought. Flooding, driven by hurricanes, northeasters and other storms, clearly presents the greatest hazard to the town. These are shown on the map series (Appendix B).

The Bolton Local Hazard Mitigation Planning Team identified 37 Critical Facilities. These are shown on the map series and also listed in Table 23, identifying which facilities are located within the mapped hazard zones.

A HAZUS-MH analysis provided estimates of damages from: hurricanes with a probabilistic 100-year return period (\$3.5 million) to those with a 500-year return period (\$11.8 million); earthquakes with magnitudes of 5 (\$109.89 million) and 7 (\$646.87 million); as well as damage estimates for 100-year (\$3.5 million) and 500-year flooding (\$4.8 million).

HAZARD MITIGATION GOALS

The Bolton Local Hazard Mitigation Planning Team identified and endorsed 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 and incorporate climate sustainability and resiliency in hazard mitigation planning.

HAZARD MITIGATION STRATEGY

The Bolton Local Hazard Mitigation Planning Team identified a number of mitigation measures that would serve to reduce the Town’s vulnerability to natural hazard events. Overall, the hazard mitigation strategy recognizes that mitigating hazards for Bolton 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 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 Bolton’s Hazard Mitigation Plan 2018 Update is summarized in Table 1.

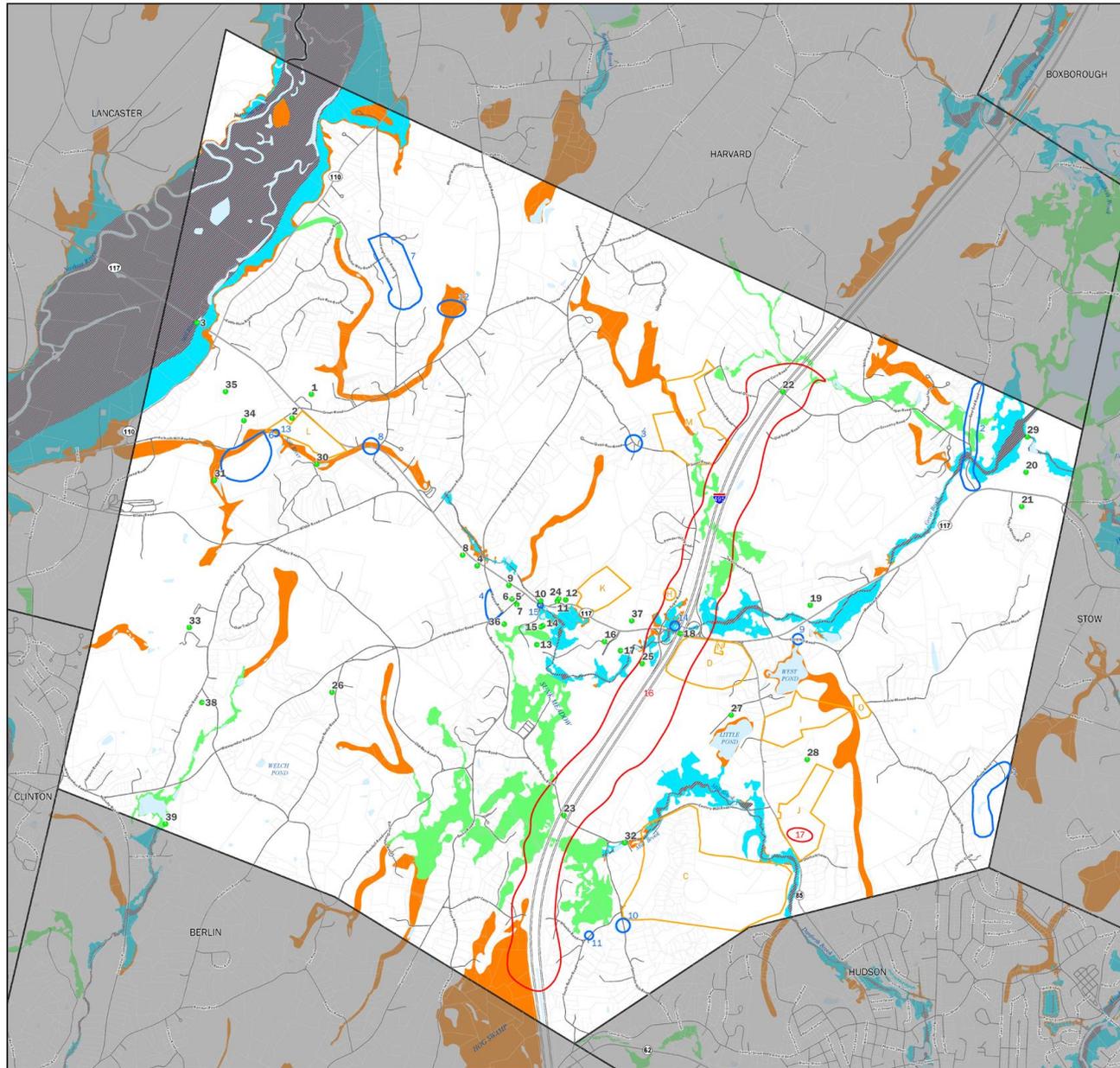
Table 1: Plan Review and Update Process

Section	Reviews and Updates
Section 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 Bolton Board of Selectmen. The plan was also available on the Town’s website for public comment.
Section 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 and assessed the potential impacts of flooding using the latest data.
Section 5: Goals	The Hazard Mitigation Goals were reviewed and endorsed by the Bolton Local Hazard Mitigation Planning Team.
Section 6: Existing Mitigation Measures	The list of existing mitigation measures was updated to reflect current mitigation activities in the town.
Sections 7 and 8: Hazard Mitigation Strategy	Mitigation measures from the 2010 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 2017 Plan Update or modify or delete them. The Plan Update’s hazard mitigation strategy reflects both new measures and measures carried forward from the 2010 plan. The Local Hazard Mitigation Team prioritized all of these measures based on current conditions.
Section 9: Plan Adoption & Maintenance	This section of the plan was updated with a new on-going plan implementation review and 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.

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.

Though not formally done in the 2010 Plan, the Town will document any actions taken within this iteration of the Hazard Mitigation Plan on challenges met and actions successfully adopted as part of the ongoing plan maintenance to be conducted by the Bolton Hazard Mitigation Implementation Team, as described in Section IX, Plan Adoption and Maintenance.

Figure 1: Existing Features: Critical Facilities, Development Sites, Open Space, & Local Hazard Areas



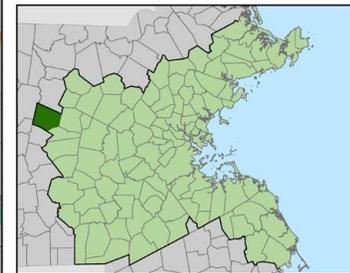
FEMA Hazard Mitigation Planning Grant
BOLTON, MA

DRAFT

- Sites**
- Critical Infrastructure Sites* * See details in separate table
 - Repetitive Loss Sites * See details in separate table
 - Water Bodies
- Areas of Concern***
- Brush Fire
 - Development
 - Flooding
 - Other
- Transportation**
- Ⓧ Train Stations
 - Commuter Rail Lines
 - Trains

FEMA National Flood Hazard Layer

- Flood Zone Designations**
- A: 1% Annual Chance of Flooding, no BFE
 - AE: 1% Annual Chance of Flooding, with BFE
 - AE: Regulatory Floodway
 - X: 0.2% Annual Chance of Flooding
- 0 0.25 0.5 Miles



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)

Flood Zones datalayer updated by MassGIS October 2013
 from finalized data provided by
 Federal Emergency Management Agency (FEMA)
 BOLTON, MA

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 Date: 2/21/2018

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).

Massachusetts has taken a regional approach and has encouraged the regional planning agencies to apply for grants to prepare plans for groups of their member communities. The Metropolitan Area Planning Council (MAPC) received a grant from the Federal Emergency Management Agency (FEMA) under the Pre-Disaster Mitigation (PDM) Program, to assist the Town of Bolton to update its local Hazard Mitigation Plan, which was first adopted in 2010.

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.

PREVIOUS FEDERAL/STATE DISASTERS

Massachusetts has experienced 20 natural hazards that triggered federal or state disaster declarations since 1991. These are listed in Table 2 below. The majority of these events involved flooding, while five were due to hurricanes or nor'easters, and four were due to severe winter weather.

Table 2: Previous Federal/State Disaster Declarations

Disaster Name (Date of Event)	Type of Assistance	Declared Areas
Hurricane Bob (August 1991)	FEMA Public Assistance Project Grants	Counties of Barnstable, Bristol, Dukes, Essex, Hampden, Middlesex, Plymouth, Nantucket, Norfolk, Suffolk
	Hazard Mitigation Grant Program	Counties of Barnstable, Bristol, Dukes, Essex, Hampden, Middlesex, Plymouth, Nantucket, Norfolk, Suffolk (16 projects)
No-Name Storm (October 1991)	FEMA Public Assistance Project Grants	Counties of Barnstable, Bristol, Dukes, Essex, Middlesex, Plymouth, Nantucket, Norfolk
	FEMA Individual Household Program	Counties of Barnstable, Bristol, Dukes, Essex, Middlesex, Plymouth, Nantucket, Norfolk

Disaster Name (Date of Event)	Type of Assistance	Declared Areas
	Hazard Mitigation Grant Program	Counties of Barnstable, Bristol, Dukes, Essex, Middlesex, Plymouth, Nantucket, Norfolk, Suffolk (10 projects)
March Blizzard (March 1993)	FEMA Public Assistance Project Grants	All 14 Counties
January Blizzard (January 1996)	FEMA Public Assistance Project Grants	All 14 Counties
May Windstorm (May 1996)	State Public Assistance Project Grants	Counties of Plymouth, Norfolk, Bristol
October Flood (October 1996)	FEMA Public Assistance Project Grants	Counties of Essex, Middlesex, Norfolk, Plymouth, Suffolk
	FEMA Individual Household Program	Counties of Essex, Middlesex, Norfolk, Plymouth, Suffolk
	Hazard Mitigation Grant Program	Counties of Essex, Middlesex, Norfolk, Plymouth, Suffolk (36 projects)
(1997)	Community Development Block Grant-HUD	Counties of Essex, Middlesex, Norfolk, Plymouth, Suffolk
June Flood (June 1998)	FEMA Individual Household Program	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester
	Hazard Mitigation Grant Program	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester (19 projects)
(1998)	Community Development Block Grant-HUD	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester
March Flood (March 2001)	FEMA Individual Household Program	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester
	Hazard Mitigation Grant Program	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester (16 projects)
February Snowstorm (Feb 17-18, 2003)	FEMA Public Assistance Project Grants	All 14 Counties
January Blizzard (January 22-23, 2005)	FEMA Public Assistance Project Grants	All 14 Counties
Hurricane Katrina (August 29, 2005)	FEMA Public Assistance Project Grants	All 14 Counties
May Rainstorm/ Flood (May 12-23, 2006)	Hazard Mitigation Grant Program	Statewide
April Nor'easter (April 15-27, 2007)	Hazard Mitigation Grant Program	Statewide

Disaster Name (Date of Event)	Type of Assistance	Declared Areas
Flooding (March, 2010)	FEMA Public Assistance FEMA Individuals and Households Program SBA Loan	Bristol, Essex, Middlesex, Suffolk, Norfolk, Plymouth, Worcester
	Hazard Mitigation Grant Program	Statewide
Tropical Storm Irene (August 27-28, 2011)	FEMA Public Assistance	Statewide
Hurricane Sandy (October 27-30, 2012)	FEMA Public Assistance	Statewide
Severe snowstorm and Flooding (February 8-09, 2013)	FEMA Public Assistance; Hazard Mitigation Grant Program	Statewide
Blizzard of 2015 (January 26-28, 2015)	FEMA Public Assistance; Hazard Mitigation Grant Program	Statewide

Source: Database provided by MEMA

FEMA FUNDED MITIGATION PROJECTS

The Town of Bolton has received funding from FEMA to complete this Hazard Mitigation Plan 5-year update under the Hazard Mitigation Grant Program (HMGP). This project totaled \$18,000, with \$13,500 covered by FEMA grants and \$4,500 by local funding. The project is summarized in Table 3 below.

Table 3: FEMA-Funded Mitigation Projects

Grant	Project Title	Scope of Work	Total Cost	Federal Funding	Local Funding
PDMC-16	Local Hazard Mitigation Plan	5-Year update of hazard mitigation plan	\$18,000	\$13,500	\$4,500

Source: MEMA 2016 Grants Database

COMMUNITY PROFILE

Bolton is located in Worcester County and is bordered by Harvard on the north, Stow on the east, Berlin and Hudson on the south, and Clinton and Lancaster on the west. Bolton is 17 miles northeast of Worcester, 31 miles northwest of Boston. Principal highways in Bolton are State Routes 85, 110, and 117, and Interstate Route 495. There is no passenger or freight rail service in Bolton, or passenger bus routes. The closest air facility to Bolton is the Minute Man Airport, a reliever facility located in Stow, MA.

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

The Town of Bolton was incorporated in 1738. At the time, the town was primarily agricultural, a legacy which continues to shape the town's economy. Agriculture and the retail sale of agricultural products comprise a significant portion of the town's business sector. Other large employers and employment centers

include Hebert Candies, an office park near I-495, and two large mixed commercial buildings located near Route 117. The Town of Bolton remains a residential and agricultural community. Much of this rural landscape is still intact in a town that is now primarily a residential suburb for surrounding industrial communities and an exurb for the greater I-495 corridor. The town's heavily wooded land area makes it particularly susceptible to damage from wind related hazards and ice storms.

The town is 20.12 square miles in area and in 2016 was home to 5,113 persons with 1,753 housing units. Table 1 provides key Bolton population and housing stock characteristics.

Table 4: Bolton Population and Housing Characteristics

<p>Population = 5,113</p> <ul style="list-style-type: none">• 271 are under age 5• 560 are 65 or over in age• 132 residents with an ambulatory disability <p>Number of Housing Units = 1,753</p> <ul style="list-style-type: none">• 101 are renter-occupied housing units• 209 (11.9%) were built before 1940

Sources: 2012-2016 American Community Survey 5-Year Estimates

The Town is governed by a Board of Selectmen with a Town Manager and operates under an open Town Meeting format. The town maintains a website at <http://www.townofbolton.com/>.

SECTION 3: PLANNING PROCESS & PUBLIC PARTICIPATION

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 a Local Hazard Mitigation Planning Teams two public meetings hosted by the local Hazard Mitigation Team, posting of the plan to the Town’s website, and invitations sent to neighboring communities, Town boards and commissions, and other local or regional entities to review the plan and provide comment.

PLANNING PROCESS SUMMARY

The six-step planning process outlined below is based on the guidance provided by FEMA’s 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.



1. **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 B.
2. **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:
 - Town of Bolton, Administrative Bylaws
 - Town of Bolton, General Bylaws
 - Town of Bolton, Zoning Bylaws
 - Town of Bolton, Open Space and Recreation Plan, 2017 (Draft)
 - Town of Bolton, Master Plan 2006
 - Massachusetts State Hazard Mitigation Plan, 2013
 - FEMA, Local Mitigation Plan Review Guide, October 2011
 - FEMA, Flood Risk Report: Concord River Watershed, February 2013
 - FEMA, Flood Insurance Rate Maps for Worcester County, MA, 2012
 - Metropolitan Area Planning Council, GIS Lab, Regional Plans and Data.
 - New England Seismic Network, Boston College Weston Observatory, <http://aki.bc.edu/index.htm>
 - NOAA National Centers for Environmental Information (NCEI), <https://www.ncei.noaa.gov/>
 - Northeast States Emergency Consortium, <http://www.nesec.org/>
 - USGS, National Water Information System, <http://nwis.waterdata.usgs.gov/usa/nwis>
 - US Census, 2010 and 2012-2016 American Community Survey 5-Year Estimates
3. **Review of 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.
4. **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 Chapter VII.
5. **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.

6. **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.

2010 PLAN IMPLEMENTATION & MAINTENANCE

The 2010 Town of Bolton 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. Since approval of the plan by FEMA and local adoption, several mitigation measures have been successfully implemented and work has begun on several others. The Town officially opened a new joint public safety facility in September 2010 and has upgraded public shelter facilities with generators.

THE LOCAL MULTIPLE HAZARD COMMUNITY PLANNING TEAM

MAPC worked with the local community representatives to organize a Local Hazard Mitigation Planning Team for Bolton. 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 helping to develop new mitigation measures for this plan update. The Local Hazard Mitigation Planning Team membership can be found listed below.

Name	Representing
Leslie Caisse	Department of Public Works
Joseph Lynch	Department of Public Works
Rebecca Longvall	Conservation Commission
Warren Nelon	Police Department
David Farrell	Fire Department
Erica Uriarte	Planning Department

The Local Hazard Mitigation Planning Team met on the following dates: November 30, 2017; March 15, 2018; May 22, 2018. The purpose of the meetings was to introduce the Hazard Mitigation Planning program, review and update hazard mitigation goals, and to gather information on local hazard mitigation issues and sites or areas related to these. Later meetings focused on verifying information gathered by MAPC staff and discussion of existing mitigation practices, the status of mitigation measures identified in the 2010 Hazard Mitigation Plan, and potential new or revised mitigation measures. The agendas for these meetings are included in Appendix A.

The Bolton Planning Board and the 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 Director and the Conservation Agent on the Local Hazard Mitigation Team. In addition, MAPC, which is the State-designated regional planning agency for 101 cities and towns including Bolton, works with all agencies that regulate development in the region, including the listed municipal entities and state agencies, such as the MassDOT and the MBTA.

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 historic 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 is available for review.

Natural hazard mitigation plans unfortunately rarely attract much public involvement in the Boston region, unless there has been a recent hazard event. One of the best strategies for overcoming this challenge is to include discussion of the hazard mitigation plan on the agenda of an existing board or commission. 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 comment.

The public had an opportunity to provide input to the hazard mitigation planning process during two public presentations before the Bolton Board of Selectmen on March 22, 2018 and July 12, 2018. Meeting announcements, press advisories, and agendas are included in Appendix C.

LOCAL STAKEHOLDER INVOLVEMENT

The local Hazard Mitigation Planning Team was encouraged to reach 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 municipalities inviting them to review the Hazard Mitigation Plan and submit comments to the Town:

- Bolton Conservation Trust
- Bolton Local
- Bolton Council on Aging
- Nashoba Winery
- Bolton Lions Club
- Paragon
- Bolton Orchards
- Town of Harvard
- Town of Stow
- Town of Hudson
- Town of Berlin
- Town of Clinton
- Town of Lancaster

See Appendix C for public meeting notices. The draft Bolton Hazard Mitigation Plan 2018 Update was posted at the following URL for the second public meeting: <https://mapc-org.sharefile.com/d-s9ab1ba18d7941c38>. Members of the public could access the draft document and submit comments or questions to the Town and MAPC. The town received three public comments, which are shown in Appendix C along with responses.

CONTINUING PUBLIC PARTICIPATION

Following the adoption of the plan update, the planning 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. 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

October 3, 2017	Kickoff Webinar with Massachusetts Emergency Management Agency (MEMA)
November 30, 2017	Meeting of the Bolton Local Hazard Mitigation Planning Team
March 15, 2018	Meeting of the Bolton Local Hazard Mitigation Planning Team
March 22, 2018	First Public Meeting with Bolton Board of Selectmen
May 30, 2018	Meeting of the Bolton Local Hazard Mitigation Planning Team
July 12, 2018	Second Public Meeting with Bolton Board of Selectmen
August 15, 2018	Draft Plan Update submitted to MEMA
November 1, 2018	FEMA issued notice of Approvable Pending Adoption
November 15, 2018	Final Plan Adopted by the Town
November 27, 2018	FEMA formal Approval of the Plan

MILESTONES FOR PLAN IMPLEMENTATION AND UPDATING

Spring 2021	Mid-Term Survey of Plan Progress (see Section 9 of this plan)
Fall 2021-Spring 2022	Seek grant funding for 2023 Plan Update (PDM/HMGP grants as available)
Fall 2022-Fall 2023	Prepare the 2023 Plan Update, submit to MEMA and FEMA for approval

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SECTION 4: RISK ASSESSMENT

The risk assessment analyzes the potential natural hazards that could occur within the Town of Bolton 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 Bolton’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.

OVERVIEW OF HAZARDS AND IMPACTS

The Massachusetts Hazard Mitigation Plan provides an in-depth overview of natural hazards in Massachusetts. Previous state and federal disaster declarations since 1991 are summarized in Table 2. Table 5 below summarizes the hazard risks for Bolton. This evaluation takes into account the frequency of the hazard, historical records, and variations in land use. This analysis is based on the vulnerability assessment in the Massachusetts State Hazard Mitigation Plan. The statewide assessment was modified to reflect local conditions in Bolton using the definitions for hazard frequency and severity listed below. Based on this, the Town set an overall priority for each hazard.

Table 5: Hazard Risks Summary

Hazard	Frequency		Severity	
	Massachusetts	Bolton	Massachusetts	Bolton
Flooding	High	High	Serious	Serious
Dam Failure	Very Low	Very Low	Extensive	Extensive
Coastal Hazards	High	N/A	Serious	N/A
Tsunami	Very Low	N/A	Extensive	N/A
Hurricane/Tropical Storm	Medium	Medium	Serious	Serious
Nor’easter	High	High	Minor	Minor
Earthquakes	Very Low	Very Low	Serious	Serious
Landslides	Low	Low	Minor	Minor
Snow & Blizzard	High	High	Minor	Minor
Ice Storm	Medium	Medium	Minor	Minor
Ice Jams	Low	N/A	Serious	N/A
Wildland Fire	Medium	Medium	Minor	Minor
Major Urban Fires	Low	N/A	Serious	N/A
Thunderstorms	High	High	Minor	Minor
Tornadoes	Medium	Medium	Serious	Serious
Drought	Low	Low	Minor	Minor
Extreme Temperatures	Medium	Medium	Minor	Minor

Source: Massachusetts State Hazard Mitigation Plan, 2013; modified for Bolton

Of the hazards listed in the 2013 Massachusetts State Hazard Mitigation Plan, several hazard categories are not applicable to the Town of Bolton, including: coastal hazards and tsunamis, due to the town’s inland location away from the coast; and major urban fires, due to the lack of significant urban areas in close proximity to wildfire hazards that could pose a significant threat of major urban fires. In addition, The US Army Corps Ice Jam Database shows no record of ice jams in Bolton.

Definitions Used in the Commonwealth of Massachusetts State Hazard Mitigation Plan

Frequency

- **Very low frequency:** events that occur less frequently than once in 100 years (less than 1% per year).
- **Low frequency:** events that occur from once in 50 years to once in 100 years (1% to 2% per year).
- **Medium frequency:** events that occur from once in 5 years to once in 50 years (2% to 20% per year).
- **High frequency:** events that occur more frequently than once in 5 years (Greater than 20% per year).

Severity

- **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.

FLOOD-RELATED HAZARDS

Flooding was the most prevalent serious natural hazard identified by local officials in Bolton. 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 FLOOD

There have been a number of major floods that have affected the Metro Boston region over the last fifty years. Significant flood events that have impacted Bolton include:

- August 1954
- March 1968
- January 1979
- April 1987
- October 1991 ("The Perfect Storm")
- October 1996
- June 1998
- March 2001
- April 2004
- May 2006
- April 2007
- March 2010
- January 2018

Local data for previous flooding occurrences are not collected by the Town of Bolton. The best available local data is for Worcester County through the National Centers for Environmental Information. Worcester County, which includes the Town of Bolton, experienced 47 flood events from 1996 to 2016. No deaths or injuries were reported and the total reported property damage in the county was \$11.33 million dollars. Of that total, \$8.1 million is attributed to the three major events of March 2010.

Table 6: Worcester County Flood Events, 1996 to 2017

Date	Deaths	Injuries	Property Damage
1/28/1996	0	0	\$0
4/17/1996	0	0	\$0
6/8/1996	0	0	\$0
8/4/1996	0	0	\$0
1/23/1998	0	0	\$0
3/9/1998	0	0	\$300,000
4/22/2000	0	0	\$0
3/22/2001	0	0	\$0
4/1/2004	0	0	\$0
1/24/2005	0	0	\$100,000
10/15/2005	0	0	\$1,740,000
7/11/2006	0	0	\$2,000
7/28/2006	0	0	\$20,000
10/28/2006	0	0	\$5,000
4/16/2007	0	0	\$500,000
2/13/2008	0	0	\$10,000
3/8/2008	0	0	\$25,000
7/1/2008	0	0	\$1,000
7/22/2008	0	0	\$5,000
8/7/2008	0	0	\$20,000
9/6/2008	0	0	\$100,000
9/7/2008	0	0	\$1,000
12/12/2008	0	0	\$10,000
7/24/2009	0	0	\$0
3/14/2010	0	0	\$2,700,000
3/15/2010	0	0	\$1,350,000
3/29/2010	0	0	\$4,050,000
4/1/2010	0	0	\$0
7/19/2010	0	0	\$0
3/7/2011	0	0	\$25,000
9/8/2011	0	0	\$30,000
8/15/2012	0	0	\$10,000
6/14/2013	0	0	\$40,000
7/23/2013	0	0	\$0
9/2/2013	0	0	\$5,000
7/7/2014	0	0	\$0
10/23/2014	0	0	\$200,000
8/15/2015	0	0	\$50,000

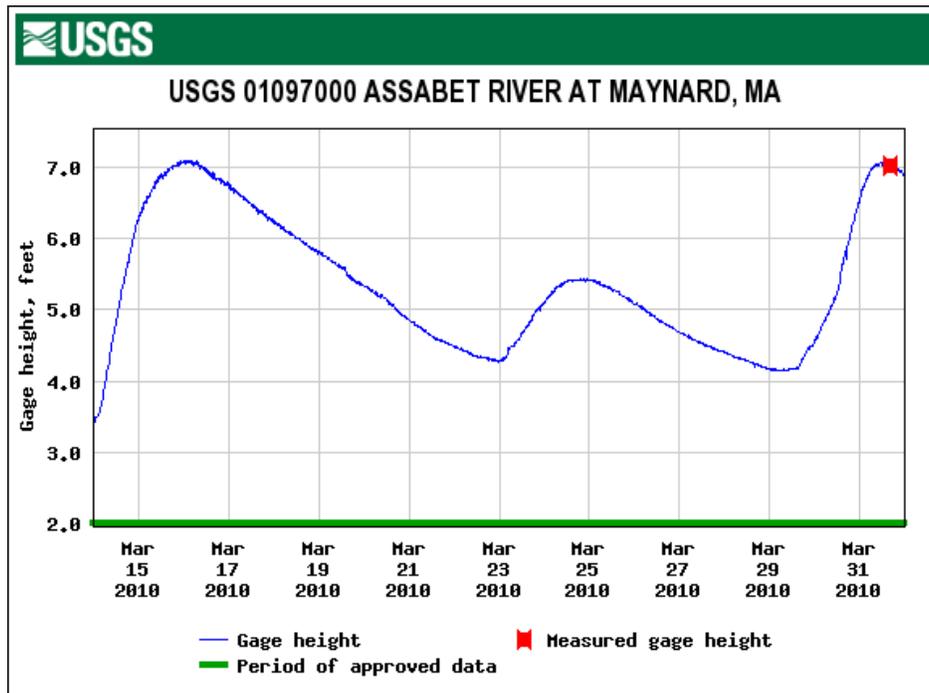
Date	Deaths	Injuries	Property Damage
9/30/2015	0	0	\$5,000
7/22/2016	0	0	\$0
7/29/2016	0	0	\$5,000
8/12/2016	0	0	\$0
8/13/2016	0	0	\$25,000
8/14/2016	0	0	\$0
6/27/2017	0	0	\$3,000
7/8/2017	0	0	\$0
7/12/2017	0	0	\$0
Total	0	0	\$11.33 M

Source: NOAA, National Centers for Environmental Information

The most severe flooding since the previous plan occurred during March 2010, when a total of 14.83 inches of rainfall accumulation was recorded by the National Weather Service (NWS). The weather pattern that 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.

One indication of the extent of flooding is the gage height at the nearest USGS streamflow gauging station, which is on the Assabet River in nearby Maynard. The USGS gage height, shown in Figure 2, reached 7 feet on March 16 and again on March 31, 2010. Flood stage at this gage is 5 feet.

Figure 2: Flow Gage Data for Assabet River, March 2010



Source: United States Geological Survey, 2018

OVERVIEW OF TOWN-WIDE FLOODING

As with most of Massachusetts, flooding is the most prevalent natural hazard for Bolton, and therefore the Town's focuses much of its hazard mitigation efforts on issues related to flooding. Flooding in Bolton is occasional, usually within or near floodplain areas. Some localized areas will also flood due to culvert or drainage system deficiencies or clogging. In some areas of town, flooding occurs due to beaver activity. Although relatively frequent in comparison to other natural hazards, much of the flooding experienced by the town fits the category of "nuisance" flooding, which causes inconvenience but not significant damage.

Flooding typically occurs within or near floodplain areas associated with the town's water courses and their tributaries; Nashua River, Still River, Great Brook, Mill Brook, and Danforth Brook. Bolton also has several ponds, some of which are kettle ponds and some which are man-made. Some localized areas will flood due to culvert or drainage system deficiencies or clogging. Beaver activity contributes to flooding, as well.

While the most significant flooding originates with the Nashua and Still Rivers, which occasionally overtop Route 117 at the western end of town, the town's conservation areas and other open space provides extensive natural flood storage. The land's ability to absorb and contain flood waters minimizes damage to populated areas. Without undeveloped areas such as the Bolton Flats Wildlife Management Area and Skunk Meadows, flood damage to private property and town roads would be a more significant issue.

Further development in town can bring new impervious areas and more engineered drainage systems, which can result in the possibility of future flooding problems. Therefore, protection of open space and strong development controls will be necessary to mitigate against future flooding.

POTENTIAL FLOOD HAZARD AREAS

Information on potential flood hazard areas was taken from two sources. The first was the National Flood Insurance Rate Maps. The FIRM flood zones are shown on Map 3 (Appendix B) and are defined below.

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.

Zone X500 (0.2% annual chance): Zone X500 is the flood insurance rate zone that corresponds 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.

In addition, 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.”

LOCALLY IDENTIFIED AREAS OF FLOODING

In addition to the FEMA flood zones, the town identified several other local areas of potential flooding with the corresponding map location. The 2010 version of this plan listed Wilder Road as an area of flooding, but in August 2017 the Town repaired an improperly function culvert which was to blame for the flooding and drainage has since improved; the site has therefore been removed from this list. Several additional problem areas of flooding were not included in the 2010 plan, which the town also recognized and repaired. Berlin Road, Wilder Road, and Sampson Road have all seen successful projects aimed at remedying drainage and flooding issues.

Table 7: Other Locally Identified Areas of Flooding

Map ID	Name	Description
1	Teele Road	This area off of Teele Road in the southeast corner of town near the border of Stow has experienced flooding due to beaver activity.
2	East End Road	East End Road near Great Brook has experienced flooding. Sidewalks have washed out, significant siltation has occurred, and this causes threats to endangered species in the area. Temporary improvements have recently been made.
3	Golden Run Road	This site at Golden Run Road and Quail Road has experienced localized flooding. It also experiences icing in the winter. Upgrades to the site are currently being considered by the Town.
4	Manor Road	This site at Manor Road has experienced localized flooding.
6	Forbush Mill Road	This site at Forbush Mill Road has experienced flooding due to its proximity to floodplain and likely due to runoff from adjacent gravel works operations.
7	Vaughn Hill Road	This site at Vaughn Hill Road has experienced flooding, which has resulted in significant property damage. Water flows downhill across right of way and has seriously damaged lower lying property, including wiping out a residential septic system.
8	Main Street	This site along Main Street, where Route 117 crosses the Still River, has experienced flooding due to its location in floodplain, as well as beaver activity. The river has overtopped Route 117 in the past.
9	Long Hill Road	A stopgap measure to address flooding has been implemented, but a more long term solution is needed.
10	Spectacle Hill	General flooding issue without a singular cause
11	South Bolton Road	Flooding due to water pooling in low point of the road; the water needs a place to go.
12	Vaughn Hill at Green Road Entrance	This site includes a beaver dam on conservation property. Failure of the dam would affect areas downstream along Green Road and Forbush Hill Road.
13	LIS Pond, along Forbush Hill Road	Beaver dam
14	Sugar Road	Beaver dam
15	Corner of Main and Mechanic	Stone culvert at this location is in a poor state of repair. The roadway would be damaged if the culvert were to fail.

Potential flooding damages in Bolton have been estimated using HAZUS-MH. Total direct building-related economic losses are estimated at \$3.5 million for a 100-year flood event and \$4.8 million for a 500-year flood event. Other potential impacts on the town are detailed in Table 31.

REPETITIVE LOSS STRUCTURES

As defined by the Community Rating System (CRS) of the National Flood Insurance Program (NFIP), a repetitive loss property is any property which the NFIP has paid two or more flood claims of \$1,000 or more in any given 10-year period since 1978. There are no Repetitive Loss properties in Bolton.

For more information on repetitive losses, see https://www.fema.gov/txt/rebuild/repetitive_loss_faqs.txt and <https://www.fema.gov/repetitive-flood-claims-grant-program-fact-sheet>.

Based on the record of previous occurrences, flooding in Bolton is a high frequency event as defined by the 2013 Massachusetts State Hazard Mitigation Plan. High frequency events are those with a greater than 20% chance of occurring each year, occurring more frequently than once in 5 years.

DAMS AND DAM FAILURE

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. Although complete and consistent records of complete dam failure is not available, the 2013 State Hazard Mitigation Plan highlights four dam failures within the last 50 years; one event, the 1968 Lee Lake Dam failure, resulted in two fatalities. There have been no recorded dam breaches in Bolton.

According to data provided by the Massachusetts Department of Conservation and Recreation, there are 14 dams in Bolton of various sizes (see Table 8). The Department of Conservation and Recreation provides a classification of dam hazards, as summarized below. Of the 14 dams listed in Bolton, two are owned by the Commonwealth of Massachusetts (Dept. of Conservation and Recreation and Dept. of Capital Assets Management), both of which are classified as Low Hazard Dams. Eight dams are privately owned and classified as Small Unregulated Dams, and four are owned by the Town of Bolton and classified as Small Unregulated Dams. None of the town's dams were listed in the State Auditor's report that identified dams in unsafe or poor condition.

One of these town-owned dams, the Fyfeshire Pond Dam, was previously considered a significant hazard dam. In 2008, the Department of Conservation and Recreation issued a Dam Safety Order requiring a Phase I inspection of Fyfeshire Dam. As a result of the inspection, the dam was determined to be structurally deficient and in unsafe condition, and the Office of Dam Safety classified the dam as a small size, significant hazard potential structure. The Town weighed whether to repair or remove the dam, but ultimately decided on a third option, which was to lower the dam to reduce the risk, which also removed it from state jurisdiction. Town Meeting voted to fund the project in 2012 and work was completed in 2014.¹

¹ <http://www.townofbolton.com/conservation-commission/pages/fyfeshire-dam-information>

Table 8 DCR Inventory of Dams in Bolton

Dam Name	Dam Number	Owner	Hazard Potential Classification
Delaney Complex E. Bolton Dam	MA01191	Comm. of MA - DCR	Low
Old Mill Pond Dam	MA01509	Private	Small Unregulated
Private Pond Dam	MA01510	Private	Small Unregulated
Fish Pond Dam	MA01511	Private	Small Unregulated
Fyfeshire Pond Dam	MA01512	Municipal – Bolton Cons. Comm.	Small Unregulated
Fish Pool Dam	MA01513	Private	Small Unregulated
Visockas Pond Dam	MA01514	Private	Small Unregulated
Storage Pond Dam	MA01516	Private	Small Unregulated
Farm Pond Dam	MA01520	Municipal – Bolton Cons. Comm.	Small Unregulated
Private Pond Dam	MA01522	Private	Small Unregulated
Pool Dam	MA02281	Municipal – Bolton Cons. Comm.	Small Unregulated
West Pond Dam	MA02282	Private	Small Unregulated
Swimming Pool Dam	MA02500	Comm. of MA - DCAM	Low
Upper Fyfeshire Pond Dam	MA02501	Municipal – Bolton Cons. Comm.	Small Unregulated

Source: MA Department of Conservation and Recreation Office of Dam Safety

DCR Dam Hazard Classification

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.

Based on the record of previous occurrences, dam failure in Bolton is a very low frequency event as defined by the 2013 Massachusetts State Hazard Mitigation Plan. Very low frequency events are those with less than a 1% probability per year, occurring less often than once in 100 years.

WIND-RELATED 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 Bolton. Information on wind related hazards can be found on Map 5 in Appendix B.

Tree damage during high winds has the potential to be a significant hazard in Bolton. Trees can knock out power lines and block major roadways, which hinders emergency response. While Bolton does experience downed trees that have caused isolated power outages and roadway blockages, the town also takes pride in its tree-lined streets. Therefore, maintaining trees in a proactive fashion has been a trade-off for the tree amenities. The Department of Public Works has effective tree trimming and removal programs, although this work would benefit from increased resources that better match the town's needs.

HURRICANES AND TROPICAL STORMS

A hurricane is a violent wind and rainstorm with wind speeds of 74 to 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 land. A tropical storm has similar characteristics, but wind speeds are below 74 miles per hour. Since 1900, 39 tropical storms have impacted New England (NESEC). Massachusetts has experienced approximately 32 tropical storms, nine Category 1 hurricanes, five Category 2 hurricanes and one Category 3 hurricane.

As shown in the hazard mapping in Appendix B, three tropical storms and one hurricane have tracked through Bolton, dating back to 1894. A hurricane or storm track is the line that delineates the path of the eye of a hurricane or tropical storm. The town also experiences the impacts of the wind and rain of hurricanes and tropical storms regardless of whether the storm track passed through the town. The hazard mapping indicates that the 100 year wind speed in Bolton is 110 miles per hour.

Table 9: Hurricane Records for Massachusetts, 1938 to 2012

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

Source: NOAA

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:

Table 10: Saffir/Simpson Scale

Scale No. (Category)	Winds (mph)	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: National Oceanic and Atmospheric Administration

Hurricanes typically have regional impacts beyond their immediate tracks. 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 Bolton. Potential hurricane damages to Bolton have been estimated using HAZUS-MH. Total damages are estimated at \$3.5 million for a 100-year storm and \$11.8 million for a 500-year storm. Other potential impacts such as households displaced, sheltering needs, and debris generation, are detailed in Table 29.

Based on records of previous occurrences, hurricanes in Bolton are a medium frequency event as defined by the 2013 Massachusetts State Hazard Mitigation Plan. This hazard may occur anywhere from once in 5 years to once in 50 years (2% to 20% per year).

TORNADOS

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

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 1, 2007, the National Weather Service began rating tornados using the Enhanced Fujita-scale (EF-scale), which allows surveyors to create more precise assessments of tornado severity. The EF-scale is summarized below:

Table 11: Enhanced Fujita Scale

Fujita Scale			Derived		Operational EF Scale	
F Number	Fastest ¼ mile (mph)	3-second gust (mph)	EF Number	3-second gust (mph)	EF Number	3-second gust (mph)
0	40 – 72	45 – 78	0	65 – 85	0	65 – 85
1	73 – 112	79 – 117	1	86 – 109	1	86 – 110
2	113 – 157	118 – 161	2	110 – 137	2	111 – 135
3	158 – 207	162 – 209	3	138 – 167	3	136 – 165
4	208 – 260	210 – 261	4	168 – 199	4	166 – 200
5	261 – 318	262 – 317	5	200 – 234	5	Over 200

Source: Massachusetts State Hazard Mitigation Plan, 2013

A majority of the tornado events which occur in Massachusetts occur in Worcester County. The strongest tornado in Massachusetts history was the Worcester Tornado in 1953 (NESEC), which resulted in 90 deaths and over \$250 million in damages. However, the most recent tornado events in Massachusetts were in Springfield in 2011, in Revere in 2014, and in Webster in 2018. 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 damages and 13 homes and businesses were rendered uninhabitable. The Webster tornado in August 2018 was an F1 event that destroyed two buildings and damaged several others.

In Bolton, one tornado has been recorded at the very southern border of the town. Since 1953, there have been 30 tornadoes in Worcester County recorded by the National Centers for Environmental Information.

Excluding the Worcester Tornado of 1953 - the strongest and most deadly tornado in state history - , these tornadoes resulted in a total of two fatalities, 25 injuries, and \$9.1 million in property damage.

Table 12: Tornado Records for Worcester County

Date	Fujita	Length (miles)	Width (feet)	Deaths	Injuries	Property Damage
6/9/1953	4	25	784	90	1229	\$252,500,000
10/24/1955	1	3	33	0	0	\$2,500
6/1/1956	1	0	33	0	14	\$25,000
11/21/1956	2	0	17	0	0	\$2,500,000
6/19/1957	1	2	33	0	0	\$25,000
7/5/1957	2	1	20	0	0	\$2,500
7/11/1958	1	0	92	0	0	\$2,750
7/16/1958	1	0	33	0	1	\$2,500
7/29/1958	1	2	33	0	0	\$2,500
10/12/1962	2	4	133	0	0	\$25,000
5/20/1963	2	2	33	0	0	\$52,500
8/31/1966	1	1	59	0	1	\$250
7/17/1968	1	0	17	0	0	\$2,500
5/29/1969	1	1	13	0	0	\$2,500
10/3/1970	3	35	60	0	0	\$250,000
7/1/1971	1	2	20	0	2	\$25,000
11/7/1971	1	0	27	0	0	\$2,500
8/9/1972	2	10	10	0	1	\$25,000
5/3/1976	1	0	27	0	0	\$2,500
8/10/1979	2	10	30	2	2	\$2,500,000
6/22/1981	3	7	167	0	3	\$25,000
8/8/1986	1	1	100	0	0	\$2,500
7/10/1989	1	0	50	0	0	\$1,000,000
8/10/1990	0	1	10	0	0	\$30
6/17/2001	1	1	600	0	0	\$25,000
7/23/2002	1	0	75	0	0	\$50,000
7/19/2007	0	2	50	0	0	\$0
6/1/2011	2	4	453	0	0	\$0
8/31/2014	0	2	176	0	0	\$100,000
6/23/2015	0	1	75	0	0	\$25,000
Total:				92	1,253	\$259,178,030

Source: NOAA, National Centers 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.

Although tornadoes are a potential town-wide hazard in Bolton, tornado impacts are relatively localized compared to severe storms and hurricanes. Damages from any tornado in Bolton would greatly depend on the track of the tornado.

Based on the record of previous occurrences since 1953, Tornado events in Bolton 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 (2% to 20% per year).

NOR'EASTERS

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 10 to 40 mph with gusts of up to 70 mph. These storms are accompanied by heavy rain or snow, depending on temperatures.

Previous occurrences of nor'easters include the following, and are listed in the Massachusetts State Hazard Mitigation Plan from 2013:

Table 13: Nor'easter Events for Massachusetts, 1978 to 2011

Nor'easter Event	Date
Blizzard of 1978	February 1978
Severe Coastal Storm ("Perfect Storm")	October 1991
Great Nor'easter of 1992	December 1992
Blizzard/Nor'easter	January 2005
Coastal Storm/Nor'easter	October 2005
Severe Storms, Inland & Coastal Flooding/Nor'easter	April 2007
Winter Storm/Nor'easter	January 2011
Severe Storm/Nor'easter	October 2011
Blizzard of 2013	February 2013
Blizzard of 2015	January 2015
Severe Storms/Nor'easters 2018	March 2018

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, a series of blizzards in 2011, 2013, 2015, and 2018 were large nor'easters that caused significant snowfall amounts, as well as coastal damage.

Bolton is vulnerable to both the wind and precipitation that accompany 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 Bolton could be at risk from the wind, rain, or snow impacts from a nor'easter, depending on the track and radius of the storm. Due to its inland location, the town would not be subject to coastal hazards.

Based on the record of previous occurrences, nor'easters in Bolton 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).

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. A thunderstorm typically features lightning, strong winds, 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 town's entire area is potentially subject to severe thunderstorms.

The best available data on previous occurrences of thunderstorms in Bolton is for Worcester County through the National Centers for Environmental Information (NCEI). Between the years 1996 and 2016, NCDC records show 132 thunderstorm events in Worcester County (Table 14). These storms resulted in a total of \$13,170,500 in property damages. Three deaths and six injuries were reported.

Table 14: Worcester County Thunderstorm Events, 1996 to 2016

Date	Magnitude*	Deaths	Injuries	Damage (\$)
5/21/1996	50	0	0	\$0
6/13/1996	50	0	0	\$0
2/22/1997	52	0	0	\$0
7/3/1997	50	0	0	\$0
7/9/1997	60	0	1	\$4,000
7/17/1997	50	0	0	\$0
8/16/1997	50	0	0	\$0
5/29/1998	50	0	0	\$5,000
5/31/1998	67	2	0	\$10,053,000
7/23/1998	50	0	0	\$0
6/29/1999	50	0	0	\$0
7/6/1999	60	0	0	\$0
7/24/1999	50	0	0	\$0
7/26/1999	50	0	0	\$0
7/29/1999	50	0	0	\$0
6/2/2000	50	0	0	\$0
6/26/2000	50	0	0	\$0
5/12/2001	50	0	0	\$0
6/20/2001	50	0	0	\$0
6/30/2001	51	0	0	\$0
7/1/2001	50	0	0	\$0
5/31/2002	50	0	0	\$2,000
6/16/2002	58	0	0	\$20,000
6/27/2002	50	0	0	\$35,000
7/19/2002	50	0	0	\$2,000
7/23/2002	68	0	0	\$27,000
8/2/2002	50	0	0	\$15,000
8/16/2002	50	0	0	\$3,000

Date	Magnitude*	Deaths	Injuries	Damage (\$)
6/30/2003	50	0	0	\$10,000
7/22/2003	50	0	0	\$5,000
8/22/2003	50	0	0	\$30,000
6/9/2004	50	0	0	\$10,000
7/8/2004	50	0	0	\$15,000
8/20/2004	53	0	0	\$180,000
8/21/2004	50	0	0	\$5,000
6/26/2005	50	0	0	\$30,000
7/27/2005	50	0	0	\$25,000
8/5/2005	52	0	2	\$45,000
8/14/2005	50	0	0	\$15,000
4/1/2006	50	0	0	\$2,000
5/21/2006	50	0	2	\$98,000
6/1/2006	50	0	0	\$25,000
6/20/2006	50	0	0	\$20,000
6/23/2006	50	0	0	\$40,000
7/3/2006	50	0	0	\$25,000
7/4/2006	50	0	0	\$50,000
7/11/2006	50	0	0	\$25,000
7/21/2006	50	0	0	\$5,000
7/28/2006	50	0	0	\$25,000
8/2/2006	60	0	0	\$250,000
8/10/2006	50	0	0	\$10,000
8/20/2006	50	0	0	\$10,000
5/15/2007	50	0	0	\$0
5/16/2007	50	0	0	\$0
6/27/2007	50	0	0	\$0
6/28/2007	55	0	0	\$0
7/15/2007	50	0	0	\$0
7/28/2007	50	0	0	\$0
8/3/2007	50	0	0	\$0
8/17/2007	50	0	0	\$0
9/8/2007	50	0	0	\$73,000
10/20/2007	50	0	0	\$0
4/1/2008	50	0	0	\$10,000
5/27/2008	50	0	0	\$1,500
6/10/2008	52	0	0	\$145,000
6/22/2008	50	1	0	\$0
6/23/2008	50	0	0	\$500
6/24/2008	50	0	0	\$5,000
6/29/2008	50	0	0	\$33,500
6/30/2008	50	0	0	\$9,000

Date	Magnitude*	Deaths	Injuries	Damage (\$)
7/1/2008	50	0	0	\$13,000
7/3/2008	50	0	0	\$1,000
7/18/2008	50	0	0	\$3,000
7/19/2008	50	0	0	\$5,000
7/20/2008	50	0	0	\$5,000
7/27/2008	50	0	0	\$15,000
8/7/2008	50	0	0	\$3,000
8/10/2008	50	0	0	\$1,000
9/9/2008	50	0	0	\$6,000
5/9/2009	51	0	0	\$7,000
5/24/2009	56	0	0	\$15,000
7/31/2009	50	0	0	\$10,000
8/5/2009	50	0	0	\$10,000
8/21/2009	50	0	0	\$31,000
5/4/2010	50	0	0	\$56,000
6/1/2010	50	0	0	\$1,000
6/3/2010	50	0	0	\$60,000
6/5/2010	50	0	0	\$46,000
6/6/2010	50	0	0	\$53,000
6/10/2010	50	0	0	\$2,000
6/24/2010	50	0	0	\$71,000
7/16/2010	50	0	0	\$100,000
7/19/2010	50	0	0	\$20,000
9/13/2010	50	0	0	\$40,000
6/1/2011	51	0	0	\$50,000
6/8/2011	50	0	0	\$45,000
6/9/2011	50	0	0	\$15,000
8/19/2011	50	0	0	\$1,000
5/29/2012	50	0	0	\$5,000
6/22/2012	40	0	0	\$5,000
7/24/2012	50	0	0	\$20,000
8/4/2012	50	0	0	\$5,000
8/5/2012	50	0	0	\$10,000
8/10/2012	50	0	0	\$10,000
5/22/2013	50	0	0	\$5,000
6/17/2013	50	0	0	\$6,000
10/7/2013	50	0	0	\$20,000
7/3/2014	50	0	0	\$30,000
7/7/2014	50	0	0	\$100,000
7/15/2014	50	0	0	\$10,000
7/28/2014	50	0	0	\$15,000
8/5/2014	45	0	0	\$15,000

Date	Magnitude*	Deaths	Injuries	Damage (\$)
9/2/2014	50	0	0	\$5,000
9/6/2014	48	0	0	\$60,000
6/9/2015	49	0	0	\$21,000
6/23/2015	50	0	0	\$10,000
7/28/2015	50	0	0	\$10,000
8/4/2015	49	0	0	\$55,000
8/15/2015	50	0	0	\$15,000
2/24/2016	48	0	0	\$30,000
2/25/2016	50	0	0	\$125,000
3/17/2016	45	0	0	\$5,000
7/7/2016	40	0	0	\$5,000
7/18/2016	45	0	0	\$10,000
7/22/2016	58	0	0	\$251,000
7/23/2016	50	0	0	\$55,000
8/6/2016	47	0	0	\$11,000
8/12/2016	50	0	0	\$25,000
8/13/2016	48	0	0	\$30,000
8/14/2016	50	0	0	\$15,000
8/16/2016	40	0	0	\$5,000
9/11/2016	50	0	1	\$88,000
Total		3	6	\$ 13,170,500

*Magnitude refers to maximum wind speed

Source: NOAA, National Centers for Environmental Information

Severe thunderstorms are a town-wide hazard for Bolton. The town's vulnerability to severe thunderstorms is similar to that of nor'easters. High winds can cause falling trees and power outages, as well as obstruction of key routes and emergency access. Heavy precipitation may also cause localized flooding, both riverine and urban drainage related.

Based on the record of previous occurrences, severe thunderstorms in Bolton 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).

WINTER STORMS

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. 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. This in turn can cause property damage and potential injuries. Power outages may also result from fallen trees and utility lines.

Winter storms are a potential town-wide hazard in Bolton. The average annual snowfall for most of the town is 48 – 72 inches. The town is vulnerable to a number of public safety issues that can arise during snow storms. Impassible streets are a challenge for emergency vehicles and affect residents and

employers. Snow-covered sidewalks force people to walk in streets, which are already less safe due to snow, slush, puddles, and ice. Large piles of snow can also block sight lines for drivers, particularly at intersections. Not all residents are able to clear their properties, especially the elderly. Refreezing of melting snow can cause dangerous roadway conditions.

The Town of Bolton’s Snow & Ice Removal program entails three steps beginning at the start of storm, lasting through its duration, and includes follow up procedures. The Public Works Department staff is well trained and equipped to work at all hours, if necessary, to keep the roadways open and passable.

HEAVY SNOW AND BLIZZARDS

A blizzard is a winter snow storm with sustained or frequent wind gusts to 35 mph or more, accompanied by falling or blowing snow which reduces visibility to or below ¼ mile. These conditions must be the predominant condition over a three hour period. Extremely cold temperatures are often associated with blizzard conditions, but are not a formal part of the definition. The hazard related to the combination of snow, wind, and low visibility significantly increases when temperatures drop 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 four 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.

The Northeast Snowfall Impact Scale (NESIS), developed by Paul Kocin of The Weather Channel and Louis Uccellini of the National Weather Service (Kocin and Uccellini, 2004), characterizes and ranks high impact northeast snowstorms. These storms have large areas of 10 inch snowfall accumulations and greater. NESIS has five categories: Extreme, Crippling, Major, Significant, and Notable. NESIS scores are a function of the area affected by the snowstorm, the amount of snow, and the number of people living in the path of the storm. The largest NESIS values result from storms producing heavy snowfall over large areas that include major metropolitan centers. The NESIS categories are summarized below:

Table 15: NESIS Categories

Category	NESIS	Value Description
1	1 – 2.499	Notable
2	2.5 – 3.99	Significant
3	4 – 5.99	Major
4	6 – 9.99	Crippling
5	10+	Extreme

Source: Massachusetts State Hazard Mitigation Plan, 2013

The most significant winter storm in recent history was the “Blizzard of 1978,” which resulted in over three feet of snowfall and multiple day closures of roadways, businesses, and schools. In Bolton, blizzards and severe winter storms have occurred in the following years:

Table 16: Severe Winter Storm Records for Massachusetts

Severe Winter Storm Event	Date
Blizzard of 1978	February 1978
Blizzard	March 1993
Blizzard	January 1996
Severe Snow Storm	March 2001
Severe Snow Storm	December 2003
Severe Snow Storm	January 2004

Severe Winter Storm Event	Date
Severe Snow Storm	January 2005
Severe Snow Storm	April 2007
Severe Snow Storm	December 2010
Severe Snow Storm	January 2011
Blizzard of 2013	February 2013
Blizzard of 2015	January 2015

Source: National Oceanic and Atmospheric Administration

The Town of Bolton does not keep local records of winter storms. Data for Worcester County, which includes Bolton, is the best available data to help understand previous occurrences and impacts of heavy snow events. According to National Climate Data Center (NCDC) records, from 1996 to 2016, Worcester County experienced 76 heavy snowfall events, resulting in no deaths or injuries, and \$5.5 million dollars in property damage. See Table 17 for and heavy snow events and impacts in Worcester County.

Table 17: Heavy Snow Events and Impacts in Worcester County, 1996 to 2016

Date	Deaths	Injuries	Property Damage (\$)
1/2/1996	0	0	\$0
1/7/1996	0	0	\$2,500,000
1/12/1996	0	0	\$0
2/2/1996	0	0	\$0
2/16/1996	0	0	\$0
3/2/1996	0	0	\$0
3/7/1996	0	0	\$0
4/7/1996	0	0	\$0
4/9/1996	0	0	\$0
12/6/1996	0	0	\$0
12/7/1996	0	0	\$2,720,000
3/31/1997	0	0	\$0
4/1/1997	0	0	\$0
12/23/1997	0	0	\$0
1/15/1998	0	0	\$0
1/23/1998	0	0	\$0
12/29/1998	0	0	\$0
1/14/1999	0	0	\$0
2/25/1999	0	0	\$0
3/6/1999	0	0	\$0
3/15/1999	0	0	\$0
1/13/2000	0	0	\$0
1/25/2000	0	0	\$0
2/18/2000	0	0	\$0
12/30/2000	0	0	\$0
1/20/2001	0	0	\$0
2/5/2001	0	0	\$0
3/5/2001	0	0	\$0
3/9/2001	0	0	\$0
3/30/2001	0	0	\$0
12/8/2001	0	0	\$0
3/20/2002	0	0	\$0
11/27/2002	0	0	\$0
2/1/2003	0	0	\$15,000
3/16/2004	0	0	\$0

Date	Deaths	Injuries	Property Damage (\$)
12/19/2004	0	0	\$0
1/3/2006	0	0	\$50,000
12/13/2007	0	0	\$0
12/16/2007	0	0	\$0
1/14/2008	0	0	\$50,000
2/12/2008	0	0	\$0
2/22/2008	0	0	\$0
3/1/2008	0	0	\$0
12/19/2008	0	0	\$0
12/21/2008	0	0	\$0
1/18/2009	0	0	\$0
3/1/2009	0	0	\$0
12/9/2009	0	0	\$5,000
12/19/2009	0	0	\$0
2/16/2010	0	0	\$0
2/23/2010	0	0	\$15,000
2/26/2010	0	0	\$0
1/12/2011	0	0	\$0
1/26/2011	0	0	\$0
10/29/2011	0	0	\$80,000
12/26/2012	0	0	\$0
12/29/2012	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
2/5/2014	0	0	\$0
2/13/2014	0	0	\$0
2/18/2014	0	0	\$0
11/26/2014	0	0	\$40,000
1/24/2015	0	0	\$0
1/26/2015	0	0	\$0
2/2/2015	0	0	\$0
2/5/2015	0	0	\$0
2/8/2015	0	0	\$0
2/14/2015	0	0	\$0
2/5/2016	0	0	\$0
12/29/2016	0	0	\$0
Totals	0	0	\$5,475,000

Source: NOAA, National Centers for Environmental Information

Blizzards are a town-wide hazard for Bolton. Blizzards are considered to be high frequency events based on past occurrences, as defined by the Massachusetts State Hazard Mitigation Plan, 2013. This hazard occurs more than once in five years, with a greater than 20% chance of occurring each year.

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. Hail size typically refers to the diameter of the hailstones. Warnings and reports may report hail size through comparisons with real-world objects that correspond to certain diameters:

Table 18: 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
Tea cup	3.00
Grapefruit	4.00
Softball	4.50

While ice pellets and sleet are examples of these, 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 damaging electric lines.

Town-specific data for previous ice storm occurrences are not collected by the Town of Bolton. The best available local data is for Worcester County through the National Centers for Environmental Information. Worcester County, which includes the Town of Bolton, experienced five events from 1996 to 2016.

Table 19: Worcester County Ice Storm Events, 1996 to 2016

Date	Deaths	Injuries	Damage
1/9/1998	0	0	\$15,000
11/16/2002	0	0	\$300,000
1/15/2007	0	1	\$15,000
2/1/2008	0	0	0
12/11/2008	0	0	\$23,000,000
Totals	0	1	\$23,330,000

Source: NOAA, National Centers for Environmental Information

Ice storms are considered to be medium frequency events based on past occurrences, and as defined by the Massachusetts State Hazard Mitigation Plan. This hazard occurs once in five years to once in 50 years, with a 2% to 20% chance of occurring each year.

GEOLOGIC HAZARDS

Geologic hazards include earthquakes, landslides, sinkholes, subsidence, and unstable soils such as fill, peat, and clay. Town officials did not identify any problems with areas of geologic instability, such as sinkholes or subsidence.

Although new construction under the most recent building codes generally will be built to seismic standards, there are still many structures in town which pre-date the most recent building code. Information on geologic hazards in Bolton can be found on Map 4 in Appendix B.

EARTHQUAKES

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).

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 below:

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 very damaging in highly populated areas.
7.0 – 7.9	Major earthquake. Can cause serious damage over large areas.
8 or greater	Great earthquake. Can totally destroy communities near the epicenter.

According to the State Hazard Mitigation Plan, New England experiences an average of five earthquakes per year. From 1668 to 2016, 408 earthquakes were felt in Massachusetts, although the only damaging earthquakes occurred in 1727 and 1755. 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. Historical records of some of the more significant earthquakes in the region are shown in Table 20.

Table 20: Historical Earthquakes in Massachusetts or Surrounding Area

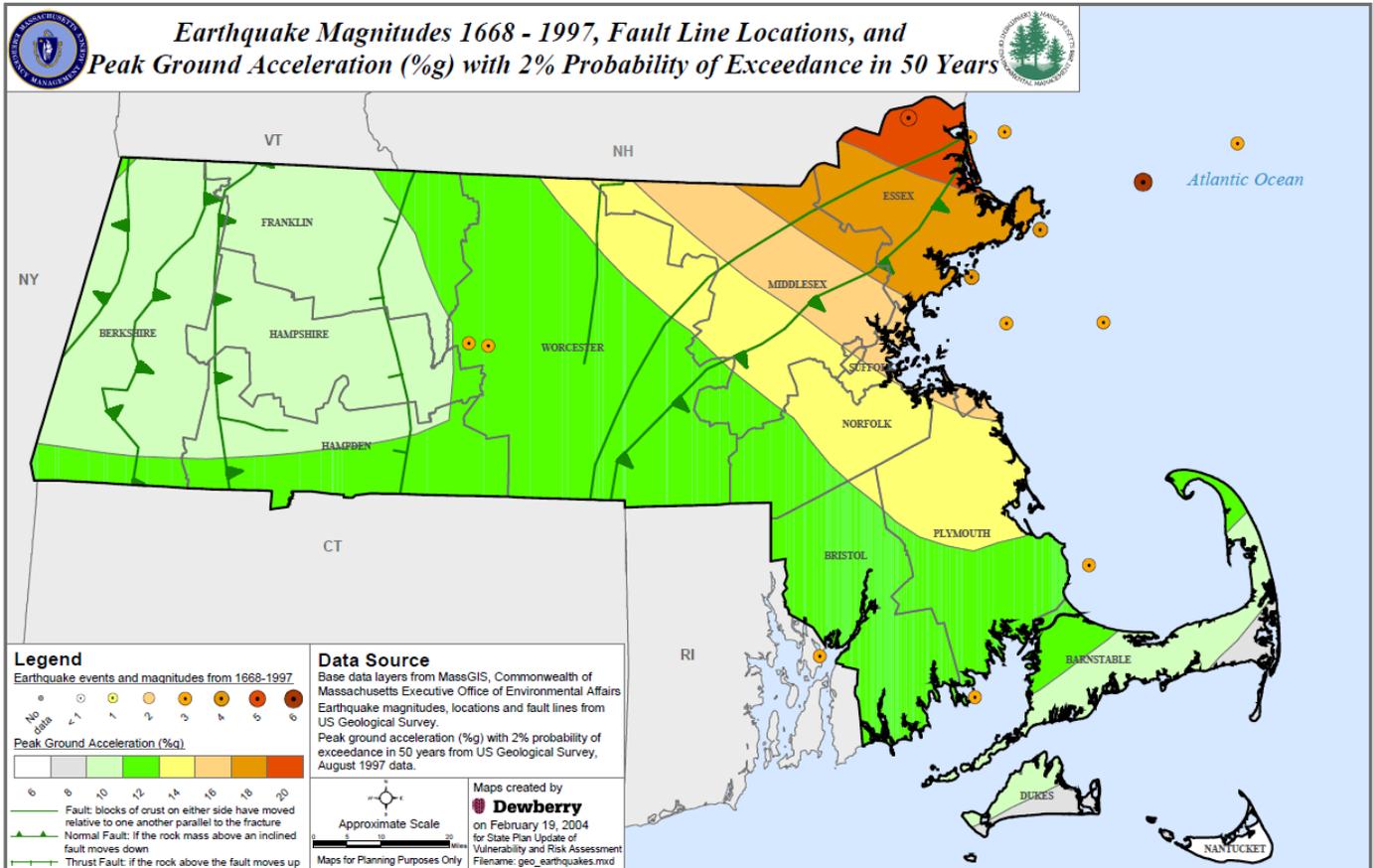
Location	Date	Magnitude
MA - Cape Ann	11/10/1727	5
MA - Cape Ann	12/29/1727	NA
MA - Cape Ann	2/10/1728	NA
MA - Cape Ann	3/30/1729	NA
MA - Cape Ann	12/9/1729	NA
MA - Cape Ann	2/20/1730	NA
MA - Cape Ann	3/9/1730	NA
MA - Boston	6/24/1741	NA
MA - Cape Ann	6/14/1744	4.7
MA - Salem	7/1/1744	NA
MA - Off Cape 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
VA - Mineral	8/23/11	5.8
MA - Nantucket	4/12/12	4.5
ME - Hollis	10/17/12	4.0

Source: City of Boston, Hazard Identification and Risk Assessment

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 (Figure 4). Bolton is in the middle part of the range for Massachusetts, at 12 %g to 14 %g, making it a relatively moderate area of earthquake risk within the state, although the state 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 Bolton.

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.

Figure 3: State of Massachusetts Earthquake Probability Map



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 can also trigger landslides.

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. The Massachusetts State Hazard Mitigation Plan classifies earthquakes as "very low" frequency events that occur less frequently than once in 100 years, or a less than 1% chance per year. Earthquakes are a potential town-wide hazard in Bolton, though the town has a low susceptibility to liquefaction.

Most municipal officials acknowledged that earthquakes are the hazard for which their community was least prepared. There have been no recorded earthquake epicenters within Bolton. Much of the development in town pre-dates the current building code and could be vulnerable in the event of a severe earthquake. The 2010 Bolton Hazard Mitigation Plan highlights the vulnerability of the former Fire and Police Station buildings, which date to 1962 and 1849 respectively. However, the newly constructed Public Safety Building, which now houses the Police, Fire, and Ambulance Departments in a shared facility, meets all recent building codes and is less vulnerable to earthquakes than the former facilities.

Earthquakes are a potential town-wide hazard in Bolton. Based on past occurrences and the Massachusetts Hazard Mitigation Plan, earthquakes are very low frequency events that occur less frequently than once in 100 years (less than a 1% chance each year).

Potential earthquake damages to Bolton have been estimated using HAZUS-MH. Total building damages are estimated at \$110 million for a 5.0 magnitude earthquake and \$647 million for a 7.0 magnitude earthquake. Other potential impacts are detailed in Table 30.

LANDSLIDES

According to the U.S. Geological Survey, 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 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; earthquake created stresses that make weak slopes fail; excess weight from accumulation of rain or snow; and stockpiling of rock or ore from waste piles or 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. A lack of vegetation and root structure that normally stabilize soil can destabilize hilly terrain.

There is no universally accepted measure of landslide extent, but it has been represented as a measure of the destructiveness. The table below summarizes the estimated intensity for a range of landslides. Fast moving rock falls have the highest intensity while slow moving landslides have the lowest intensity.

Table 21: Landslide Volume and Velocity

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

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

The western half of Bolton is classified as having a medium risk for landslides, while the eastern half of town is classified as low risk (see Map 4, Appendix B). There are several steep slopes in the town that have the potential to cause erosion during construction, as a result of development, or as a result of clearing vegetation.

Should a landslide occur in the future, the type and degree of impacts would be highly localized. The town’s vulnerabilities could include damage to structures, damage to transportation and other

infrastructure, and localized road closures. Injuries and casualties, while possible, would be unlikely given the low extent and impact of landslides in Bolton.

Based on past occurrences and the Massachusetts Hazard Mitigation Plan, landslides are low frequency events that can occur once in 50 to 100 years (a 1% to 2% chance of occurring each year).

FIRE-RELATED HAZARDS

A wildland or brush fire is an uncontrolled fire occurring in a forested 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, brush fires typically burn no more than the underbrush of a forested area. There are three different classes of wildfires:

- 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

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.

These fires can present a hazard where there is the potential for them 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.

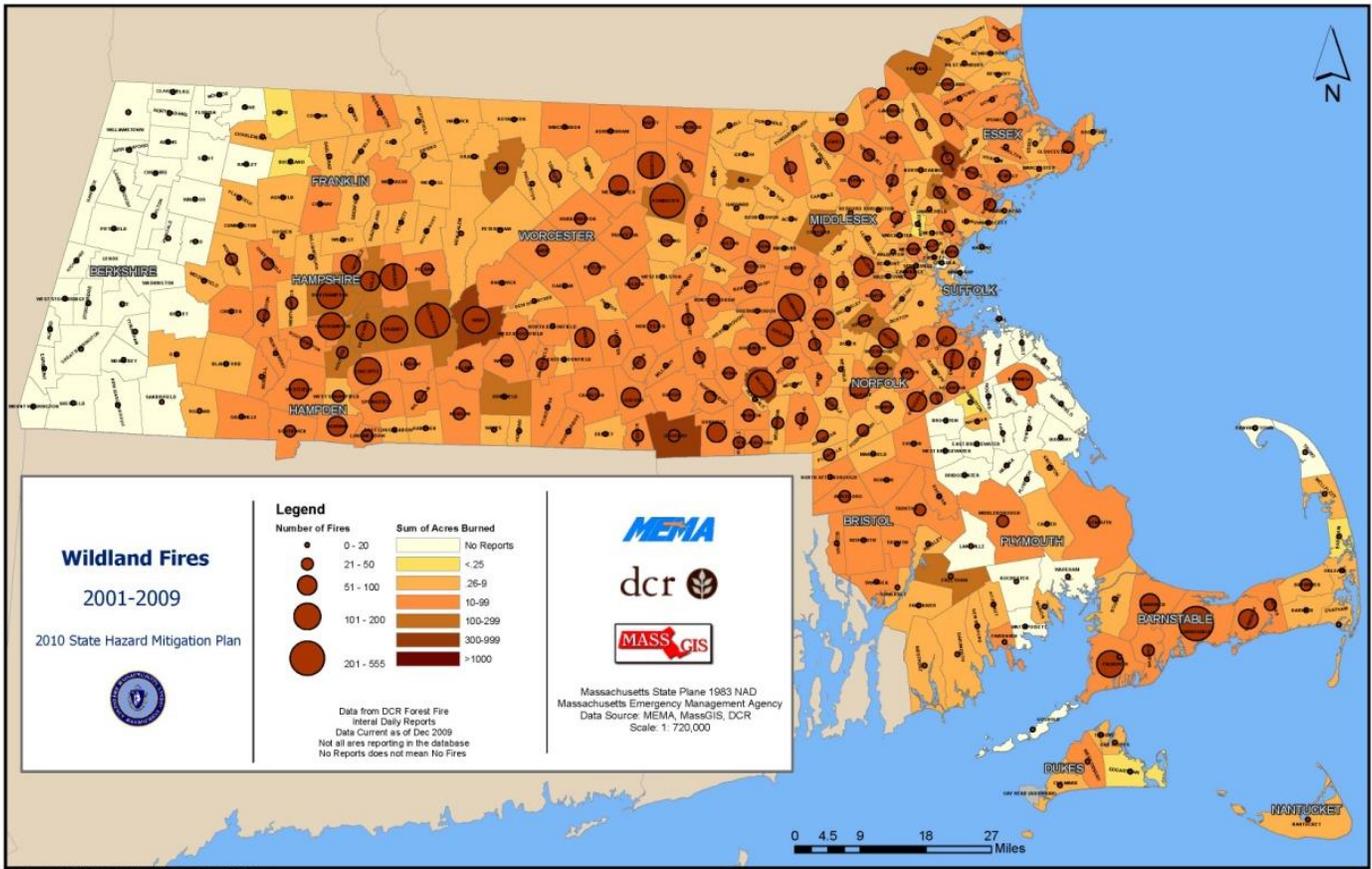
If heavy rains follow a fire, other natural disasters can occur, including landslides, mudflows, and floods. If the wild fire destroys the ground cover, then erosion becomes one of several potential problems.

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 4 below, indicates that the wildfire extent in Bolton consists of 10 to 99 acres burned, with 21 to 50 recordable fires from 2001 to 2009.

According to local officials, natural fires in Bolton are not a significant issue. The town sees approximately 8 brush fires annually, but these fires do not usually cause property damage or injuries. The common causes of these fires are due to permit fires getting out of control, or carelessness by juveniles. It is important, however, to remember that fire can also be a result of other events such as from the aftermath of an earthquake. The brush fires are typically not concentrated in certain locations, but are distributed throughout the town. However, the area surrounding the 495 corridor was highlighted as generally more vulnerable to wildland fires.

The town has no public water supply system, therefore fire fighting is dependent on fire ponds and cisterns located throughout the town. The town requires new cisterns or access to fire ponds for new developments at the discretion of the fire chief.

Figure 4: Massachusetts Wildfires, 2001 to 2009



Source: 2013 Massachusetts State Hazard Mitigation Plan

Wildfires have not caused significant damage in Bolton. Potential damages from wildfires in the town would depend on the extent and type of land affected. There could be the need for post-fire revegetation to restore a burned property, which could cost from a few thousand dollars to tens of thousands for an extensive area. However, there are no data on actual wildfire damages in the town.

Based on past occurrences and the Massachusetts Hazard Mitigation Plan, brush fires are medium frequency events that can occur once in 5 years to 50 years (a 2% to 20% chance of occurring each year).

EXTREME TEMPERATURES

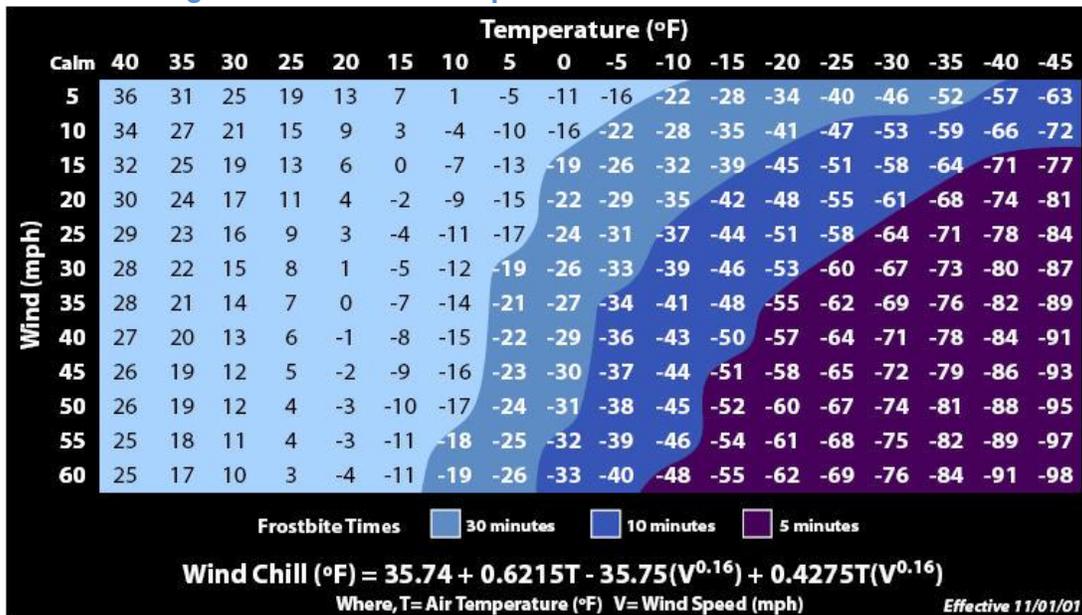
Extreme temperatures occur when either high temperature or low temperatures relative to average local temperatures occur. These can occur for brief periods of time and be acute, or they can occur over long periods of time where there is a long stretch of excessively hot or cold weather.

Bolton 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 that are far outside of the normal seasonal ranges for Massachusetts. The average temperature for winter (December to February) in Massachusetts is 31.8°F. The average temperature for summer (June to August) is 71°F. Extreme temperatures are a town-wide hazard.

EXTREME COLD

For extreme cold, temperature is typically measured using the Wind Chill Temperature Index, which is provided by the National Weather Service (NWS). The latest version of the index was implemented in 2001 and is meant to show how cold conditions feel on unexposed skin and can lead to frostbite. The index is provided in Figure 5. Temperatures that drop decidedly below normal and wind speeds that increase can cause harmful wind-chill factors. The wind chill is the apparent temperature felt on exposed skin due to the combination of air temperature and wind speed.

Figure 5: Wind Chill Temperature Index and Frostbite Risk



Source: National Weather Service

Extreme cold is a dangerous situation that can result in health emergencies for susceptible people, such as those without shelter, those who are stranded, or those who live in homes that are poorly insulated or without heat. The elderly and people with disabilities are often most vulnerable. In Bolton, 9.4 percent of the population are over 65 and 5.2 percent of the population has a disability.

The Town of Bolton does not collect data for previous occurrences of extreme cold. The best available local data are for Worcester County, through the National Centers for Environmental Information (NCEI). There are three extreme cold events on record in February 2015 and 2016 for the county, which caused no deaths, no injuries, or property damage.

Table 22: Worcester County Extreme Cold and Wind Chill Occurrences

Date	Deaths	Injuries	Damage (\$)
2/15/2015	0	0	0
2/20/2015	0	0	0
2/13/2016	0	0	0

Source: NOAA, National Centers for Environmental Information

EXTREME HEAT

A heat wave in 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 NWS. These advisories are issued when the heat index (Figure 6) is forecasted to exceed 100°F for two or more hours; an excessive heat advisory is issued if the forecast predicts the temperature to rise above 105°F.

Figure 6: Heat Index Chart

		Temperature (°F)															
		80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
Relative Humidity (%)	40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
	45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
	50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
	55	81	84	86	89	93	97	101	106	112	117	124	130	137			
	60	82	84	88	91	95	100	105	110	116	123	129	137				
	65	82	85	89	93	98	103	108	114	121	128	136					
	70	83	86	90	95	100	105	112	119	126	134						
	75	84	88	92	97	103	109	116	124	132							
	80	84	89	94	100	106	113	121	129								
	85	85	90	96	102	110	117	126	135								
	90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127											
100	87	95	103	112	121	132											
Category		Heat Index		Health Hazards													
Extreme Danger		130 °F – Higher		Heat Stroke or Sunstroke is likely with continued exposure.													
Danger		105 °F – 129 °F		Sunstroke, muscle cramps, and/or heat exhaustion possible with prolonged exposure and/or physical activity.													
Extreme Caution		90 °F – 105 °F		Sunstroke, muscle cramps, and/or heat exhaustions possible with prolonged exposure and/or physical activity.													
Caution		80 °F – 90 °F		Fatigue possible with prolonged exposure and/or physical activity.													

Extreme heat poses a potentially greater risk to the elderly, children, and people with certain medical conditions, such as heart disease. However, even young and healthy individuals can succumb to heat if they participate in strenuous physical activities during hot weather. . In Bolton children under 5 years old make up 4.8 percent of the population, and 9.4 percent are over 65 years old.

Hot summer days can also worsen air pollution. With increased extreme heat, urban areas of the northeast are likely to experience more days that fail to meet air quality standards.

The Town of Bolton does not collect data on excessive heat occurrences. The best available local data are for Worcester County, through the National Centers for Environmental Information. From 1996 to 2016, there have been a total of three excessive heat days, resulting in no deaths, injuries, or property damage (see Table 23).

Table 23: Worcester County Extreme Heat Occurrences

Date	Deaths	Injuries	Damage (\$)
4/24/2001	0	0	0
5/2/2001	0	0	0
5/3/2001	0	0	0
Total	0	0	0

Source: NOAA, National Centers for Environmental Information

Extreme temperatures are medium frequency events based on past occurrences, and as defined by the 2013 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% to 20% chance of occurring each year.

DROUGHT

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 1960s, a cool drought occurred because dry air from the north caused lower temperatures in the springs and summers of 1962 through 1965. 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 record drought in Massachusetts modern history.

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

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 six regions: Western, Central, Connecticut River Valley, Northeast, Southeast, and Cape and Islands. Bolton is located in the Northeast region. Drought is a potential town-wide hazard in Bolton.

Five levels of drought have been developed to characterize drought severity: Normal, Advisory, Watch, Warning, and Emergency. These drought levels are based on the conditions of natural resources and are intended to provide information on the current status of water resources. The levels provide a basic framework from which to take actions to assess, communicate, and respond to drought conditions.

The drought levels begin with a normal situation where data are routinely collected and distributed, move to heightened vigilance with increased data collection during an advisory, and to increased assessment and proactive education during a watch. Water restrictions might be appropriate at the watch or warning stage, depending on the capacity of each individual water supply system. A warning 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 become necessary. Drought levels are used to coordinate both state agency and local response to drought situations.

As dry conditions can have a range of different impacts, a number of drought indices are available to assess these various 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 the six regions in Massachusetts. County by county or watershed-specific determinations may also be made.

A determination of drought level is based on seven indices:

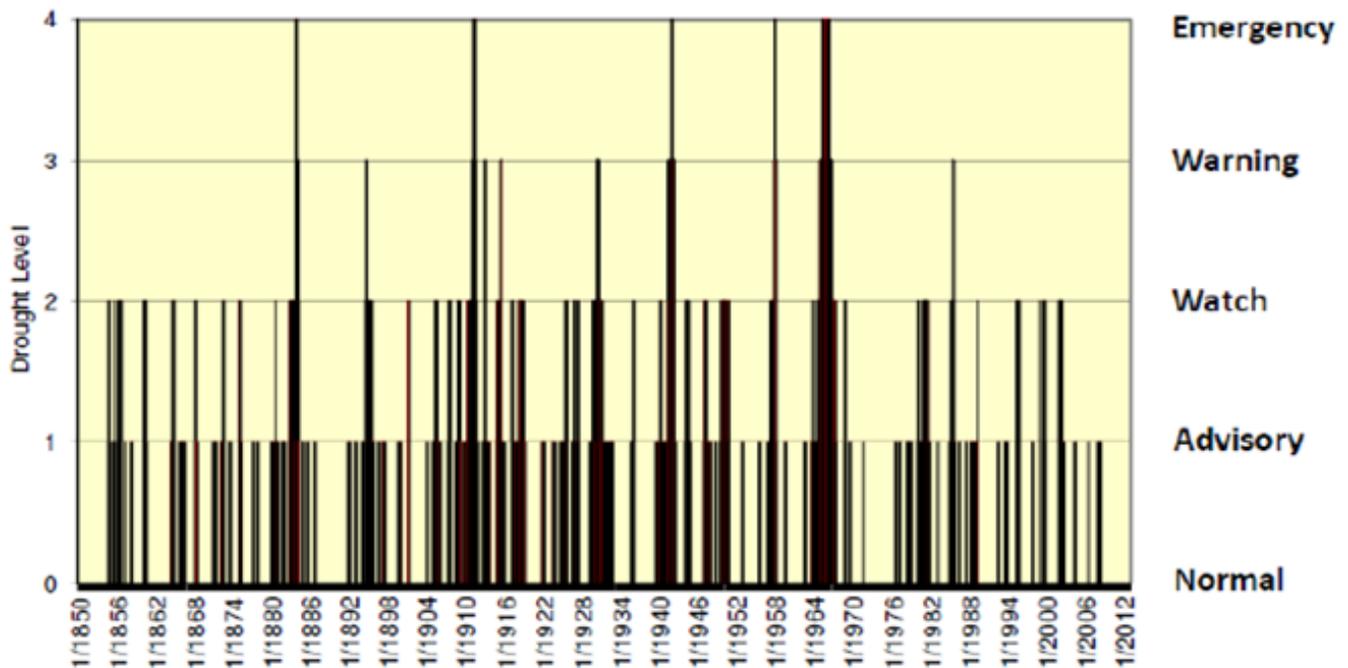
1. Standardized Precipitation Index (SPI) reflects soil moisture and precipitation.
2. Crop Moisture Index (CMI) reflects soil moisture conditions for agriculture.
3. Keetch Byram Drought Index (KBDI) is designed for fire-potential assessment.
4. Precipitation Index is a comparison of measured precipitation amounts to historic normal precipitation.
5. The Groundwater Level Index is based on the number of consecutive month's groundwater levels 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).
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.

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

Because drought tends to be a regional natural hazard, this plan references state data as the best available data for drought. The statewide scale is a composite of the six regions in the state. Regional composite precipitation values are based on monthly values from six stations, and three stations in the smaller regions (Cape and Islands and West regions).

Figure 7 depicts the incidents of drought levels' occurrence in Massachusetts from 1850 to 2012 using the Standardized Precipitation Index (SPI) parameter alone. On a monthly basis, the state would have been in a Drought Watch to Emergency condition 11% of the time between 1850 and 2012. Table 24 summarizes the chronology of major droughts since the 1920s.

Figure 7: Statewide Drought Levels using SPI Thresholds, 1850 to 2012



Source: Massachusetts State Drought Management Plan 2013

Table 24: Chronology of Major Droughts in Massachusetts

Date	Area Affected	Recurrence Interval (years)	Remarks
1929 to 1932	Statewide	10 to >50	Water-supply sources altered in 13 communities. Multistate.
		15 to >50	More severe in eastern and extreme western Massachusetts. Multistate.
1957 to 1959	Statewide	5 to 25	Record low water levels in observation wells, northeastern Massachusetts.
1961 to 1969	Statewide	35 to >50	Water-supply shortages common. Record drought. Multistate.
1980 to 1983	Statewide	10 to 30	Most severe in Ipswich and Taunton River basins; minimal effect in Nashua River basin. Multistate.
1958 to 1988	Housatonic River Basin	25	Duration and severity unknown. Streamflow showed mixed trends elsewhere.
2016	Statewide	N/A	Drought declaration began in June 2016 and covers 98 percent of the state, with more severe drought in the Central, Northeast, and Southeast regions.

Drought Emergencies

Drought emergencies have been reached infrequently, with five events occurring in the period between 1850 and 2012: 1883, 1911, 1941, 1957, and 1965 to 1966. The drought period between 1965 and 1966 is viewed as the most severe drought to have occurred in modern times in Massachusetts because of its long duration. On a monthly basis over the 162-year period of record, there is a 1% chance of being in a drought emergency.

Drought Warning

Drought Warning levels not associated with Drought Emergencies have occurred five times, in 1894, 1915, 1930, 1985, and 2016. On a monthly basis over the 162-year period of record, there is a two percent chance of being in a drought Warning level. As of July 2016, a Drought Warning had been declared for the Northeast region, which includes the Town of Bolton. November 2016 marked the eighth consecutive month of below average rainfall, and Drought Warnings were extended to the entire state except the Cape and Islands (see Figure 8). Conditions returned to normal by April 2017.

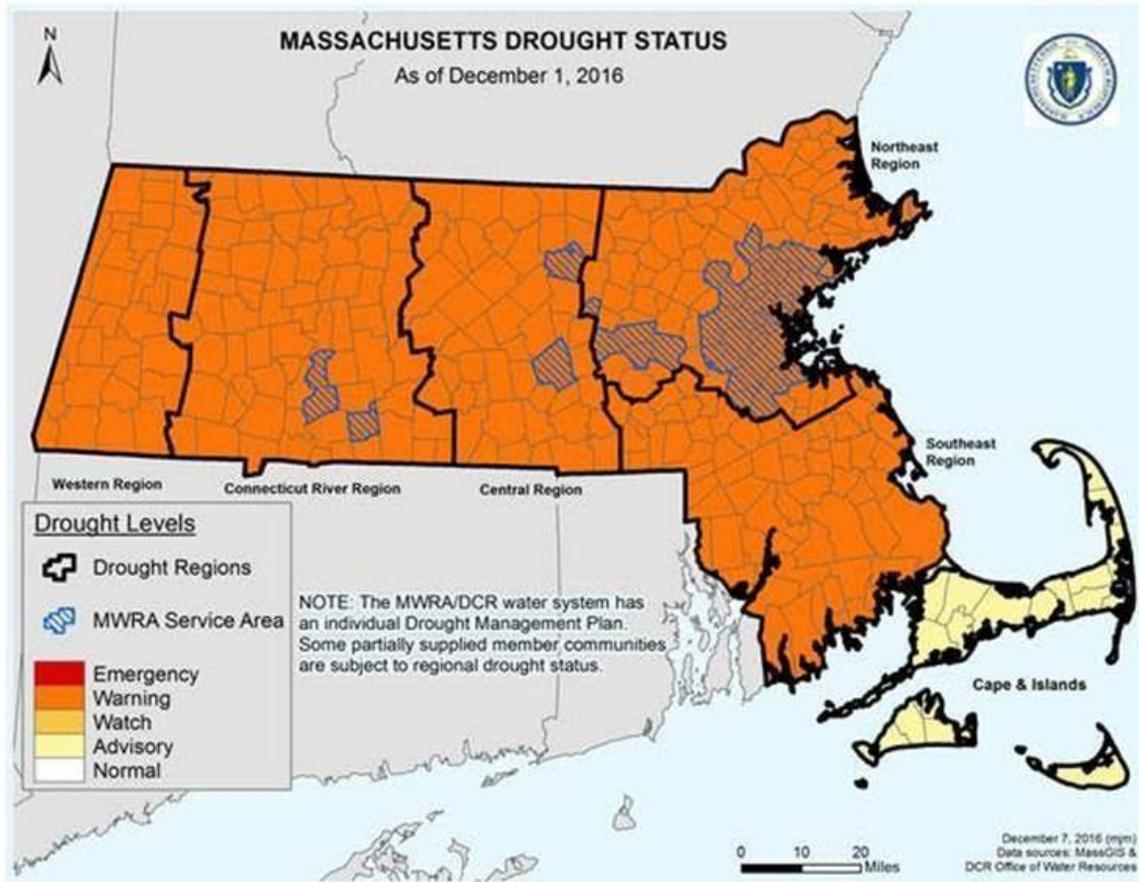
In response to the 2016 Drought Warning, the Bolton Board of Selectmen voted to form a volunteer Water Resource Subcommittee, tasked with establishing an effective municipal water conservation program. In order to inform their work, the Subcommittee created and distributed a survey of Bolton residents to determine their general level of water conservation awareness and their attitudes towards Town led conservation efforts. In April 2018 the Subcommittee released their final report based which included four recommendations for Town government and locally based voluntary associations to consider. The Subcommittee dissolved following the release of their report.

Drought Watches

Drought Watches not associated with higher levels of drought generally have occurred in three to four years per decade between 1850 and 1950. In the 1980s, there was a lengthy drought watch level of precipitation between 1980 and 1981, followed by a Drought Warning in 1985. A frequency of drought watches at a rate of three years per decade resumed in the 1990s (1995, 1998, 1999). In the 2000s,

Drought Watches occurred in 2001 and 2002 and 2016. The overall frequency of being in a drought Watch is 8 percent on a monthly basis over the 162-year period of record.

Figure 8: Massachusetts Drought Status, December 2016



Source: MA Department of Conservation and Recreation, Office of Water Resources

Under a severe long term drought the Town of Bolton could be vulnerable to restrictions on water supply. Potential damages of a severe drought could include losses of landscaped areas if outdoor watering is restricted long term, and potential loss of business revenues if water supplies were severely restricted for a prolonged period. Agricultural businesses, such as Bolton’s apple orchards, are particularly vulnerable to economic losses resulting from droughts. As this hazard has never occurred to this degree in Bolton, there are no data or estimates of potential damages, but under a severe drought scenario it would be reasonable to expect a range of potential damages from several hundreds of thousands to several million dollars.

The state has experienced droughts emergencies five times between 1850 and 2012. Drought emergencies are a low frequency natural hazard event that can occur from once in 50 years to once in 100 years (1% to 2% chance per year) as defined by the Massachusetts State Hazard Mitigation Plan, 2013.

LAND USE AND DEVELOPMENT TRENDS

EXISTING LAND USE

The most recent land use statistics available from the state are from aerial photography done in 2005. Table 25 shows the acreage and percentage of land in 33 categories. When the five residential categories are aggregated, residential uses make up 1376.46 acres, or 10.72% of the area of the town. Commercial and industrial combined make up only 0.61% of the town, or 78.56 acres. Recreation, urban public, and golf courses comprise a total of .03%, or 351.38 acres.

Table 25: Town of Bolton, MA 2005 Land Use

Land Use Type	Acres	Percent
Crop Land (1)	411.38	3.20%
Pasture (2)	364.69	2.84%
Forest (3)	7847.43	61.11%
Wetland (4)	411.65	3.21%
Mining (5)	0.45	0.00%
Open Land (6)	144.19	1.12%
Participation Recreation (7)	45.12	0.35%
Spectator Recreation (8)	0.00	0.00%
Water-Based Recreation (9)	1.83	0.01%
Multi-Family Residential (10)	14.43	0.11%
High Density Residential (11)	8.79	0.07%
Medium Density Residential (12)	12.85	0.10%
Low Density Residential (13)	747.43	5.82%
Salt Water Wetland (14)	0.00	0.00%
Commercial (15)	50.47	0.39%
Industrial (16)	28.09	0.22%
Urban Open (17)	44.47	0.35%
Transportation (18)	176.81	1.38%
Waste Disposal (19)	41.21	0.32%
Water (20)	97.69	0.76%
Cranberry Bog (23)	0.00	0.00%
Powerline (24)	0.00	0.00%
Saltwater Sandy Beach (25)	0.00	0.00%
Golf Course (26)	231.57	1.80%
Marina (29)	0.00	0.00%
Urban Public (31)	72.87	0.57%
Cemetery (34)	20.31	0.16%
Orchard (35)	390.87	3.04%
Nursery (36)	0.00	0.00%
Forested Wetland (37)	1045.17	8.14%
Very Low Density Res. (38)	592.97	4.62%

Land Use Type	Acres	Percent
Junkyards (39)	5.24	0.04%
Brushland/Successional (40)	33.69	0.26%
TOTAL ACRES	12841.67	100.00%
Sq. Miles	20.07	
Source: MassGIS		

For more information on how the land use statistics were developed and the definitions of the categories, please go to <https://docs.digital.mass.gov/dataset/massgis-data-land-use-2005>.

NATURAL, CULTURAL, AND HISTORIC RESOURCE AREAS

Within Bolton’s boundaries, forest land accounts for the majority of land coverage with almost 8,000 acres in total. The forests, wetlands, and other open spaces within Bolton provide habitat for a diverse range of animal and plant communities. As of early 2018, the Massachusetts Natural Heritage and Endangered Species Program (MNHESP) indicates that 17 endangered, threatened, or special concern species have been observed in Bolton, seven more than were documented in the 2005 Open Space and Recreation Plan. Especially critical habitats in town include 41 certified vernal pools, and areas such as Bolton Flats Wildlife Management Area and the extensive undeveloped land along Great Brook. The Town of Bolton’s Conservation Commission owns and manages roughly 1,150 acres of permanently protected open space. In addition to its ecological value, Bolton’s natural resources also provide aesthetic pleasures. In order to protect this quality, the Town adopted a Scenic Roads bylaw (§ 250-24), which requires Planning Board permission to cut or remove trees along roads designated as scenic.

Bolton also includes historic and cultural resources, such as the Bolton Center Historic District and the Pan Burying Ground, both of which are included on the National Register of Historic Places (NRHP). Town residents place a high value on the town’s character, drawn from its agricultural history and rural setting. Historical features under protection or town ownership include: the Wilder Farm pond, Lime Kiln, burying grounds, the Powder House, Rattlesnake Hill, one of the Vaughn Hills, and parts of Welch and Little Ponds.

DEVELOPMENT TRENDS

Residents of Bolton highly value the town’s rural character, and the Town views the preservation of working agricultural sites and natural open space as a goal in directing long term development. Several creative zoning mechanisms have been adopted to mutually advance development and preservation, including a Farmland and Open Space Planned Residential Development (FOSPRD) bylaw (§ 250-14). The FOSPRD allows for reduced frontage and setbacks, on the condition that open land on the development site is preserved under a conservation restriction held by the Town or other permanent means. Since the adoption of the 2005 Open Space and Recreation Plan, the FOSPRD bylaw enabled the acquisition of 100 acres in the Century Mill development, 43.6 acres of the Houghton Farm development on Sugar Road, among others.

A review of recent development projects identified by MAPC and the Local Hazard Mitigation Committee indicate that since the adoption of the 2010 Hazard Mitigation Plan, seven significant projects have begun or been completed, producing 237 units of housing (Table 26). These recent developments are not located within the FEMA flood zones in the town.

Table 26: Summary of Bolton Developments, 2010-2017

Name	Status	Year	Housing Units	Commercial Square Feet	Project Type
Bolton Orchard Solar Farm I & II	Completed	2013, 2016	N/A	N/A	Solar Energy Facility
Century Mill Estates	Under Construction	2017	78	0	Residential
Regency	Completed	2011	60	0	Residential
Sunset Ridge	Completed	2011	28	0	Residential
Northwoods	Completed	2010	36	0	Residential
Craftman Village at Brigham Farm	Under Construction	2017	30	0	Residential
147 Long Hill Road	Under Construction	2017	5	0	Residential

POTENTIAL FUTURE DEVELOPMENT

MAPC consulted with the Local Hazard Mitigation Planning Team to determine areas most likely to be developed in the future, based on the Town’s comprehensive planning efforts and current trends and projects. Current, proposed, and potential future development projects include:

- Main Street and Hudson Road: Located in Mixed Use Village Overlay District, which allows for higher density commercial and residential development.
- Camp Virginia: 50-acre property, zoned residential and on market
- Keyes Farm: 18 residential lots
- 649 Main Street: 5 residential lots
- Tadmor: 11 residential lots, 1 commercial lot
- Houghton Farms: 15 residential lots
- 470 Main Street: 2500 Square Feet, commercial

FUTURE DEVELOPMENT IN HAZARD AREAS

In order to characterize any change in the town’s vulnerability associated with new developments, a GIS mapping analysis was conducted which overlaid the future development sites with the FEMA Flood Insurance Rate Map and other hazard maps. This information is provided so that planners can ensure that development proposals comply with floodplain zoning and that careful attention is paid to drainage issues. Table 27 shows the relationship between potential future development areas and the FEMA flood zones and landslides categories.

Three sites technically overlapped with FEMA identified flood zones, although the overlapping areas are very slight percentages (2 to 7 percent) of the total development site, typically outside of the developed area. All of the development sites are within an area of low incidence for landslides.

With respect to other natural hazards, there is no geographic variability across the town. All of the potential development sites are located in the zone of 48 to 72 inches of average annual snowfall. The entire town is also within one zone for wind, which is a 100-year wind maximum speed of 110 miles per hour (Appendix B). Overall, Bolton’s potential future development would not significantly increasing the town’s vulnerability

Table 27: Future Development Sites in Hazard Areas

Map ID	Potential Future Project	Flood Zones	Landslides
I	Camp Virginia	7.43% in X: 0.2% Annual Chance of Flooding	Low incidence
J	Keyes Farm		Low incidence
K	649 Main Street		Low incidence
L	Tadmor	2.76% in X: 0.2% Annual Chance of Flooding	Moderate susceptibility and low incidence
M	Houghton Farms	4.24% in A: 1% Annual Chance of Flooding, no BFE , and 6.36% in X: 0.2% Annual Chance of Flooding	Low incidence
N	470 Main Street		Low incidence

CRITICAL FACILITIES & INFRASTRUCTURE IN HAZARD AREAS

Critical facilities and 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 37 facilities identified in Bolton. These are listed in Table 28 and are shown on the maps in Appendix B.

Explanation of Columns in Table 28

- **Column 1: ID #:** The first column in Table 21 is an ID number which appears on the maps that are part of this plan. See Appendix B.
- **Column 2: Name:** The second column is the name of the site. If no name appears in this column, this information was not provided to MAPC by the community.
- **Column 3: Type:** The third column indicates what type of site it is.
- **Column 4: Landslide Risk:** The fourth column indicates the degree of landslide risk for that site. This information came from NESEC. 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>.
- **Column 5: FEMA Flood Zone:** The fifth column addresses the risk of flooding. A “No” entry in this column means that the site is not within any of the mapped risk zones on the Flood Insurance Rate Maps (FIRM maps). If there is an entry in this column, it indicates the type of flood zone.
- **Column 6: Locally-Identified Area of Flooding:** The sixth column indicates the risk of flooding in local hazard areas. A “No” entry in this column means that the site is not within any of the mapped flood hazard zones. If there is an entry in this column, it indicates the local hazard area.
- **Column 7: Brush Fire Area:** The seventh column indicates the risk of brush fire in local hazard areas. A “No” entry in this column means that the site is not within any of the mapped brush fire hazard zones. If there is an entry in this column, it indicates the local hazard area.
- **Column 8: Average Annual Snowfall:** Areas designated "low" receive an annual average of 36.1 to 48.0 inches of snow. Areas designated "high" receive an annual average of 48.1 to 72 inches of snow, as shown on Map 6 in Appendix B.

Table 28: Critical Facilities and Relationship to Hazard Areas

ID #	Name	Type	Landslide Risk	FEMA Flood Zone	Locally-Identified Area of Flooding	Brush Fire Area	Average Annual Snow Fall
1	Nashoba Regional High School	School	Moderate susceptibility and low incidence	No	No	No	H 48.1 - 72.0
2	Department of Public Works	Municipal	Moderate susceptibility and low incidence	No	No	No	H 48.1 - 72.0
3	Bridge	Bridge	Moderate susceptibility and low incidence	AE: Regulatory Floodway	No	No	H 48.1 - 72.0
4	Verizon Telephone Switch	Telecommunications	Moderate susceptibility and low incidence	No	No	No	H 48.1 - 72.0
5	Public Safety Building	Fire Station + Police Station + Emergency Medical Services	Low incidence	No	No	No	H 48.1 - 72.0
7	Trinity	Church	Low incidence	No	No	No	H 48.1 - 72.0
8	St. Francis	Church	Low incidence	No	No	No	H 48.1 - 72.0
9	Bolton Public Library	Municipal + Place of Assembly	Moderate susceptibility and low incidence	No	No	No	H 48.1 - 72.0
10	Bolton Access Television Corporation (BATCO)	Telecommunications	Low incidence	No	No	No	H 48.1 - 72.0
11	First Parish	Church	Low incidence	No	No	No	H 48.1 - 72.0
12	Town Hall	Municipal	Low incidence	No	No	No	H 48.1 - 72.0
13	Florence Sawyer School	School	Low incidence	No	No	No	H 48.1 - 72.0
14	Emerson School	School	Low incidence	No	No	No	H 48.1 - 72.0
15	School Superintendents Office	School	Low incidence	No	No	No	H 48.1 - 72.0
16	Bolton Country Manor	Elder Housing	Low incidence	No	No	No	H 48.1 - 72.0
17	Bolton Office Park	Industrial + Telecommunications + MedEvac Landing Zone	Low incidence	No	No	No	H 48.1 - 72.0
18	495 Bridges	Bridge	Low incidence	No	No	No	H 48.1 - 72.0
20	Paragon	Industrial + Communications Tower + MedEvac Landing Zone	Low incidence	No	No	495 Corridor	H 48.1 - 72.0
21	Cobham	Industrial	Low incidence	No	No	No	H 48.1 - 72.0
22	495 Bridge	Bridge	Low incidence	No	No	No	H 48.1 - 72.0
23	495 Bridge	Bridge	Low incidence	No	No	No	H 48.1 - 72.0
24	Children's Horizons	Child Care	Low incidence	No	No	495 Corridor	H 48.1 - 72.0
25	Verizon Communications Tower	Communication Tower	Low incidence	No	No	495 Corridor	H 48.1 - 72.0
26	Bolton Public Safety Communications	Communication Tower	Low incidence	No	No	No	H 48.1 - 72.0
27	Camp Resolute Boy Scout Camp	Camp	Low incidence	No	No	495 Corridor	H 48.1 - 72.0
28	Cell Phone Tower	Communication Tower	Moderate susceptibility and	No	No	No	H 48.1 - 72.0

ID #	Name	Type	Landslide Risk	FEMA Flood Zone	Locally-Identified Area of Flooding	Brush Fire Area	Average Annual Snow Fall
			low incidence				
29	Delaney Complex Dam	Dam	Low incidence	No	No	No	H 48.1 - 72.0
30	Wilder Road Dam	Dam	Low incidence	No	No	No	H 48.1 - 72.0
31	Forbush Mill Road Dam	Dam	Low incidence	No	No	No	H 48.1 - 72.0
32	Century Mill Dam	Dam	Moderate susceptibility and low incidence	X: 0.2% Annual Chance of Flooding	No	No	H 48.1 - 72.0
33	International Golf Course	Place of Assembly	Moderate susceptibility and low incidence	X: 0.2% Annual Chance of Flooding	No	No	H 48.1 - 72.0
34	Transfer Station and Salt Barn	Municipal + Communication Tower	Low incidence	AE: 1% Annual Chance of Flooding; with BFE	No	No	H 48.1 - 72.0
35	Bolton Orchards Solar Farm	Solar Energy Facility	Moderate susceptibility and low incidence	No	No	No	H 48.1 - 72.0
36	Memorial Field	MedEvac Landing Zone	Moderate susceptibility and low incidence	A: 1% Annual Chance of Flooding; no BFE	No	No	H 48.1 - 72.0
37	Bolton Corners	MedEvac Landing Zone	Moderate susceptibility and low incidence	No	No	No	H 48.1 - 72.0
38	Schultz Farm	MedEvac Landing Zone	Moderate susceptibility and low incidence	No	No	No	H 48.1 - 72.0
39	Fyfeshire Conservation Area Dam	Dam	Moderate susceptibility and low incidence	A: 1% Annual Chance of Flooding; no BFE	No	No	H 48.1 - 72.0

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 through the HAZUS-MH software.

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 Bolton, 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.

ESTIMATED DAMAGES FROM HURRICANES

The HAZUS software was used to model potential damages to the community from a 100-year and 500-year hurricane event; storms that are 1% and 0.2% 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 29: Estimated Damages from Hurricanes

	100-year Storm	500-year Storm
Building Characteristics		
Estimated total number of buildings	1,867	
Estimated total building replacement value (2014 \$)	\$817,000,000	
Building Damages		
# of buildings sustaining minor damage	25	199
# of buildings sustaining moderate damage	1	19
# of buildings sustaining severe damage	0	1
# of buildings destroyed	0	0
Population Needs		
# of households displaced	0	0
# of people seeking public shelter	0	0
Debris		
Building debris generated (tons)	71	478
Tree debris generated (tons)	4,427	12,164
# of truckloads to clear building debris	3	19
Value of Damages		
Total property damage (buildings and content)	\$3,464,220	\$11,818,820
Total losses due to business interruption	\$7,550	\$ 478,120

ESTIMATED DAMAGES FROM EARTHQUAKES

The HAZUS 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 a magnitude 7.0. Historically, major earthquakes are rare in New England, though a magnitude 5 event occurred in 1963.

Table 30: Estimated Damages from Earthquakes

	Magnitude 5.0	Magnitude 7.0
Building Characteristics		
Estimated total number of buildings	1,867	
Estimated total building replacement value (2014 \$)	\$817,000,000	
Building Damages		
# of buildings sustaining slight damage	555	203
# of buildings sustaining moderate damage	294	632
# of buildings sustaining extensive damage	77	496
# of buildings completely damaged	20	505
Population Needs		
# of households displaced	18	373
# of people seeking public shelter	10	214
Debris		
Building debris generated (tons)	20,000	\$120,000
# of truckloads to clear debris (@ 25 tons/truck)	680	4,680
Value of Damages		
Total property damage	\$93,260,000	\$564,780,000
Total losses due to business interruption	\$16,630,000	\$82,090,000

ESTIMATED DAMAGES FROM FLOODING

The HAZUS flooding module allows users model the potential damages caused by a 100-year flood event and a 500-year flood event.

Table 31: Estimated Damages from Flooding

	100-Year Flood	500-Year Flood
Building Characteristics		
Estimated total number of buildings	1,867	
Estimated total building replacement value (2014 \$)	\$817,000,000	
Building Damages		
# of buildings sustaining moderate damage	2	5
# of buildings sustaining extensive damage	0	0
# of buildings substantially damaged	0	0
Population Needs		
# of households displaced	35	43
# of people seeking public shelter	28	44
Value of Damages		
Total property damage	\$3,490,000	\$4,840,000
Total losses due to business interruption	\$10,000	\$10,000

SECTION 5: HAZARD MITIGATION GOALS

The Bolton Local Hazard Mitigation Planning Team reviewed and discussed the goals from the 2010 Hazard Mitigation Plan for the Town of Bolton. 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 and incorporate climate sustainability and resiliency in hazard mitigation planning.

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SECTION 6: EXISTING MITIGATION MEASURES

The existing protections in the Town of Bolton 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 are listed by hazard type here and are summarized in Table 14.

EXISTING TOWN-WIDE MITIGATION FOR FLOOD-RELATED HAZARDS

Bolton employs a number of practices to help minimize potential flooding and impacts from flooding, and to maintain existing drainage infrastructure. Existing town-wide mitigation measures include the following:

1. Bolton participates in the NFIP with eight policies in force as of June 30, 2018. FEMA maintains a database on flood insurance policies and claims. This database can be found on the FEMA website at <https://www.fema.gov/policy-claim-statistics-flood-insurance>.

The following information is provided for the Town of Bolton:

Flood insurance policies in force	10
Coverage amount of flood insurance policies	\$ 3,015,000
Premiums paid	\$5,996
Total losses (all losses submitted regardless of the status)	4
Closed losses (losses that have been paid)	3
Open losses (losses that have not been paid in full)	0
CWOP losses (losses that have been closed without payment)	1
Total payments (total amount paid on losses)	\$ 12,916.13

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.

2. The Town of Bolton contracts with a third party to sweep all streets in town once per year, in the spring.
3. Catch basins on public property are cleaned on an annual basis. Drainage system maintenance occurs on an as-needed basis.
4. The Public Works Department provides upgrades to culverts, drainage pipes, and other drainage infrastructure on an as-needed basis.
5. The Town mitigates beaver activity using a variety of methods, following the beaver management guidelines produced by the Conservation Commission. The Town will generally try and breach problematic dams as a first resort. In addition, some areas in town impacted by beaver activity are retrofitted with piping to drain pondin or “beaver deceivers,” flow devices which inhibit beavers’ ability to dam pipes and culverts. The Town also hires trappers to mitigate beaver activity, as

necessary; however, trappers and trapping services are in high demand regionally. As required by state law, trappers must obtain through the local Board of Health.

6. The Town has a Floodplain Overlay District (§ 250-22, Zoning Bylaws) that restricts and regulates certain activities located within a flood zone.
7. The Town has a Wetlands Bylaw (§ 233, General Bylaws) to protect resource areas in and around wetlands. The jurisdiction and performance standards of the bylaw and regulations are more stringent than the state wetlands policy and are administered by the Conservation Commission, who have jurisdiction under the Wetland's Protection Act.
8. The Massachusetts Stormwater Policy is applied to developments within the jurisdiction of the Conservation Commission.
9. The subdivision regulations state that runoff from subdivision developments may not increase in proposed conditions more than in existing conditions.
10. Chapter 105 of the General Bylaws, "Agricultural Preservation", "encourages the pursuit of agriculture, promotes agriculture-based economic opportunities, and protects farmlands within the Town of Bolton by allowing agricultural uses and related activities to function with minimal conflict with abutters and Town agencies."
11. The Town has adopted a zoning bylaw (§ 250-14, Zoning Bylaws) allowing the creation of Farmland and Open Space Planned Residential Developments by using a special permit to preserve agricultural and open space. Large subdivisions must file both a FOSPRD plan and a conventional subdivision plan for consideration by the Planning Board. The Planning Board then decides which plan is in the best interest of Bolton. The changes seemed to have worked, as several subdivisions have been built under these regulations, with the Town receiving deeded acreage.
12. Develop inventory of all culverts in town, and use as the basis for a prioritized maintenance plan
13. Bolton has a minimum lot size of 80,000 square foot for conventional ANR lots and requires 200 feet of frontage on a town road. There is a provision for backland lots that must have a minimum of 4.5 acres of land and only 50 feet of frontage.
14. The town has numerous conservation land parcels that are purchased by or gifted to the Town. When completed, the Town's 2017 Open Space and Recreation Plan – currently available in Draft form – will provide a comprehensive inventory of open space and identify of key parcels for purchase or protection. The Conservation Commission and Bolton Conservation Trust oversee conservation areas in the town.
15. Low-lying wetland areas provide significant flood storage for some of the town's rivers. Bolton Flats is critical for flood control along the Nashua and Still Rivers. The Skunk Meadows and wetlands south of that area are important for flood storage along Mill Brook.

EXISTING DAM FAILURE MITIGATION MEASURES

16. 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.
17. State law requires a permit for the construction of any dam.

EXISTING TOWN-WIDE MITIGATION FOR WIND-RELATED HAZARDS

18. The Bolton Tree Warden, through the Department of Public Works, provides general tree trimming and maintenance along the town's public ways.
19. The utility companies provide tree trimming and dead tree removal along the town's public ways.

EXISTING TOWN-WIDE MITIGATION FOR WINTER-RELATED HAZARDS

20. The Public Works Department provides standard snow plowing operations, including salting and sanding.
21. The Public Works Department provides public education on snow removal on the town's website.
22. Overnight parking is prohibited per the Selectmen's Regulations, Traffic Rules and Orders (§ 300-17).
23. Section 211-4 of the General Bylaws prohibits discharge of snow or ice onto public ways by any party other than a Town employee acting in the service of the Town of Bolton.

EXISTING TOWN-WIDE MITIGATION FOR FIRE-RELATED HAZARDS

24. A permit is required for each day of outdoor burning during open burning season.
25. The Fire Department/Chief reviews all subdivision and site plans for compliance with site access, water supply needs, and all other applicable regulations.
26. The Fire Department provides fire prevention information on its website.

EXISTING TOWN-WIDE MITIGATION FOR EARTHQUAKE HAZARDS

27. Rivers, ponds, and designated Fire Ponds in town are available to be tapped into for water supply if necessary.
28. Section 250-19.1 of the Zoning Bylaws requires installation of a firefighting water supply for commercial developments. "An accessible tank, reservoir, or water hole containing at least one gallon of water for each square foot of total floor area of buildings of combustible material and one gallon of water for each two square feet of total floor area of buildings of noncombustible material shall be provided and maintained within 1,000 feet of each industrial or commercial building unless said building is located within 1,000 feet of an existing equivalent body of water."
29. The El Paso gas company provides educational information and training on hazard mitigation for its Tennessee Gas Pipeline.

EXISTING TOWN-WIDE MITIGATION FOR LANDSLIDE HAZARDS

30. Town design standards in the subdivision rules and regulations have a maximum slope restriction for new roads (§ 5224).
31. Section 205-5 of the General Bylaws requires a permit for the removal of any soil to or from a site.

EXISTING MULTI-HAZARD MITIGATION MEASURES

32. Multiple departments, such as Planning, Zoning, Health, Public Works, Fire, Police, and Conservation, review all subdivision and site plans prior to approval.
33. 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.
34. The Massachusetts State Building Code contains many detailed regulations regarding wind loads, earthquake resistant design, flood-proofing and snow loads.
35. Local Emergency Management Planning Committee (LEPC)
36. The Board of Selectmen recently voted to adopt Reverse 911 for the town.
37. The Public Safety Communications facility and public shelter facilities have been equipped with backup generators.

COMPILATION OF EXISTING MITIGATION

The following table summarizes the many existing natural hazard mitigation measures already in place in Bolton. Because of the number of entities, public and private, involved in natural hazard mitigation, it is likely that this list is a starting point for a more comprehensive inventory of all measures. Please note that the numbers shown in parentheses correspond to the Hazard Areas of Concern included on the maps in Appendix B.

Table 32: Existing Mitigation Measures

Hazard	Area	Mitigation Measure
Flood-Related	Town-Wide	<ul style="list-style-type: none"> A) Participation in the National Flood Insurance Program B) Annual street sweeping C) Annual catch basin cleaning and as-needed drainage system maintenance D) Ongoing drainage system improvements and upgrades as needed E) Beaver mitigation and beaver management guidelines F) Flood Plain Overlay District G) Wetlands Bylaw H) Massachusetts Stormwater Policy I) Stormwater requirements in Subdivision Regulations J) Stormwater requirements in Site Plan Approval K) Agricultural Preservation Bylaw L) FOSPRD District M) Large minimum lot size and

Hazard	Area	Mitigation Measure
		dimension requirements N) Open space preservation O) Existing wetland areas provide significant flood storage
Dams	Town-Wide	A) DCR Dam Safety Regulations B) Construction permits required
Wind-Related	Town-Wide	A) Tree maintenance and removal as needed by Public Works / Tree Warden B) Tree maintenance and removal as needed by the utility companies
Winter-Related	Town-Wide	A) Standard snow operations, sanding and salting B) Public Education on snow operations on the town website C) Overnight parking ban D) Discharge of snow and ice prohibited on public ways
Fire-Related	Town-Wide	A) Open burning permits required B) Fire Department reviews all development plans C) Fire Department provides public education on its website
Geologic - Earthquake	Town-Wide	A) Rivers and ponds are available to tap into for fire-fighting water supply. B) Cisterns or ponds are required for new developments. C) El Paso Gas Company provides training and information to towns.
Geologic - Landslides	Town-Wide	A) Maximum slopes for subdivision roads B) Earth Removal Bylaw
Multi-Hazard	Town-Wide	A) Multi-department review of developments B) Comprehensive Emergency Management Plan (CEMP) C) Enforcement of State Building Code

Hazard	Area	Mitigation Measure
		D) Local Emergency Management Planning Committee (LEPC) E) Reverse 911 F) Public Safety Communications and public shelter facilities have backup generators

LOCAL CAPACITY FOR IMPLEMENTATION

Under the Massachusetts system of “Home Rule,” the Town of Bolton 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, such as the Planning Board or Conservation Commission.

The Town of Bolton has recognized several existing mitigation measures that require implementation or improvements, and has the capacity within its local boards and departments to address these. The Town of Bolton’s Public Works department will address the assessment and repair of dams and drainage infrastructure. The Bolton Planning Board will implement the stormwater requirements in the town’s Site Plan Review regulations. The Conservation Commission will address mitigation of beaver activity. Tree trimming for wind mitigation will be addressed by the Tree Warden/Public Works Department. The Fire Department will enforce open burning restrictions and review of new development.

SECTION 7: MITIGATION MEASURES FROM PREVIOUS PLAN

IMPLEMENTATION PROGRESS ON THE PREVIOUS PLAN

At a meeting of the Bolton Hazard Mitigation Planning Committee, Town staff reviewed the mitigation measures identified in the 2010 Bolton 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 2018 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 33 summarizes the status of mitigation measures from the 2010 plan that are being continued in the 2018 Update.

As indicated in Table 33, Bolton has made considerable progress on implementing several of the hazard mitigation measures identified in the 2010 Hazard Mitigation 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. Overall, seven mitigation measures from the 2010 plan will be retained in the 2018 plan update. Most retain the same priority in this 2018 update.

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. The Fire and Police Departments will ensure their response and communication equipment are sufficient for the range of possible natural hazards. The Tree Warden will continue working to manage the hazard potential of dead or precariously placed trees. The Recreation Department can explore effective responses to drought conditions, and the Conservation Commission will continue identifying and acquiring land which support natural mitigation processes.

Table 33: Mitigation Measures from the 2010 Plan

Mitigation Measure	Priority in 2010 Plan	Current Status	Retain in 2018 Plan?
HIGH PRIORITY MITIGATION MEASURES			
A) <u>New Fire, Police, and Emergency Operations Facility</u>	High	The Town's new combined public safety facility has been constructed and was opened in late 2010.	No
B) <u>Upgraded Public Shelter Facilities with Generator</u>	High	Completed	No
C) <u>Communications Repeater for Backup</u>	High	The upgrade is in progress as of early 2018.	Yes

Mitigation Measure	Priority in 2010 Plan	Current Status	Retain in 2018 Plan?
D) <u>Equipment for Fire Department to Better Respond to Brush Fires</u>	High	No new fire apparatus for brush fires has been purchased since the 2010 plan	Yes
E) <u>Tree Maintenance Program Funding</u>	High	The Tree Warden does a good job with available resources, but increased funding is required to meet the town's needs.	Yes
MEDIUM PRIORITY MITIGATION MEASURES			
F) <u>Continuation of Open Space Protection and Land Acquisition</u>	Medium	According to a draft of Bolton's 2017 Open Space and Recreation Plan, the Town has acquired slightly more than 50 acres of open space since 2010.	Yes
G) <u>Continuation of Ongoing Upgrades and Maintenance of Drainage Infrastructure</u>	Medium	In order to improve the efficiency of drainage infrastructure upgrades and maintenance, the town has added a new mitigation measure related to inventorying town wide drainage infrastructure.	Yes
H) <u>Stormwater Revisions to Subdivision and Site Plan Requirements</u>	Medium	The Town of Bolton received a waiver from the requirements of the MS4 permit requirements in 2015	No
I) <u>Upgrades to East End Road at Great Brook</u>	Medium	Temporary improvements have been made to the site.	No
J) <u>Century Mill Dam Assessment</u>	Medium	The town has completed preliminary research related to ownership of the Century Mill Dam, but more research is required for an authoritative conclusion.	Yes
K) <u>Public Education Regarding Brush Fires</u>	Medium	The Fire Department has a "Fire Prevention" section on their website with resources and information for town residents. This site is updated to reflect the most recent rules and regulations.	Yes

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 (HGMP), the Pre-Disaster Mitigation program (PDM), and the Flood Mitigation Assistance (FMA) program. The three links below provide additional information on these programs.

<http://www.fema.gov/government/grant/hmgp/index.shtm>

<http://www.fema.gov/government/grant/pdm/index.shtm>

<http://www.fema.gov/government/grant/fma/index.shtm>

Hazard Mitigation 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.

(Source: FEMA Local Multi-Hazard Mitigation Planning Guidance)

IDENTIFICATION OF POTENTIAL MITIGATION MEASURES

During the local hazard team meetings, officials in Bolton determined possible mitigation measures for the various natural hazards that have impacted or could impact the town. In addition, MAPC solicited suggestions for mitigation measures when it collected hazard information from town officials and from other town plans and studies. MAPC compiled all suggested potential mitigation measures in matrix below. The summary table is then followed by series of considerations that were factored into determining mitigation measures. These include: regional and inter-community issues, regional partners and facilities, and new development and infrastructure. Following those considerations, the Hazard Mitigation Strategy chapter of the plan then provides an explanation of the prioritization process of the potential mitigation measures to be included in the updated mitigation plan, as well as a prioritized matrix of the measures.

INTRODUCTION TO POTENTIAL MITIGATION MEASURES TABLE (TABLE 34)

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 34, 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.

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.

Abbreviations Used in Table 34

FEMA Mitigation Grants includes:

FMA = Flood Mitigation Assistance Program

HMGP = Hazard Mitigation Grant Program

PDM = Pre-Disaster Mitigation Program

ACOE = Army Corps of Engineers.

DHS/EOPS = Department of Homeland Security/Emergency Operations

DEP (SRF) = Department of Environmental Protection (State Revolving Fund)

USDA = United States Department of Agriculture

Mass DOT = Massachusetts Department of Transportation

DCR = MA Department of Conservation and Recreation

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Table 34: Potential Mitigation Measures for a Hazard Mitigation Strategy

Mitigation Measure	Priority in Update	Priority in 2010 Plan	Lead Implementation	Time Frame	Estimated Cost Range	Potential Funding Sources
DAM-RELATED						
A. Century Mill Dam Assessment: Conduct a physical assessment and conclusive research about ownership and legal responsibility for any needed repairs	High	Medium	Public Works	2018-2020	Town Staff Time or \$10-25K for consultant	Town General Fund
B. Century Mill Dam Repairs: following assessment, coordinate any needed repairs by dam owner	High		Private	2019-2021	Unknown without assessment	Private owner
FLOOD-RELATED						
C. Conduct inventory of all drainage infrastructure in town and use inventory to develop a priority maintenance plan	High		Public Works	2018-2023	Town Staff Time and materials vary	Town General Fund
D. Assessment of country drainage systems: Identify areas which inundate and pool water frequently	Low		Public Works	2018-2020	Town staff time	Town General Fund
E. Spectacle Hill Road Improvements: Establish formal drainage area and divert overflow to pond on private land.	High		Public Works	2018-2020	Public works has \$54K to do engineering and design. Would require roughly \$200K more to build. Easements also required.	Town General Fund, FEMA
F. Conduct drainage upgrades to area of Golden Run and Quail Run	Medium		Public Works	2018-2020	\$10-20K	Town General Fund, FEMA
G. Construct drainage upgrades to Forbush Mill Road	Medium		Public Works	2018-2020	\$10-20K	Town General Fund, FEMA
FIRE-RELATED						
H. Acquire equipment for the Fire Department to better respond to Brush Fires	High	High	Fire Department	2020-2023	Approx. \$100,000	Town General Fund, Public Safety Grants
I. Provide Public Education Regarding the hazards of Brush Fires and recommended mitigation for residents	Medium	Medium	Fire Department	2018-2020	Town Staff Time or \$5k-15k for materials and consultant	Town General Fund, Public Safety Grants
WINTER-RELATED						
J. Provide additional Tree Maintenance Program funding to mitigate both winter hazards and wind hazards	High	High	Public Works, Tree Warden	2018-2023	\$150,000 for three years	Town General Fund
K. Assess municipal and school building roofs for snow load capacity and vulnerability	Medium		Public Works, School Department	2019-2021	Town staff time or \$10-20K for a consultant	Town General Fund, School Department Fund
WIND-RELATED						
L. Provide additional Tree Maintenance Program funding to mitigate both winter hazards and wind hazards	High	High	Public Works, Tree Warden	2018-2023	\$150,000 for three years	Town General Fund

Mitigation Measure	Priority in Update	Priority in 2010 Plan	Lead Implementation	Time Frame	Estimated Cost Range	Potential Funding Sources
DROUGHT-RELATED						
M. Develop public education strategy to increase awareness about drought conditions and water conservation	High		Public Works, Parks and Recreation	2018-2020	Town Staff Time or \$5k-15k for materials and consultant	Town General Fund
N. Research field management practices which conserve water and determine under what drought conditions to reduce watering of public spaces	Medium		Public Works, Parks and Recreation	2018-2020	Town Staff Time or \$5k-15k for a consultant	Town General Fund
EXTREME TEMPERATURE-RELATED						
O. Provide public education regarding the hazards of extreme temperatures recommended mitigation for residents	Medium		Town Administrator	2018-2020	Town Staff Time or \$5k-15k for materials and consultant	Town General Fund
EARTHQUAKE-RELATED						
P. Conduct a seismic assessment for earthquake vulnerability of municipal buildings	Low		Public Works, Building Inspector	2020-2022	Approximately \$50K for a consultant	Town General Fund
MULTIHAZARD-RELATED						
Q. Acquire a Communications Repeater for Backup of Fire and Police Departments	High	High	Fire Department / Police Department	2018-2020	Approximately \$200,000	Town General Fund, Public Safety Grants
R. Identify and designate sites for Debris Management	Low		Public Works	2020-2022	Staff time	Town General Fund
S. Acquire a fixed base 2-way radio system and repeater for the Department of Public Works	High		Public Works	2019-2021	Approximately \$200,000	Town General Fund
T. Open Space Protection and Land Acquisition	Medium	Medium	Conservation Commission, Board of Selectmen	2018-2023	Town staff time; up to \$1,000,000 to purchase land	Town General Fund, Community Preservation Act Funds, Gifts

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 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.

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 the following guidelines:

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 \$100,000
Medium	Estimated costs between \$10,000 to \$100,000
Low	Estimated costs less than \$10,000 and/or staff time
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
Low	Not clear if action has political and public support and not certain that necessary maintenance can occur following the project

Table 35 presents the prioritization of the Town’s potential hazard mitigation measures.

Table 35: Prioritization of the Hazard Mitigation Measures

Mitigation Action	Geographic Coverage	Estimated Benefit	Estimated Cost	Priority
Dam Related				
A. Century Mill Dam Assessment: Conduct a physical assessment and conclusive research about ownership and legal responsibility for any needed repairs	Site Specific	High	Medium	High
B. Century Mill Dam Repairs: following assessment, coordinate any needed repairs by dam owner	Site Specific	High	High	High
Flood Hazard Mitigation				
C. Conduct inventory of all drainage infrastructure in town and use inventory to develop a priority maintenance plan	Town Wide	High	Low	High
D. Assessment of country drainage systems: Identify areas which inundate and pool water frequently	Town Wide	Medium	Low	Low
E. Spectacle Hill Road Improvements: Establish formal drainage area and divert overflow to pond on private land.	Site Specific	High	High	High
F. Conduct drainage upgrades to area of Golden Run and Quail Run	Site Specific	Medium	Medium	Medium
G. Construct drainage upgrades to Forbush Mill Road	Site Specific	Medium	Medium	Medium
Brushfire Mitigation				
H. Acquire equipment for the Fire Department to better respond to Brush Fires	Town Wide	High	High	High
I. Provide Public Education Regarding the hazards of Brush Fires and recommended mitigation for residents	Town Wide	Low	Medium	Medium
Winter Storm Hazard Mitigation				
J. Provide additional Tree Maintenance Program funding to mitigate both winter hazards and wind hazards	Town Wide	High	High	High
K. Assess municipal and school building roofs for snow load capacity and vulnerability	Town Wide	Medium	Medium	Medium
Wind Mitigation Measures				
L. Provide additional Tree Maintenance Program funding to mitigate both winter hazards and wind hazards	Town Wide	High	High	High

Mitigation Action	Geographic Coverage	Estimated Benefit	Estimated Cost	Priority
Drought Mitigation				
M. Develop public education strategy to increase awareness about drought conditions and water conservation	Town Wide	Medium	Low	High
N. Research field management practices which conserve water and determine under what drought conditions to reduce watering of public spaces	Town Wide	Medium	Low	Medium
Extreme Temperature Mitigation				
O. Provide public education regarding the hazards of extreme temperatures recommended mitigation for residents	Town Wide	Medium	Low	Medium
Earthquake Mitigation				
P. Conduct a seismic assessment for earthquake vulnerability of municipal buildings	Town Wide	Low	Medium	Low
Other – Multi-Hazard				
Q. Acquire a Communications Repeater for Backup of Fire and Police Departments	Town Wide	High	High	High
R. Identify and designate sites for Debris Management	Town Wide	Low	Low	Low
S. Acquire a fixed base 2-way radio system and repeater for the Department of Public Works	Town Wide	High	High	High
T. Open Space Protection and Land Acquisition	Town Wide	High	High	Medium

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 Zoning and By-law changes enforced by the Planning Board and the Wetlands Act enforced by the Conservation Commission, 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 updating stormwater management bylaws.

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.

One regional issue of significance is the widespread effects of beaver dams in the area. Much of the localized flooding that occurs is due to beaver activity. The towns will mitigate the problem temporarily by hiring trappers, removing dams, or installing pipes, but a long-term comprehensive approach should be considered.

Another issue as identified by other communities is that when addressing housing, transportation, and economic development projects, the impacts to neighbors must be addressed. Communities need to keep lines of communication open and share the review of plans and projects.

REGIONAL PARTNERS

In developed communities such as the metropolitan Boston area, mitigating natural hazards, particularly flooding, is often more than a local issue. The drainage systems that serve these communities include systems of storm drains, roadway drainage structures, and other facilities owned and operated by the Town as well as state agencies such as the Massachusetts Department of Transportation (MassDOT) and the Department of Conservation and Recreation (DCR). The planning, construction, operation and maintenance of these structures are integral to the flood 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 they must make decisions about numerous competing priorities.

OVERVIEW OF REGIONAL FACILITIES WITHIN BOLTON

Major facilities owned, operated and maintained by state or regional entities include:

- Routes 85, 110, 117 and 495 (MassHighway)
- Delaney Wildlife Management Area (MA Division of Fisheries and Wildlife)
- Bolton Flats Wildlife Management Area (MA Division of Fisheries and Wildlife)
- Flood Control Easement with the Delaney Complex (MA DCR)

SECTION 9: PLAN ADOPTION & MAINTENANCE

PLAN ADOPTION

The Bolton Hazard Mitigation Plan 2018 Update was adopted by the Board of Selectmen on November 15, 2018. See Appendix D for documentation. The plan was approved by FEMA on November 27, 2018 for a five-year period that will expire on November 27, 2023.

PLAN MAINTENANCE

Although several of the mitigation measures from the town's previous Hazard Mitigation Plan have been implemented, since that plan was adopted there has not been an ongoing local process to guide implementation of the plan. Such a process is needed over the next five years for the implementation of this plan update, and will be structured as described below.

MAPC worked with the Bolton Hazard Mitigation Planning Team to prepare this plan. After approval of the plan by FEMA, this group will meet to function as the Hazard Mitigation Implementation Team, with the Commissioner of Public Works designated as the coordinator. Additional members could be added to the local implementation team from 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 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.

IMPLEMENTATION AND EVALUATION SCHEDULE

Mid-Term Survey on Progress (Spring 2021) – 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 Town Engineer, will have primary responsibility for tracking progress, evaluating, and updating the plan.

Begin to Prepare for the next Plan Update (Fall 2021-Spring 22) – FEMA's approval of this plan is valid for five years, or November 27, 2023, 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 grant and/or local 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.

Prepare and Adopt an Updated Local Hazard Mitigation Plan (Fall 2022-Fall 23) – 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 Bolton 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 Bolton Hazard Mitigation Plan 2018 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 Department
- Police Department
- Public Works
- Inspection Services
- Planning Board
- Conservation Commission
- Parks & Recreation Commission
- Board of Health
- Human Services and Safety

Other groups that will be coordinated with include large institutions, Chambers of Commerce, land conservation organizations and watershed groups. The plans will also be posted on a community's website with the caveat that a local team coordinator will review the plan for sensitive information that would be inappropriate for public posting. The posting of the plan on a web site will include a mechanism for citizen feedback such as an e-mail address to send comments.

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

SECTION 10: LIST OF REFERENCES

Town of Bolton, Massachusetts. *Subdivision Rules and Regulations*

Town of Bolton, Massachusetts. *Official Website*. <https://www.townofbolton.com/>

Town of Bolton, Massachusetts. *Administrative, General, and Zoning Bylaws*. <https://ecode360.com/BO3017>

FEMA, Flood Insurance Rate Maps for Worcester 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, <http://aki.bc.edu/index.htm>

Northeast States Emergency Consortium, website <http://www.nesec.org/>

NOAA, National Centers for Environmental Information, website <https://www.ncei.noaa.gov/>

U. S. Census, 2010, and American Community Survey, 2016

USGS, National Water Information Center, website

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APPENDIX A: LOCAL TEAM MEETINGS

AGENDA

Bolton Hazard Mitigation Plan Update
Local Hazard Mitigation Planning Team

Meeting #1
November 30, 2017
1:30 PM

Bolton Town Hall
663 Main Street
Bolton, MA 01740

1. Review Project Scope of Work and Schedule
2. Update Critical Facilities Inventory and Mapping
3. Identify/update local hazards:
 - a) Flood Hazard Areas
 - b) Fire Hazard Areas (brushfires/wildfires)
 - c) Dams
 - d) Other hazards
4. Identify/Update New and Potential Development Sites
5. Discuss Public Involvement and Outreach
 - a) Identify local stakeholders
 - b) Schedule first public meeting

AGENDA

Bolton Local Hazard Mitigation Planning Team Meeting #2 Planning Process to Update Approved 2010 Plan

March 15, 2017 – 2:00 pm
Bolton Town Hall – Bolton, MA

WELCOME AND INTRODUCTIONS

- Recap past meeting and update on work done to date

REVIEW AND UPDATE PLAN INFORMATION: GOALS, EXISTING MITIGATION MEASURES, POTENTIAL RECOMMENDATIONS

- Review information from previous plan
- Make appropriate updates
- Discuss incorporation of climate change goal(s)

PREPARATION FOR FIRST PUBLIC MEETING

- Confirm scheduled date and place on agenda
- Develop list of stakeholders
- Outreach strategy

REVIEW UPDATED LISTS AND MAPS

- Critical facilities
- Areas of concern/locally identified hazard areas
- New developments

AGENDA

Bolton Local Hazard Mitigation Planning Team Meeting #3 Planning Process to Update Approved 2010 Plan

Tuesday, May 30, 2018 at 2:00 PM
Bolton Town Hall – Bolton, MA

WELCOME AND INTRODUCTIONS

PROPOSE NEW MITIGATION MEASURES FOR 2017 PLAN

- Necessary to add some additional mitigation measures so there is at least one mitigation measure for each potential hazard
- Establish priority level

FINAL PUBLIC PRESENTATION PREP

- Plan for public presentation before the Board of Selectmen in June
- Develop list of stakeholders to invite
- Discuss outreach plan

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APPENDIX B: HAZARD MAPPING

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 eight maps as described below. The maps in this appendix are necessarily reduced scale versions for general reference. Full sized higher resolution PDF's of the maps can be downloaded from the MAPC File Transfer Protocol (FTP) website at: ftp://ftp.mapc.org/Hazard_Mitigation_Plans/maps/Bolton/

Map 1.	Population Density
Map 2.	Potential Development
Map 3.	Flood Zones
Map 4.	Earthquakes and Landslides
Map 5.	Hurricanes and Tornadoes
Map 6.	Average Snowfall
Map 7.	Composite Natural Hazards
Map 8.	Hazard Areas

Map 1: Population Density – This map uses the US Census block data for 2010 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 2: Land Use – This map depicts existing land use, based on the MacConnell Land Use map series from University of Massachusetts, available from MassGIS . The map displays 33 categories of land use based on interpretation of aerial photos. 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>

Map 3: Flood Zones – The map of flood zones used the FEMA NFIP Flood Zones as depicted on the FIRMs (Federal Insurance Rate Maps) for Worcester County dated July 16, 2014 as its source. This map is not intended for use in determining whether or not a specific property is located within a FEMA NFIP flood zone. The currently adopted FIRMS for Bolton are kept by the Town. For more information, refer to the FEMA Map Service Center website <http://www.msc.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 repetitive loss areas.

Map 4: Earthquakes and Landslides – 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>.

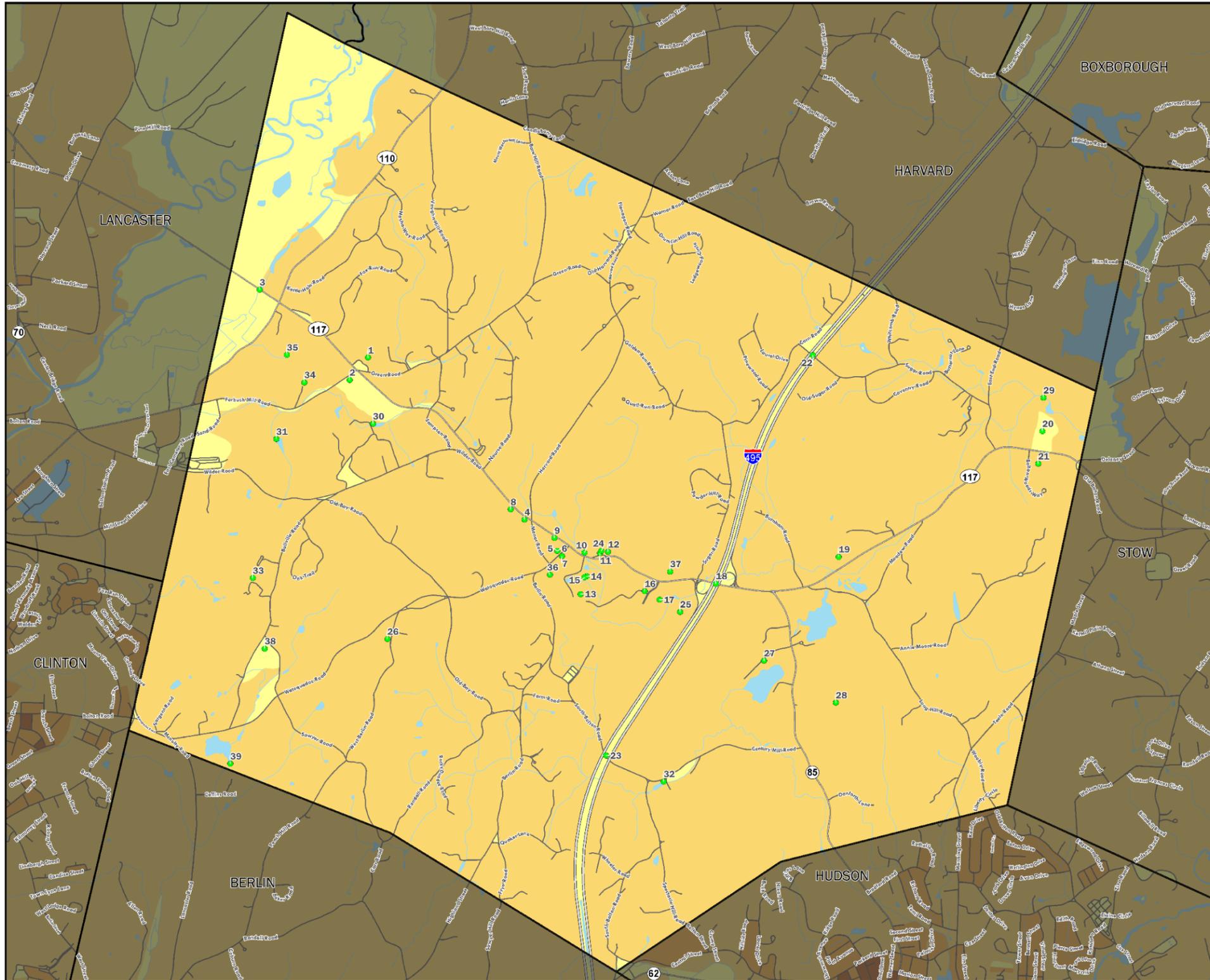
Map 5: Hurricanes and Tornadoes – This map shows a number of different items. The map includes the storm tracks for both hurricanes and tropical storms, if any occurred in this community. This information must be viewed in context. A storm track only shows where the eye of the storm passed through. In 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.

Map 6: Average Snowfall - - This map shows the average snowfall. It also shows storm tracks for nor'easters, if any storms tracked through the community.

Map 7: Composite Natural Hazards - This map shows four categories of composite natural hazards for areas of existing development. 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.

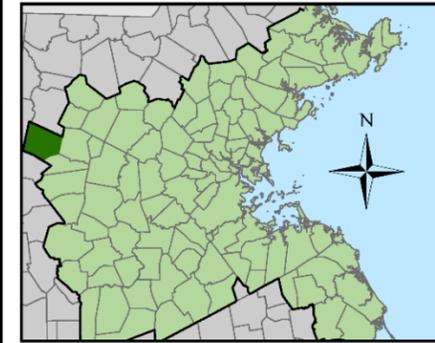
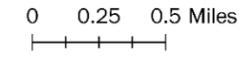
Map 8: Hazard Areas – For each community, locally identified hazard areas are overlaid on an aerial photograph dated April, 2009. The source of the aerial photograph is Mass GIS. This map also shows potential future developments, and critical infrastructure sites. MAPC consulted with town staff to determine areas that were likely to be developed or redeveloped in the fut



FEMA Hazard Mitigation Planning Grant
BOLTON, MA

Map 1: Population Density

- Sites**
- Critical Infrastructure Sites*
 - 🚂 Train Stations
 - 🚊 Commuter Rail Lines
 - 🚆 Trains
- * See details in separate table
- 💧 Water Bodies
- Population Density 2010 Census Blocks People Per Acre**
- 0 or No Data
 - 0.1 - 5.0
 - 5.1 - 15.0
 - 15.1 - 30.0
 - More than 30
- All Roads**
- Interstate
 - U.S. Highway
 - State Route
 - Street

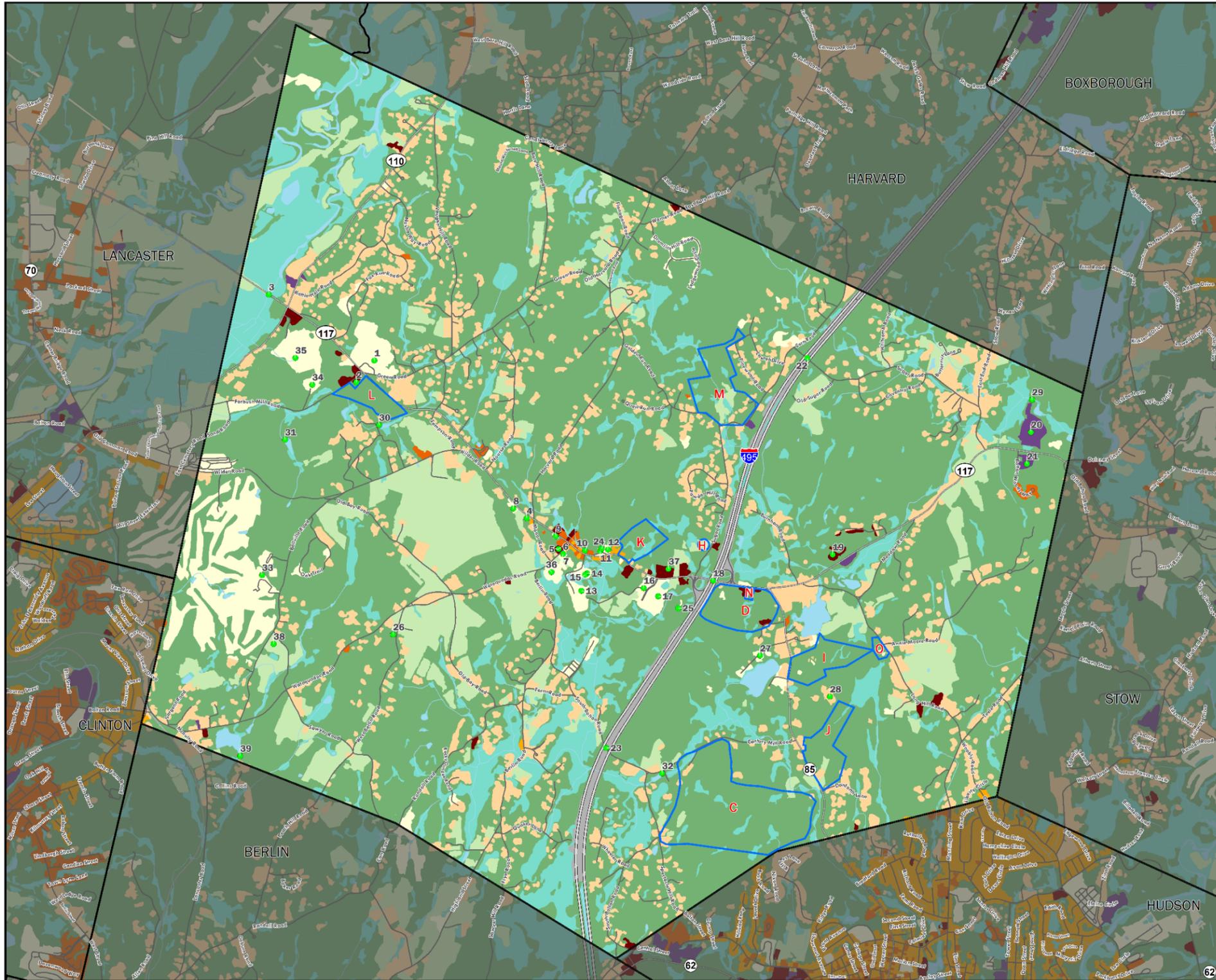


The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analyses.

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)
BOLTON, MA

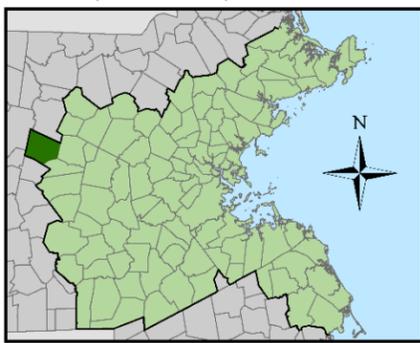
Path: \\G:\GIS\Projects\Current\Projects\PDMA\Map1\Map1.mxd
Date: 2/20/2018



FEMA Hazard Mitigation Planning Grant
BOLTON, MA
 Map 2: Land Use

- Sites**
- Critical Infrastructure Sites*
 - Repetitive Loss Sites
 - * See details in separate table
- Land Use (2005)**
- High Density Residential
 - Medium Density Residential
 - Low Density Residential
 - Non-Residential Developed
 - Commercial
 - Industrial
 - Transportation
 - Agriculture
 - Undeveloped
 - Undeveloped Wetlands
- Development Areas**
- * See details in separate table
- All Roads**
- Interstate
 - U.S. Highway
 - State Route
 - Street
- Water Bodies**
- Water Bodies
- Scale:** 0 0.25 0.5 Miles

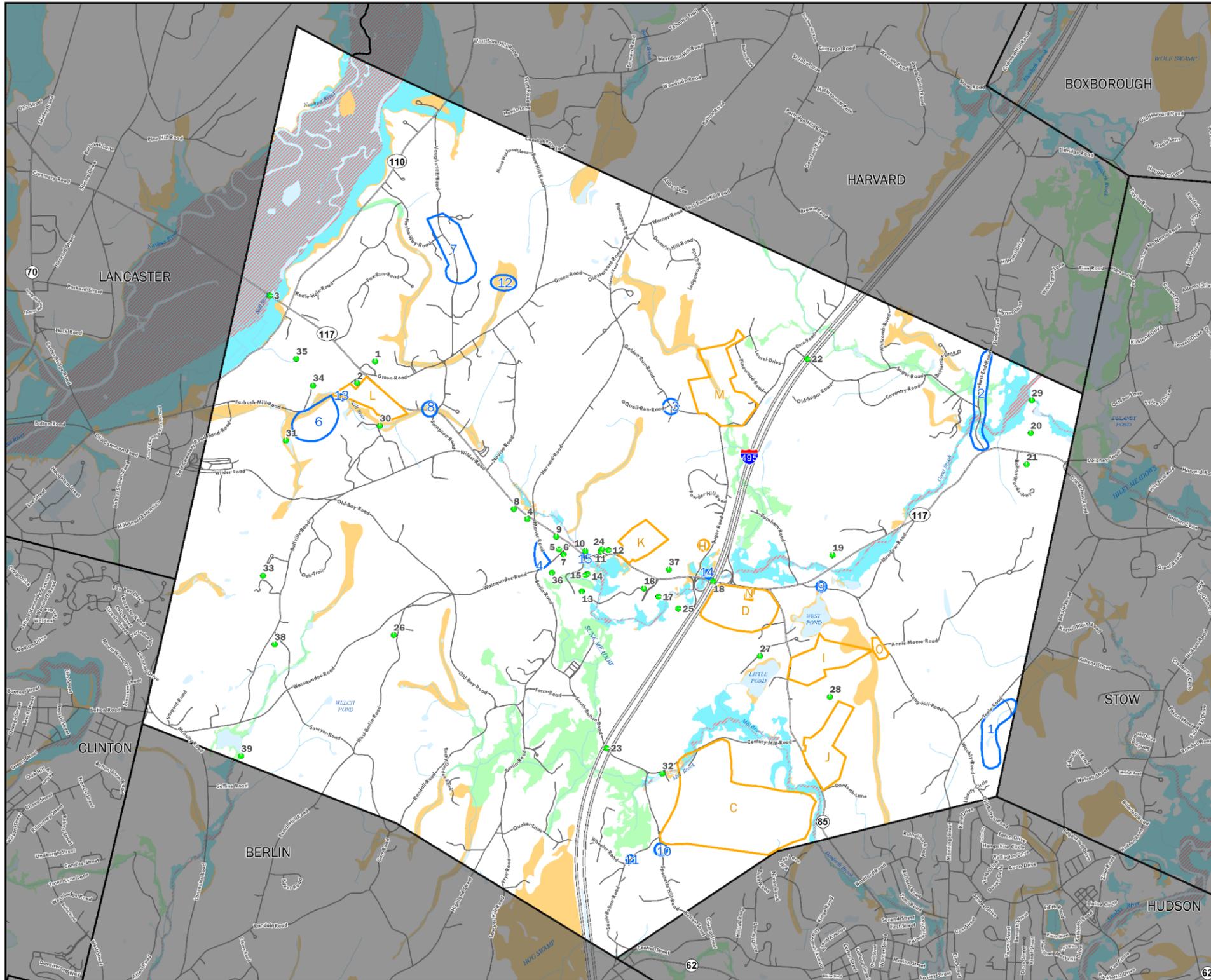
- Ⓜ Train Stations
- Commuter Rail Lines
- Trains



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

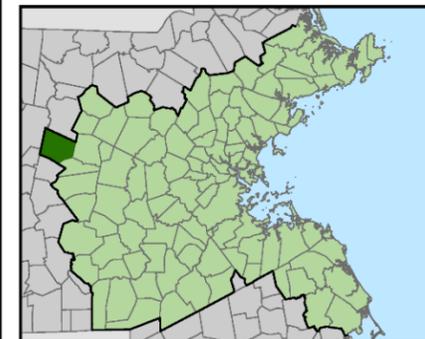
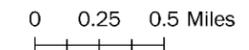
Data Sources:
 Metropolitan Area Planning Council (MAPC)
 Massachusetts Geographic Information System (MassGIS)
 Northeast States Emergency Consortium (NESEC)
 Massachusetts Emergency Management Agency (MEMA)
 Federal Emergency Management Agency (FEMA)
 BOLTON, MA
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 Date: 6/7/2018



FEMA Hazard Mitigation Planning Grant
BOLTON, MA

Map 3: Flood Zones

- Sites**
- Critical Infrastructure Sites*
 - Repetitive Loss Sites
 - * See details in separate table
- Locally Identified Hazard Areas***
- Water Bodies
 - Flooding
 - Development Areas*
 - * See Section IV Risk Assessment
- Flood Zones, 2017 (Annual Chance)**
- A: 1% Annual Chance of Flooding, no BFE
 - AE: 1% Annual Chance of Flooding, with BFE
 - AE: Regulatory Floodway
 - X: 0.2% Annual Chance of Flooding
- Other Features**
- Train Stations
 - Commuter Rail Lines
 - Trains
 - All Roads: Interstate, U.S. Highway, State Route, Street



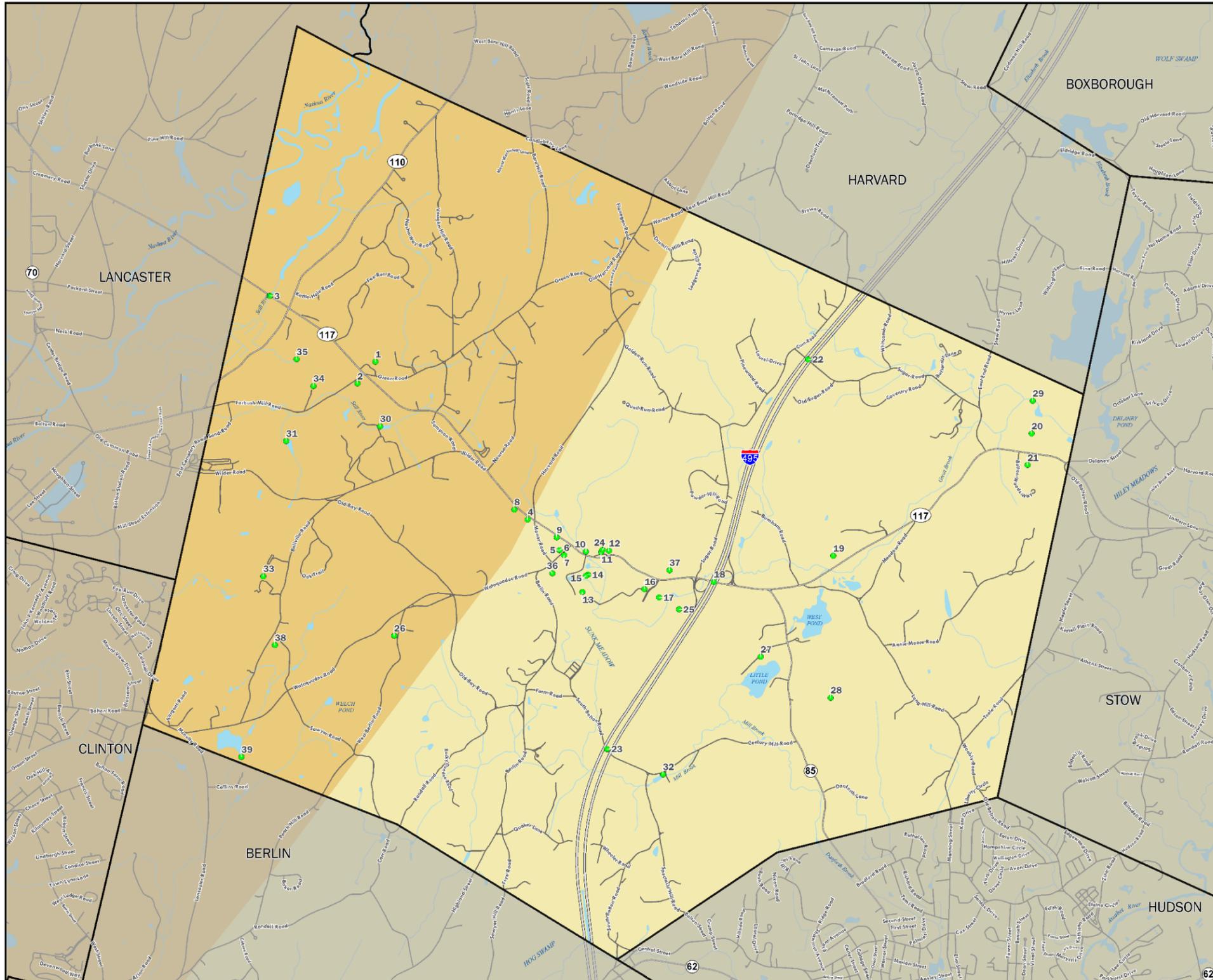
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analyses.

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)

Flood Zones datalayer updated by MassGIS October 2013 from finalized data provided by Federal Emergency Management Agency (FEMA) BOLTON, MA

Path: \\D:\GIS\Map3\Map3.mxd
 Date: 5/11/2018

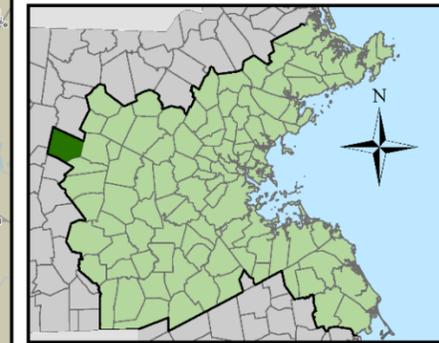
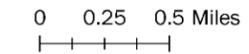


FEMA Hazard Mitigation Planning Grant
BOLTON, MA

Map 4: Earthquakes / Landslides

- Sites**
- Critical Infrastructure Sites* (Green dot)
 - Water Bodies (Blue area)
- * See details in separate table
- Earthquakes**
- Epicenters (Red dot)
 - Train Stations (T symbol)
 - Commuter Rail Lines (Purple line)
 - Trains (Black line with cross-ticks)
- Landslides**
- High landslide incidence (greater than 15% of the area is involved in landsliding) (Dark brown)
 - High susceptibility to landsliding and moderate incidence (Orange)
 - High susceptibility to landsliding and low incidence (Yellow-orange)
 - Moderate susceptibility to landsliding and low incidence (Light orange)
 - Low landslide incidence (less than 1.5 % of the area is involved in landsliding) (Pale yellow)

- All Roads**
- Interstate (Thick grey line)
 - U.S. Highway (Medium grey line)
 - State Route (Thin grey line)
 - Street (Thin black line)

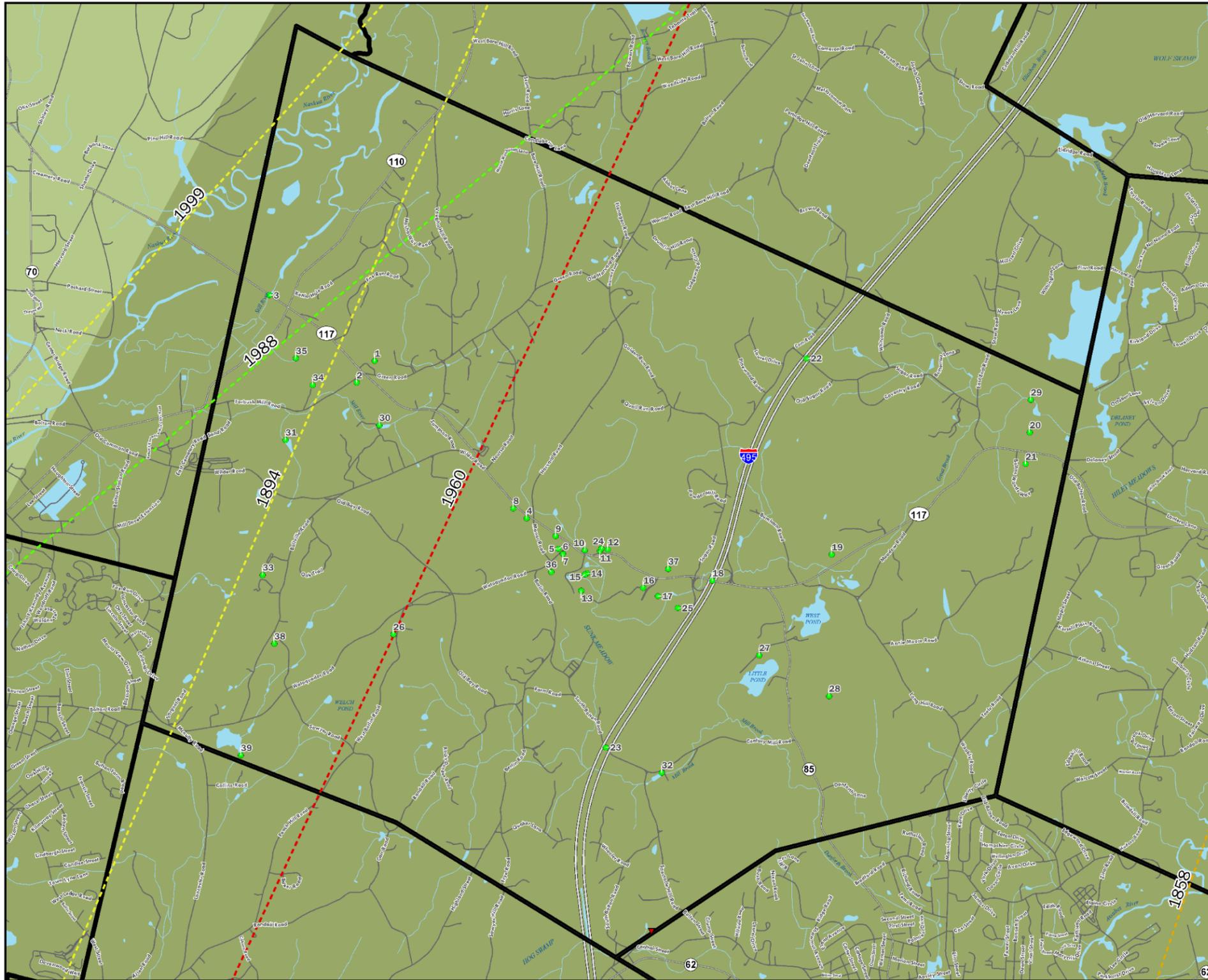


The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analyses.

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)
 BOLTON, MA

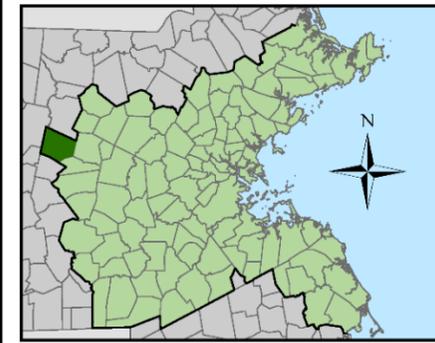
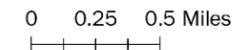
Path: \\C:\Users\jsh\Documents\Projects\Current Projects\PDMP\project_files\PDMP_Map4.mxd
 Date: 3/14/2018



FEMA Hazard Mitigation Planning Grant
BOLTON, MA

Map 5: Hurricanes / Tornadoes

- Sites**
- Critical Infrastructure Sites*
 - Repetitive Loss Sites
- * See details in separate table
- Tornadoes**
- ▼ Tornado
- Storm Tracks**
- Tropical Depression
 - Tropical Storm
 - Category 1 Hurricane
 - Category 2 Hurricane
 - Category 3 Hurricane
- Year of storm noted on map
- Hurricane Surge Inundation Areas**
- ☒
- Train Stations**
- Ⓜ Commuter Rail Lines
 - Ⓜ Trains
- All Roads**
- Interstate
 - U.S. Highway
 - State Route
 - Street
- Water Bodies**
-
- 100 Year Wind Speeds Miles Per Hour**
- 90 MPH
 - 100 MPH
 - 110 MPH
 - 120 MPH
 - 130 MPH

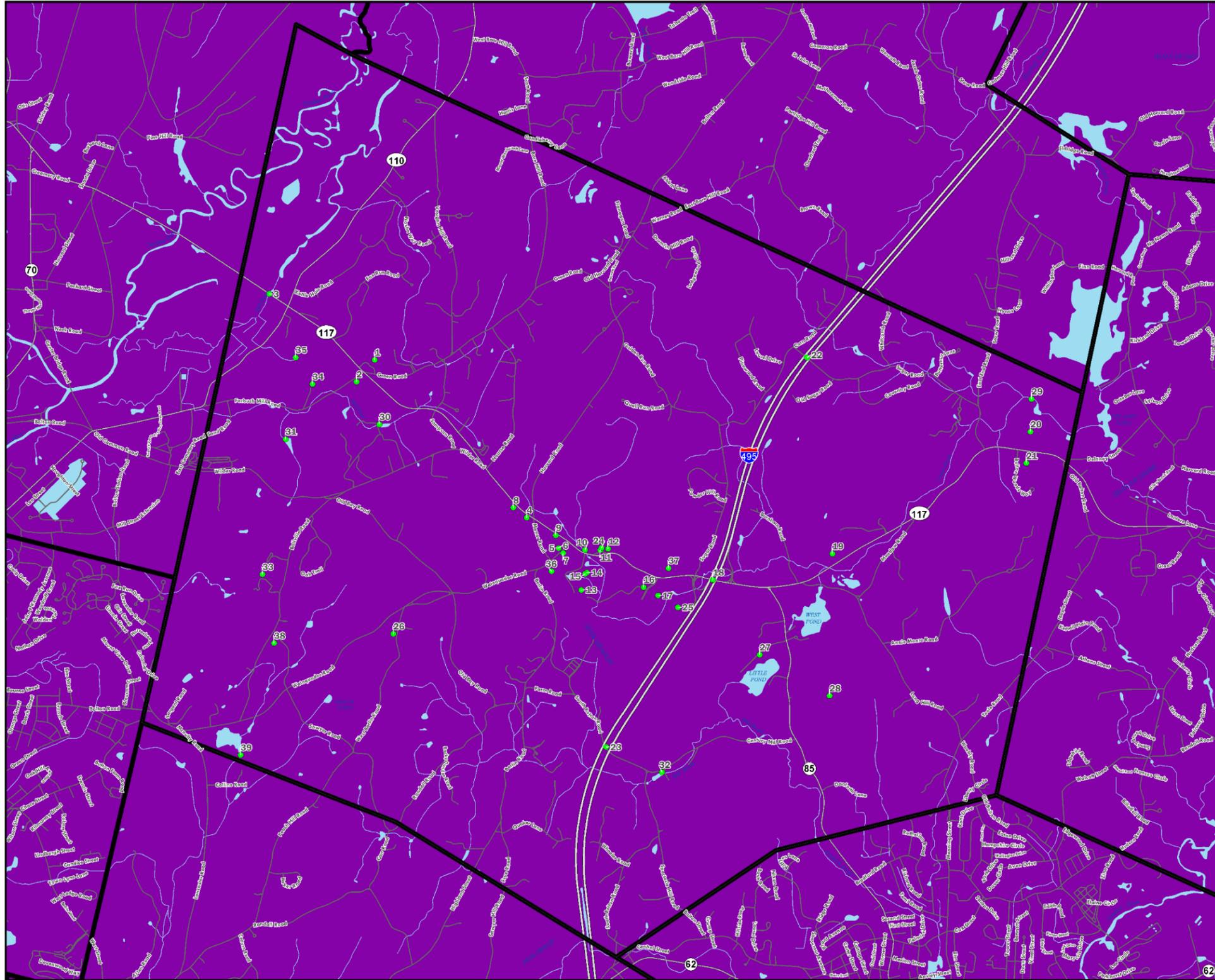


The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analyses.

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)
 BOLTON, MA

Path: \\disk0\GIS\DataServices\Projects\Current_Projects\PMMP\project_files\PMMP_Map5.mxd
 Date: 3/14/2018



FEMA Hazard Mitigation Planning Grant
BOLTON, MA

Map 6: Average Snowfall

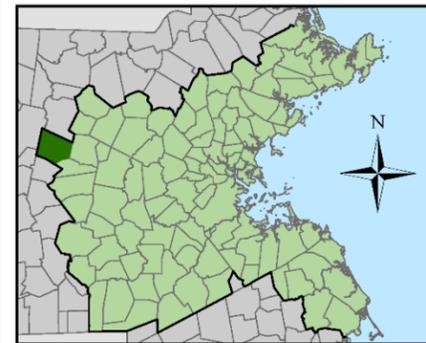
- Sites**
- Critical Infrastructure Sites*
 - Water Bodies
 - Train Stations
 - Commuter Rail Lines
 - Trains
 - All Roads
 - Interstate
 - U.S. Highway
 - State Route
 - Street

* See details in separate table

Average Annual Snowfall

- 36.1 to 48.0 inches
- 48.1 to 72.0 inches

0 0.25 0.5 Miles



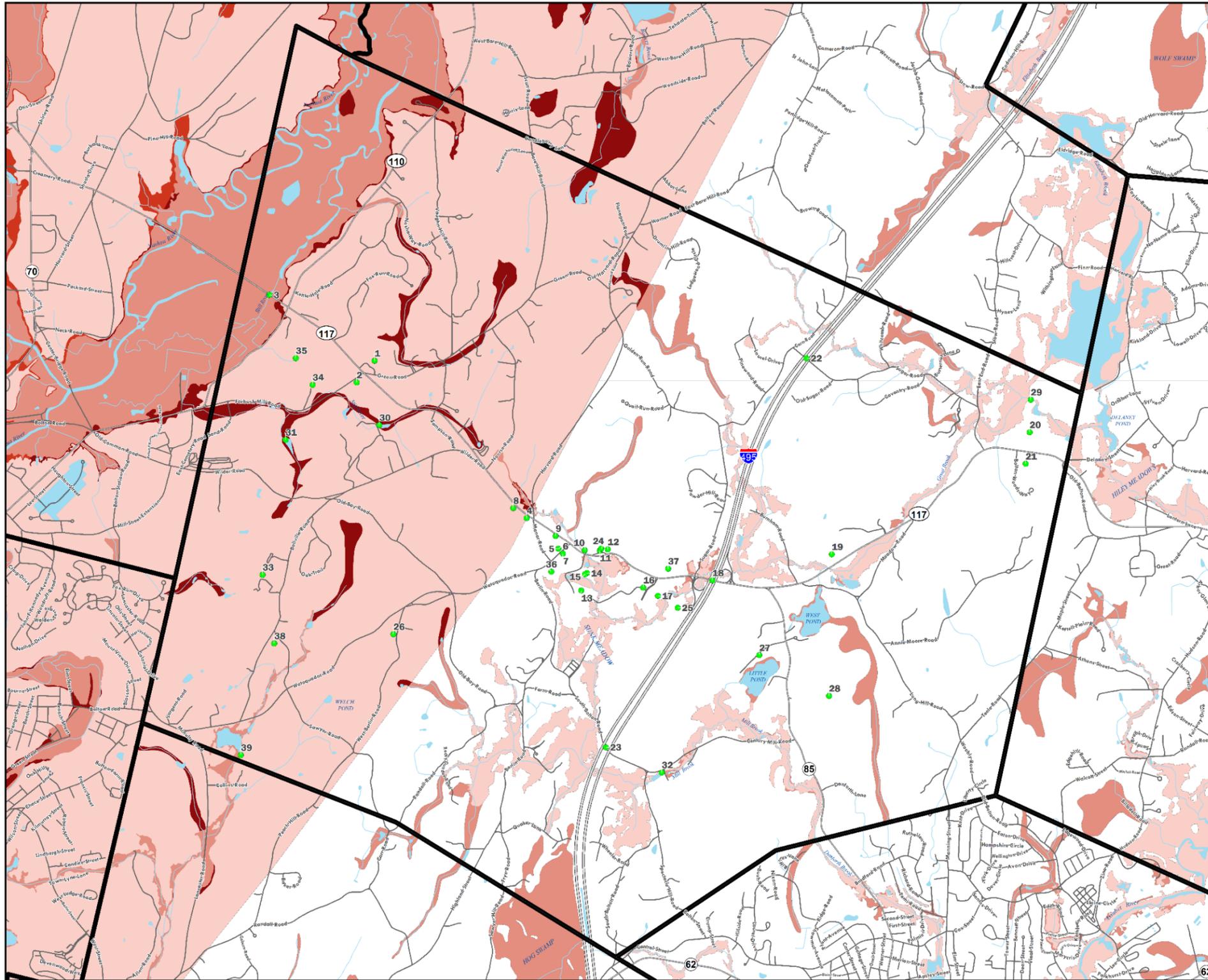
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analyses.

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)
BOLTON, MA

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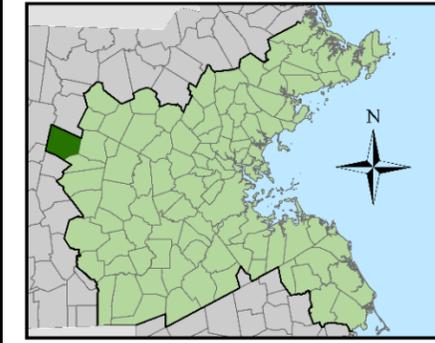
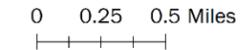
Date: 3/14/2018



FEMA Hazard Mitigation Planning Grant
BOLTON, MA

Map 7: Composite Natural Hazards

- Composite Natural Hazards**
- Low (2 Hazards)
 - Moderate (3 Hazards)
 - High (4 Hazards)
 - Very High (5 Hazards)
- Sites**
- Critical Infrastructure Sites*
 - Repetitive Loss Sites
 - * See details in separate table
- Water Bodies**
- Water Bodies
- All Roads**
- Interstate
 - U.S. Highway
 - State Route
 - Street
 - Train Stations
 - Commuter Rail Lines
 - Trains
- 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 parcel-level analyses.

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

Data Sources

Composite Natural Hazard:
 Wind, Landslide Risk, Snow - Northeast States Emergency Consortium (NESEC)
 Flood Zones - 2013 FEMA/MassGIS
 Hurricane Surge - 2013 U.S. Army Corps of Engineers, New England District

Roads/Trains: MassDOT/ CTPS

Repetitive Loss Sites: DCR/Office of Flood Hazard Management

Critical Infrastructure: Metropolitan Area Planning Council (MAPC) / BOLTON, MA

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Date: 6/7/2018

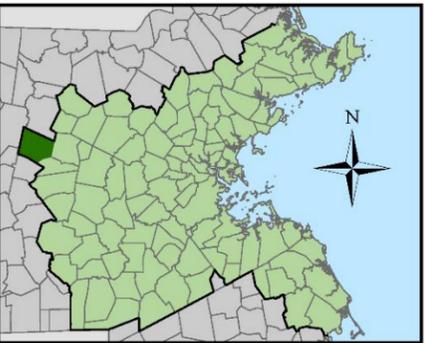


FEMA Hazard Mitigation Planning Grant
BOLTON, MA

Map 8: Local Hazard Areas

- | | |
|--|---------------------|
| Sites | Train Stations |
| Critical Infrastructure Sites* | Commuter Rail Lines |
| Repetitive Loss Sites | Trains |
| * See details in separate table | |
| Locally Identified Hazard Areas | All Roads |
| Brush Fires | Interstate |
| Flooding | U.S. Highway |
| Historic | State Route |
| * See Section IV Risk Assessment | |
| Development Sites | Street |
| * See details in separate table | |

0 0.5 1 Miles



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)
Imagery © Google
BOLTON, MA

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Date: 3/14/2018

APPENDIX C: PUBLIC PARTICIPATION

HAZARD MITIGATION PLAN PUBLIC MEETING

Natural hazards can have serious impacts
on the Town of Bolton and its residents



The Bolton Hazard Mitigation Plan is being updated to help the town reduce its vulnerability to natural hazard events such as flooding, hurricanes and winter storms. Please join the town for a public presentation and discussion about the update to the Bolton Hazard Mitigation Plan at a public meeting of the Board of Selectmen:

Date: Thursday, March 22, 2018
Time: 7:15 PM
Location: Bolton Town Hall, Board of Selectmen's Room
663 Main Street, Bolton, MA

For more information, please contact Joseph Sacchi via phone at (617) 933-0717 or email jsacchi@mapc.org



CALENDAR LISTING / MEDIA ADVISORY

BOLTON'S DRAFT HAZARD MITIGATION PLAN TO BE PRESENTED AT MARCH 22 PUBLIC MEETING

*Meeting to discuss the 2018 update of Bolton's Hazard Mitigation Plan
and solicit public input*

Who: Bolton residents, business owners, representatives of non-profit organizations and institutions, and others who are interested in preventing and reducing damage from natural hazards.

What: At the Bolton Board of Selectmen meeting on Thursday, March 22 at 7:15 PM, a presentation will be made by the Metropolitan Area Planning Council (MAPC), which is assisting the Town on the 2018 update of its Hazard Mitigation Plan.

The Town of Bolton adopted its first Hazard Mitigation Plan in 2010, which was approved by the Federal Emergency Management Agency (FEMA). The plan identifies natural hazards affecting Bolton such as floods, hurricanes, winter storms, and earthquakes, as well as actions that the town can take to reduce its vulnerability to these hazards. The Town is now in the process of preparing an updated plan for 2018 with the assistance of MAPC.

When: Thursday, March 22 at 7:15 PM

Where: Bolton Town Hall, Board of Selectmen's Meeting Room
663 Main Street
Bolton, MA 01740

MAPC is the regional planning agency for 101 communities in the metropolitan Boston area, promoting smart growth and regional collaboration. More information about MAPC is available at www.mapc.org.

##



SMART GROWTH AND REGIONAL COLLABORATION

Dear _____,

The Bolton Hazard Mitigation Plan is being updated to help the town with reducing its vulnerability to natural hazard events such as flooding, hurricanes, and winter storms. Natural hazards can have serious impacts on the Town of Sharon and its residents.

Please join the Town for a public presentation and discussion about the update to the Sharon Hazard Mitigation Plan at a public meeting on the following date and location:

Thursday, March 22, 2018 at 7:15 PM
Bolton Town Hall, Board of Selectmen's Meeting Room
663 Main Street
Bolton, MA 01740

Please feel free to forward the attached flyer to residents, business owners and anyone who may be interested in preventing and reducing damage from natural hazards.

Best,
Joseph Sacchi

Joseph Sacchi
Regional Land Use Planner
Metropolitan Area Planning Council
60 Temple Place
Boston, MA 02111
617.933.0717
jsacchi@mapc.org
www.mapc.org

Keith Burgess, President | Erin McInnes, Vice President | Julie Kelly, Treasurer | Sandra Hernandez, Secretary | Marc Debrais, Executive Director
Metropolitan Area Planning Council | 60 Temple Place | Boston, Massachusetts 02111 | 617-633-0700 | 617-462-7128 fax | mapc.org



SMART GROWTH AND REGIONAL COLLABORATION

Dear Town Clerk,

The Town of Bolton is preparing its Hazard Mitigation Plan to reduce the town's vulnerability to natural hazard events such as flooding, hurricanes, and winter storms. The plan will identify a set of hazard mitigation measures, including structural improvements, regulatory changes, educational and outreach efforts related to mitigating natural hazards in the town.

As part of the planning process, Bolton's neighboring communities are being notified of a public meeting on hazard mitigation planning process to be hosted by the Bolton Board of Selectmen:

Thursday, March 22, 2018 at 7:15 PM
Bolton Town Hall, Board of Selectmen's Meeting Room
663 Main Street
Bolton, MA 01740

A flyer announcing the meeting is attached. Please post this as a public meeting. If you have any questions about this please feel free to contact me.

Best regards,

Joseph Sacchi

Joseph Sacchi
Regional Land Use Planner
Metropolitan Area Planning Council
60 Temple Place
Boston, MA 02111
617.933.0717
jsacchi@mapc.org
www.mapc.org

Keith Deegan, President | Erin McInnes, Vice President | Julie Kelly, Treasurer | Sandra Hernandez, Secretary | Marc DeGros, Executive Director
Metropolitan Area Planning Council | 60 Temple Place | Boston, Massachusetts 02111 | 617-622-0700 | 617-462-7128 fax | mapc.org



Town of
Bolton
Massachusetts
Incorporated 1736

Published on *Bolton MA* (<https://www.townofbolton.com>)

Link to ****Revised**** Board of Selectmen Agenda

****Revised**** Board of Selectmen Agenda

Date:

Thursday, March 22, 2018 - 7:00am

****Revised**** March 21, 2018 ******

BOARD OF SELECTMEN

AGENDA

Thursday, March 22, 2018

7:00 p.m.

Town Hall, 663 Main Street

1.

7:00 to 7:10 p.m.

****This Public Hearing has been postponed****

Public hearing on the petition of National Grid and Verizon New England, Inc. to 1 Jointly Owned Pole on Harvard Road beginning at a point approximately 3000 feet Northeast of the centerline of the intersection of Main Street and continuing approximately 0 feet in a Northeast direction. National Grid to install 1, 35C2 stub pole and 1 anchor across the road from pole 29.

1.

7:00 to 7:05 p.m.

Request to place a clothing donation box at Houghton Building or other town location for one week as part of earning their Silver Award (Shandy Carpenter, Girl Scout Troop 30496)

2.

7:05 to 7:10 p.m.

Request for approval of the Town-wide yard sale including at the Bolton Common on May 5th (rain date May 6th) from 9:00 to 3:00 p.m. (Jane: Collier)

3.

7:10 to 7:20 p.m.

Begin Board of Selectmen Business

4.

7:20 to 7:35 p.m.

Discussion regarding Hazard Mitigation Plan Next Steps

5.

7:35 to 7:55 p.m.

Future structure of Fire Chief position

6.

7:55 to 8:35 p.m.

Review and vote Board's recommendations for articles on Annual Town Meeting Warrant for May 7, 2018 including discussion regarding articles for the Community Preservation Act (CPA) and meal tax

7.

8:35 to 8:45 p.m.

Town Administrator Report

Review of monthly statistics from Public Safety Department Heads

Designation of Bolton as an Age-Friendly Community

8.

8:45 to 9:15 p.m.

Board of Selectmen Business

Public Service Announcement(s)

Recommendation from Economic Development Committee to appoint Scott Panneton and

HAZARD MITIGATION PLAN PUBLIC MEETING

Natural hazards can have serious impacts
on the Town of Bolton and its residents



The Bolton Hazard Mitigation Plan is being updated to help the town reduce its vulnerability to natural hazard events such as flooding, hurricanes and winter storms. Please join the town for a public presentation and discussion about the update to the Bolton Hazard Mitigation Plan at a public meeting of the Board of Selectmen:

Date: Thursday, July 12, 2018
Time: 7:00 PM
Location: Bolton Town Hall, Board of Selectmen's Room
663 Main Street, Bolton, MA

For more information, please contact Joseph Sacchi via phone at (617) 933-0717 or email jsacchi@mapc.org



Amanda Linehan, Communications Manager, Metropolitan Area Planning Council
617-933-0705, alinehan@mapc.org

CALENDAR LISTING / MEDIA ADVISORY

BOLTON'S DRAFT HAZARD MITIGATION PLAN TO BE PRESENTED AT JULY 12 PUBLIC MEETING

Who: Bolton residents, business owners, representatives of non-profit organizations and institutions, and others who are interested in preventing and reducing damage from natural hazards.

What: At the Bolton Board of Selectmen meeting on Thursday, July 12 at 7:00 PM, a presentation will be made on the draft *Hazard Mitigation Plan 2018 Update* by the Metropolitan Area Planning Council (MAPC), which is assisting the Town on the 2018 update of its Hazard Mitigation Plan.

The draft *Hazard Mitigation Plan 2018 Update* identifies natural hazards that can affect Bolton such as floods, hurricanes, and winter storms, as well as actions that the Town can take to reduce its vulnerability to these hazards. The draft plan will be available on the Town's web site for public review until July 23.

When: Thursday, July 12 at 7:00 PM

Where: Bolton Town Hall
Board of Selectmen's Meeting Room
663 Main Street
Bolton, MA 01740

MAPC is the regional planning agency for 101 communities in the metropolitan Boston area, promoting smart growth and regional collaboration. More information about MAPC is available at www.mapc.org.

##



SMART GROWTH AND REGIONAL COLLABORATION

Dear Town Clerk,

The Town of Bolton is preparing its Hazard Mitigation Plan to reduce the town's vulnerability to natural hazard events such as flooding, hurricanes, and winter storms. The plan will identify a set of hazard mitigation measures, including structural improvements, regulatory changes, educational and outreach efforts related to mitigating natural hazards in the town.

As part of the planning process, Bolton's neighboring communities are being notified of a public meeting on hazard mitigation planning process to be hosted by the Bolton Board of Selectmen:

Thursday, July 12, 2018 at 7:00 PM
Bolton Town Hall, Board of Selectmen's Meeting Room
663 Main Street
Bolton, MA 01740

A flyer announcing the meeting is attached. Please post this as a public meeting. If you have any questions about this please feel free to contact me.

Best regards,

Joseph Sacchi

Joseph Sacchi

Regional Land Use Planner
Metropolitan Area Planning Council
60 Temple Place
Boston, MA 02111
617.933.0717
jsacchi@mapc.org
www.mapc.org

Keith Bergman, President | Erin Wortman, Vice President | Taber Keally, Treasurer | Sandra Hackman, Secretary | Marc Dralsen, Executive Director
Metropolitan Area Planning Council | 60 Temple Place | Boston, Massachusetts 02111 | 617-933-0700 | 617-482-7185 fax | mapc.org



SMART GROWTH AND REGIONAL COLLABORATION

Dear Stakeholder,

The Bolton Hazard Mitigation Plan is being updated to help the town with reducing its vulnerability to natural hazard events such as flooding, hurricanes, and winter storms. Natural hazards can have serious impacts on the Town of Bolton and its residents.

Please join the Town for a public presentation of the Draft Bolton Hazard Mitigation Plan 2017 Update at a public meeting on the following date and location:

Thursday, July 12, 2018 at 7:00 PM
Bolton Town Hall, Board of Selectmen's Meeting Room
663 Main Street
Bolton, MA 01740

Comments and questions on the draft plan are welcome. Please feel free to forward the attached flyer to residents, business owners and anyone who may be interested in preventing and reducing damage from natural hazards.

Best,
Joseph Sacchi

Joseph Sacchi
Regional Land Use Planner
Metropolitan Area Planning Council
60 Temple Place
Boston, MA 02111
617.933.0717
jsacchi@mapc.org
www.mapc.org

Keith Bergman, President | Erin Wortman, Vice President | Taber Keally, Treasurer | Sandra Hackman, Secretary | Marc Dralsen, Executive Director
Metropolitan Area Planning Council | 60 Temple Place | Boston, Massachusetts 02111 | 617-933-0700 | 617-482-7185 fax | mapc.org



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[Budgets](#)

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[Meeting Minutes](#)

[Selectmen Meetings](#)

[Town Bylaws](#)

[Warrants](#)

[Home](#) » [Board of Selectmen](#)



Board of Selectmen's Meeting

SUBMITTED ON JULY 6, 2018 - 2:57PM

Date: Thursday, July 12, 2018 - 7:00pm

BOARD OF SELECTMEN

AGENDA

Thursday, July 12, 2018

7:00 p.m.

Town Hall, 663 Main Street

Contact Info

Phone:

(978) 779-2297

Fax:

(978) 779-5461

Address:

663 Main Street
Bolton, MA 01740
United States

See map: [Google Maps](#)

1.

7:00 to 7:05 p.m.

Appointment of new Human Resources Director

2.

7:05 to 7:10 p.m.

Request for approval to hold the Halloween parade and party on Saturday, October 27th, 2018 from 3-5 p.m.
(Laura Roberts)

3.

7:10 to 7:15 p.m.

Request for permission to hold the 2017 Positive Spin for ALS Bike Ride Fundraiser on Sunday, September 23rd, 2018 (Myke Farricker)

4.

7:15 to 7:30 p.m.

Discussion regarding partial Road Acceptance for Century Mill Estates

5.

7:30 to 7:50 p.m.

Discussion regarding Affordable Housing Plan

6.

7:50 to 8:10 p.m.

Discussion regarding Master Plan process

7.

8:10 to 8:30 p.m.

Presentation and discussion regarding updates to the Bolton Hazard Mitigation Plan

PUBLIC COMMENTS AND RESPONSES

Comment #1: “Given the fact that we have both Rt 495 & 117 to contend with, I'd think our Town Plan should include some things that would deal with a toxic spill of some sort from a tanker-truck or other. My 2-cents. .. esp. as the email/notice says other factors beyond those currently covered should/could be considered.”

Response #1: While response to man-made disasters certainly merit planning and attention, planning for toxic spills along major travel routes in town is a topic handled through the Comprehensive Emergency Management Plan (CEMP) maintained by the Town.

Comment #2: “There was no mention of loss of power or cell phone/telephone coverage (and we'd want back-up power to be located out of any flood-plane areas).”

Response #2: Cell phone towers and other telecommunication facilities are included in the plan's database of critical infrastructure and analyzed for their vulnerability to localized hazards such as flooding. The Town's existing mitigation measures include the outfitting of critical public facilities with generators.

Comment #3: “During one of the worst and prolonged power outages Bolton has experienced it came to light that all of the nearby gasoline stations were without power so gas could not be pumped for the front end loaders and police vehicles (and possibly fire trucks). Private generators were borrowed to help the gas stations operate at a low level.

The hazard mitigation plan for worse case scenarios should identify gas stations that now may have generators, large capacity tanks needing less frequent resupply, and access roads.

If a state of emergency is declared for an area, can local authorities ration gasoline, diesel fuel, and similar supplies so that public safety vehicles can access what they need?”

Response #3: Although this issue involves private businesses rather than the Town's own facilities, the availability of fuel during emergency response is an important issue. The local Hazard Mitigation Team should consider this issue during the implementation phase of this plan.

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APPENDIX D: PLAN ADOPTION AND APPROVAL

1. Certificate of Adoption of the Hazard Mitigation Plan Update
By the Board of Selectmen, November 15, 2018
2. FEMA formal letter of plan approval, November 27, 2018



Board of Selectmen Bolton, Massachusetts

Town Hall, 663 Main Street, Bolton, MA 01740
Phone 978-779-2297 Fax 978-779-5461

CERTIFICATE OF ADOPTION BOARD OF SELECTMEN TOWN OF BOLTON, Massachusetts

A RESOLUTION ADOPTING THE *TOWN OF BOLTON HAZARD MITIGATION PLAN 2018 UPDATE*

WHEREAS, the Town of Bolton established a Committee to prepare the *Town of Bolton Hazard Mitigation Plan 2018 Update*; and

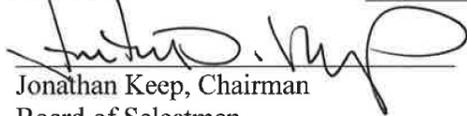
WHEREAS, the *Town of Bolton Hazard Mitigation Plan 2018 Update* contains several potential future projects to mitigate potential impacts from natural hazards in the Town of Bolton, and

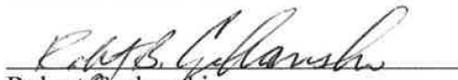
WHEREAS, duly-noticed public meetings were held by Board of Selectmen on March 22, 2018 and July 12, 2018.

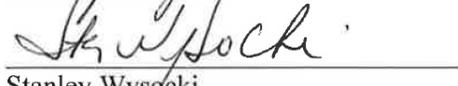
WHEREAS, the Town of Bolton authorizes responsible departments and/or agencies to execute their responsibilities demonstrated in the plan, and

NOW, THEREFORE BE IT RESOLVED that the Town of Bolton Board Of Selectmen adopts the *Town of Bolton Hazard Mitigation Plan 2018 Update*, in accordance with M.G.L. 40 §4 or the charter and bylaws of the Town of Bolton.

ADOPTED AND SIGNED this Date. 11-15-18


Jonathan Keep, Chairman
Board of Selectmen


Robert Czekanski


Stanley Wysocki



FEMA

JAN 07 2019

Kurt Schwartz, Director
Massachusetts Emergency Management Agency
400 Worcester Road
Framingham, MA 01702-5399

Dear Mr. Schwartz:

We would like to acknowledge the Town of Bolton and the Commonwealth of Massachusetts for their dedication and commitment to mitigation planning. The Department of Homeland Security (DHS), Federal Emergency Management Agency (FEMA) Region I Mitigation Planning Team has completed its review of the Town of Bolton Hazard Mitigation Plan 2018 Update and determined it meets the requirements of 44 C.F.R. Pt. 201.

With this plan approval, the Town of Bolton is eligible to apply to the Massachusetts Emergency Management Agency for mitigation grants administered by FEMA. Requests for mitigation funding will be evaluated individually according to the specific eligibility requirements identified for each of these programs. A specific mitigation activity or project identified in your community's plan may not meet the eligibility requirements for FEMA funding; even eligible mitigation activities or projects are not automatically approved.

Approved mitigation plans are eligible for points under the National Flood Insurance Program's Community Rating System (CRS). Complete information regarding the CRS can be found at <http://www.fema.gov/national-flood-insurance-program-community-rating-system>, or through your local floodplain administrator.

The Town of Bolton Hazard Mitigation Plan 2018 Update must be reviewed, revised as appropriate, and resubmitted to FEMA for approval within **five years of the plan approval date of November 27, 2018** in order to maintain eligibility for mitigation grant funding. We encourage the Town to continually update the plan's assessment of vulnerability, adhere to its maintenance schedule, and implement, when possible, the mitigation actions proposed in the plan.

Thank you for your continued dedication to public service demonstrated by preparing and adopting a strategy for reducing future disaster losses. Should you have any questions, please contact Melissa Surette at (617) 956-7559 or Melissa.Surette@fema.dhs.gov.

Sincerely,

A handwritten signature in blue ink, appearing to read "Paul F. Ford".

Paul F. Ford
Acting Regional Administrator

APPENDIX E: FEMA PLAN REVIEW TOOL

LOCAL MITIGATION PLAN REVIEW TOOL - APA Town of Bolton, MA

The *Local Mitigation Plan Review Tool* demonstrates how the Local Mitigation Plan meets the regulation in 44 CFR §201.6 and offers States and FEMA Mitigation Planners an opportunity to provide feedback to the community.

- The Regulation Checklist provides a summary of FEMA’s evaluation of whether the Plan has addressed all requirements.
- The Plan Assessment identifies the plan’s strengths as well as documents areas for future improvement.
- The Multi-jurisdiction Summary Sheet is an optional worksheet that can be used to document how each jurisdiction met the requirements of the each Element of the Plan (Planning Process; Hazard Identification and Risk Assessment; Mitigation Strategy; Plan Review, Evaluation, and Implementation; and Plan Adoption).

The FEMA Mitigation Planner must reference this *Local Mitigation Plan Review Guide* when completing the *Local Mitigation Plan Review Tool*.

Jurisdiction: Town of Bolton, Ma	Title of Plan: Town of Bolton Hazard Mitigation Plan 2018 Update	Date of Plan: October 2018
Single or Multi-jurisdiction plan? Single-jurisdiction	New Plan or Plan Update? Update	
Regional Point of Contact: Martin Pillsbury Environmental Planning Director Metropolitan Area Planning Council 60 Temple Place, Boston, MA 02111 617-933-0747; mpillsbury@mapc.org	Local Point of Contact: Joseph Lynch Director, Department of Public Works 12 Forbush Mill Road Bolton, MA 01740 (978) 779-6402 dpwdirector@townofbolton.com	

State Reviewer: Jeffrey Zukowski	Title: Hazard Mitigation Planner	Date: 9/28/2018
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FEMA Reviewer: Joshua Vidmar Brigitte Ndikum-Nyada	Title: CERC FEMA Community Planner	Date: 10/16/18 10-25-2018 – 11-1-2018
Date Received in FEMA Region I	09/28/2018	
Plan Not Approved		
Plan Approvable Pending Adoption	11/01/2018	
Plan Adopted by Jurisdiction		
Plan Approved		

**SECTION 1:
REGULATION CHECKLIST**

INSTRUCTIONS: The Regulation Checklist must be completed by FEMA. The purpose of the Checklist is to identify the location of relevant or applicable content in the Plan by Element/sub-element and to determine if each requirement has been ‘Met’ or ‘Not Met.’ The ‘Required Revisions’ summary at the bottom of each Element must be completed by FEMA to provide a clear explanation of the revisions that are required for plan approval. Required revisions must be explained for each plan sub-element that is ‘Not Met.’ Sub-elements should be referenced in each summary by using the appropriate numbers (A1, B3, etc.), where applicable. Requirements for each Element and sub-element are described in detail in this *Plan Review Guide* in Section 4, Regulation Checklist.

Regulation (44 CFR 201.6 Local Mitigation Plans)	Location in Plan (section and/or page number)	Met	Not
ELEMENT A. PLANNING PROCESS			
A1. Does the Plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction? (Requirement §201.6(c)(1))	Sec. 3, pp. 9-13; App. C, pp. 95-107	X	
A2. Does the Plan document an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, agencies that have the authority to regulate development as well as other interests to be involved in the planning process? (Requirement §201.6(b)(2))	Sec. 3, pp. 12-13; App. C, pp. 95-107	X	
A3. Does the Plan document how the public was involved in the planning process during the drafting stage? (Requirement §201.6(b)(1))	Sec. 3, pp. 12-13; App. C, pp. 95-107	X	
A4. Does the Plan describe the review and incorporation of existing plans, studies, reports, and technical information? (Requirement §201.6(b)(3))	Sec. 3, p. 10; Sec. 10, p. 79	X	
A5. Is there discussion of how the community(ies) will continue public participation in the plan maintenance process? (Requirement §201.6(c)(4)(iii))	Sec. 3, p. 13; Sec. 9, p. 78	X	
A6. Is there a description of the method and schedule for keeping the plan current (monitoring, evaluating and updating the mitigation plan within a 5-year cycle)? (Requirement §201.6(c)(4)(i))	Sec. 9, pp. 77-78	X	
ELEMENT A: REQUIRED REVISIONS			
ELEMENT B. HAZARD IDENTIFICATION AND RISK ASSESSMENT			
B1. Does the Plan include a description of the type, location, and extent of all natural hazards that can affect each jurisdiction(s)? (Requirement §201.6(c)(2)(i))	Sec. 4, pp. 15-46 App. B, pp. 87-94	X	
B2. Does the Plan include information on previous occurrences of hazard events and on the probability of future hazard events for each jurisdiction? (Requirement §201.6(c)(2)(i))	Sec. 4, pp. 15-46	X	
B3. Is there a description of each identified hazard’s impact on the community as well as an overall summary of the community’s vulnerability for each jurisdiction? (Requirement §201.6(c)(2)(ii))	Sec. 4, pp. 15-56	X	

Regulation (44 CFR 201.6 Local Mitigation Plans)	Location in Plan (section and/or page number)	Met	Not ..
B4. Does the Plan address NFIP insured structures within the jurisdiction that have been repetitively damaged by floods? (Requirement §201.6(c)(2)(ii))	Sec. 4, p. 21	X	
ELEMENT B: REQUIRED REVISIONS			
ELEMENT C. MITIGATION STRATEGY			
C1. Does the plan document each jurisdiction's existing authorities, policies, programs and resources and its ability to expand on and improve these existing policies and programs? (Requirement §201.6(c)(3))	Sec. 6, pp. 59-64	X	
C2. Does the Plan address each jurisdiction's participation in the NFIP and continued compliance with NFIP requirements, as appropriate? (Requirement §201.6(c)(3)(ii))	Sec.6, pp. 59-60	X	
C3. Does the Plan include goals to reduce/avoid long-term vulnerabilities to the identified hazards? (Requirement §201.6(c)(3)(i))	Sec. 1, p. 2; Sec. 5, p. 57	X	
C4. Does the Plan identify and analyze a comprehensive range of specific mitigation actions and projects for each jurisdiction being considered to reduce the effects of hazards, with emphasis on new and existing buildings and infrastructure? (Requirement §201.6(c)(3)(ii))	Sec. 8, pp. 71-72	x	
C5. Does the Plan contain an action plan that describes how the actions identified will be prioritized (including cost benefit review), implemented, and administered by each jurisdiction? (Requirement §201.6(c)(3)(iv)); (Requirement §201.6(c)(3)(iii))	Sec. 8, pp. 67-75	X	
C6. Does the Plan describe a process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate? (Requirement §201.6(c)(4)(ii))	Sec. 9, p. 78	X	
ELEMENT C: REQUIRED REVISIONS			
ELEMENT D. PLAN REVIEW, EVALUATION, AND IMPLEMENTATION (applicable to plan updates only)			
D1. Was the plan revised to reflect changes in development? (Requirement §201.6(d)(3))	Sec. 4, pp. 48-50	X	
D2. Was the plan revised to reflect progress in local mitigation efforts? (Requirement §201.6(d)(3))	Sec. 7, pp. 65-66; Sec. 8, pp. 71-72	X	
D3. Was the plan revised to reflect changes in priorities? (Requirement §201.6(d)(3))	Sec. 7, pp. 65-66; Sec. 8, pp. 71-72	X	
ELEMENT D: REQUIRED REVISIONS			
ELEMENT E. PLAN ADOPTION			
E1. Does the Plan include documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval? (Requirement §201.6(c)(5))	Certificate of Adoption, p. 110		

Regulation (44 CFR 201.6 Local Mitigation Plans)	Location in Plan (section and/or page number)	Met	Not .. .
E2. For multi-jurisdictional plans, has each jurisdiction requesting approval of the plan documented formal plan adoption? (Requirement §201.6(c)(5))			
ELEMENT E: REQUIRED REVISIONS			
ELEMENT F. ADDITIONAL STATE REQUIREMENTS (OPTIONAL FOR STATE REVIEWERS ONLY; NOT TO BE COMPLETED BY FEMA)			
F1.			
F2.			
ELEMENT F: REQUIRED REVISIONS			

SECTION 2: PLAN ASSESSMENT

A. Plan Strengths and Opportunities for Improvement

This section provides a discussion of the strengths of the plan document and identifies areas where these could be improved beyond minimum requirements.

Recommended Corrections:

- The page enumeration is offset because of the introductory pages. Despite that there are 118 total, the final page reads “110 of 118.”
- Of the Six-step Planning Process listed on page 9, 10 etc., it appears a word is missing from Step-three of the Planning Process. Review and correct. “Review of Mitigation---?”

Element A: Planning Process

Strengths:

- The planning process is well documented and includes a detailed schedule of the events and meetings that contributed to development of the plan. The Utility Companies are great stakeholders and should be invited to Mitigation planning process meetings.
- A diverse group of stakeholders were involved in the planning process, ensuring a range of perspectives and comprehensive analysis.

Opportunities for Improvement:

- The Town of Bolton is encouraged to insert an eye catching photograph on the cover page of its Hazard Mitigation Plan. Two pictures of a disaster related event in Town and one of a successful mitigation project would complement this document and attract more readers.
- Expand the supporting documentation of the planning process by including meeting summaries. Recording the planning team's discussion and decision-making process will be useful during plan updates.

- The Town of Bolton, is encouraged to insert the final signed copy of the **adoption certificate** within the first second (2nd) or third (3rd) page of this plan. The Adoption Certificate highlights, showcases and also celebrates the community’s successful achievement. The certificate of adoption is also a symbol of ownership of the HMP. Inserting it at the last page of the plan does not carry the intended important message.

Element B: Hazard Identification and Risk Assessment

Strengths:

- There is a well-grounded rationale provided for why certain hazards were omitted from analysis.
- The plan does an excellent job of identifying how the probability or severity of future hazard events may change in the future due to changes in climate, population, or land use.

Opportunities for Improvement:

- Incorporate existing watershed studies into the risk assessment.
- Update the table on page 16 about REGIONALLY SIGNIFICANT FLOOD to include most recent flooding, for example the flooding in **January 4th, 2018** etc. Also update table 9 Hurricane Records for Massachusetts, **1938 to 2012**. If there is no current and best available through 2017 and 2018, do state that in the plan.
- With increased focus on climate change, the Town of Bolton is encouraged to start paying close attention to information like the following in this HMP update: *“The Town of Bolton does not collect data for previous occurrences of extreme cold.”*

Element C: Mitigation Strategy

Strengths:

- The plan provides a comprehensive, detailed description of the community's existing programs, plans, and policies that relate to mitigation.
- The community's mitigation goals are unique and customized to the community.
- The plan includes specific, targeted mitigation actions that address the community's key vulnerabilities. Actions are detailed with information on funding, resources, timeframes, and responsible personnel.
- Kudos to the town for adopting such an effective and mitigation related ordinance - § 250-14, Zoning Bylaws. Table 34 does an excellent job capturing the ranking statuses of the mitigation actions from the 2010 HMP.

Opportunities for Improvement:

- Further develop the analysis of how existing capabilities could be expanded. As part of the analysis, specify what is currently lacking (funding, personnel, equipment, regulations, authority, community consensus, etc.).
- Taking into account what happened to recently in Lawrence, MA and surrounding communities, more attention should be paid to the gas line infrastructure.

Element D: Plan Update, Evaluation, and Implementation (*Plan Updates Only*)

Strengths:

- The plan clearly describes the community's development changes since the last update.
- The plan connects changes in development directly to changes in risk.

Opportunities for Improvement:

- Consider including a discussion on how mitigation activities have increased the community's resilience and support other long-term community planning goals.
- The Town of Bolton is encouraged to do everything possible to avoid allowing its Hazard Mitigation Plan 2018 Update to expire as was the case with the 2010. When a HMP is allowed to lapse and expire, it's like dropping insurance coverage for the entire community. Immediately following FEMA's formal approval, this the perfect time to start working on the next HM Plan update.
- The Town of Bolton is encouraged to contact MEMA to apply for the MVP program. Most recently, the Commonwealth launched the Municipal Vulnerability Preparedness (MVP) grant program, as described in this section, which provides support for cities and towns in Massachusetts to begin or enhance the process of planning for resiliency to extreme weather and other natural or climate-related hazards.

B Resources for Implementing Your Approved Plan

The home for the online version of the 2018 SHMCAP as well as future updates can be accessed at <http://resilientma.org/> and the State's climate action page at <https://www.mass.gov/topics/climate-action> .

Technical Assistance:

FEMA

- [FEMA Climate Change](#): Provides resources that address climate change.
- [FEMA Hazard Mitigation Planning Online Bibliography](#): This compilation of government and private online sites is a useful source of information for developing and implementing hazard mitigation programs and plans in New England.
- [FEMA Library](#): FEMA publications can be downloaded from the library website. These resources may be especially useful in public information and outreach programs. Topics include building and construction techniques, NFIP policies, and integrating historic preservation and cultural resource protection with mitigation.
- [FEMA RiskMAP](#): Technical assistance is available through RiskMAP to assist communities in identifying, selecting, and implementing activities to support mitigation planning and risk reduction. Attend RiskMAP discovery meetings that may be scheduled in the state, especially any in neighboring communities with shared watersheds boundaries.

Other Federal

- [EPA Resilience and Adaptation in New England \(RAINE\)](#): A collection of vulnerability, resilience and adaptation reports, plans, and webpages at the state, regional, and community levels. Communities can use the RAINE database to learn from nearby communities about building resiliency and adapting to climate change.
- [EPA Soak Up the Rain](#): Soak Up the Rain is a public outreach campaign focused on stormwater quality and flooding. The website contains helpful resources for public outreach and easy implementation projects for individuals and communities.
- [NOAA C-CAP Land Cover Atlas](#): This interactive mapping tool allows communities to see their land uses, how they have changed over time, and what impact those changes may be having on resilience.
- [NOAA Sea Grant](#): Sea Grant's mission is to provide integrated research, communication, education, extension and legal programs to coastal communities that lead to the responsible use of the nation's ocean, coastal and Great Lakes resources through informed personal, policy and management

decisions. Examples of the resources available help communities plan, adapt, and recovery are the Community Resilience Map of Projects and the National Sea Grant Resilience Toolkit

- [NOAA Sea Level Rise Viewer](#) and [Union for Concerned Scientists Inundation Mapper](#): These interactive mapping tools help coastal communities understand how their hazard risks may be changing. The “Preparing for Impacts” section of the inundation mapper addresses policy responses to protect communities.
- [NOAA U.S. Climate Resilience Toolkit](#): This resource provides scientific tools, information, and expertise to help manage climate-related risks and improve resilience to extreme events. The “[Steps to Resilience](#)” tool may be especially helpful in mitigation planning and implementation.

State

- [Massachusetts Emergency Management Agency](#): The Massachusetts State Hazard Mitigation Officer (SHMO) and State Mitigation Planner(s) can provide guidance regarding grants, technical assistance, available publications, and training opportunities.
- Massachusetts Departments of [Conservation and Recreation](#) and [Environmental Protection](#) can provide technical assistance and resources to communities seeking to implement their hazard mitigation plans.
- [MA Mapping Portal](#): Interactive mapping tool with downloadable data)

Not for Profit

- [Kresge Foundation Online Library](#): Reports and documents on increasing urban resilience, among other topics.
- [Naturally Resilient Communities](#): A collaboration of organizations put together this guide to nature-based solutions and case studies so that communities can learn which nature-based solutions can work for them.
- [Rockefeller Foundation Resilient Cities](#): Helping cities, organizations, and communities better prepare for, respond to, and transform from disruption.

Funding Sources:

- [Massachusetts Coastal Resilience Grant Program](#): Funding for coastal communities to address coastal flooding, erosion, and sea level rise.
- [Massachusetts Municipal Vulnerability Preparedness](#) program: Provides support for communities to plan for climate change and resilience and implement priority projects.
- [Massachusetts Water Quality Grants](#): Clean water grants that can be used for river restoration or other kinds of hazard mitigation implementation projects.
- [Federal Grants Resource Center](#) and [Grants.gov](#): Lists of grant opportunities from federal agencies (HUD, DOT/FHWA, EPA, etc.) to support rural development, sustainable communities and smart growth, climate change and adaptation, historic preservation, risk analyses, wildfire mitigation, conservation, Federal Highways pilot projects, etc.
- [FEMA Hazard Mitigation Assistance](#) (HMA): FEMA’s Hazard Mitigation Assistance provides funding for projects under the Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation (PDM), and Flood Mitigation Assistance (FMA). States, federally recognized tribes, local governments, and some not for profit organizations are eligible applicants.
- [GrantWatch](#): The website posts current foundation, local, state, and federal grants on one website, making it easy to consider a variety of sources for grants, guidance, and partnerships. Grants listed include The Partnership for Resilient Communities, the Institute for Sustainable Communities, the Rockefeller Foundation Resilience, The Nature Conservancy, The Kresge Climate-Resilient Initiative, the Threshold Foundation’s Thriving Resilient Communities funding, the RAND Corporation, and ICLEI Local Governments for Sustainability.
- USDA [Natural Resource Conservation Service](#) (NRCS) and [Rural Development Grants](#): NRCS provides conservation technical assistance, financial assistance, and conservation innovation grants. USDA Rural Development operates over fifty financial assistance programs for a variety of rural applications.