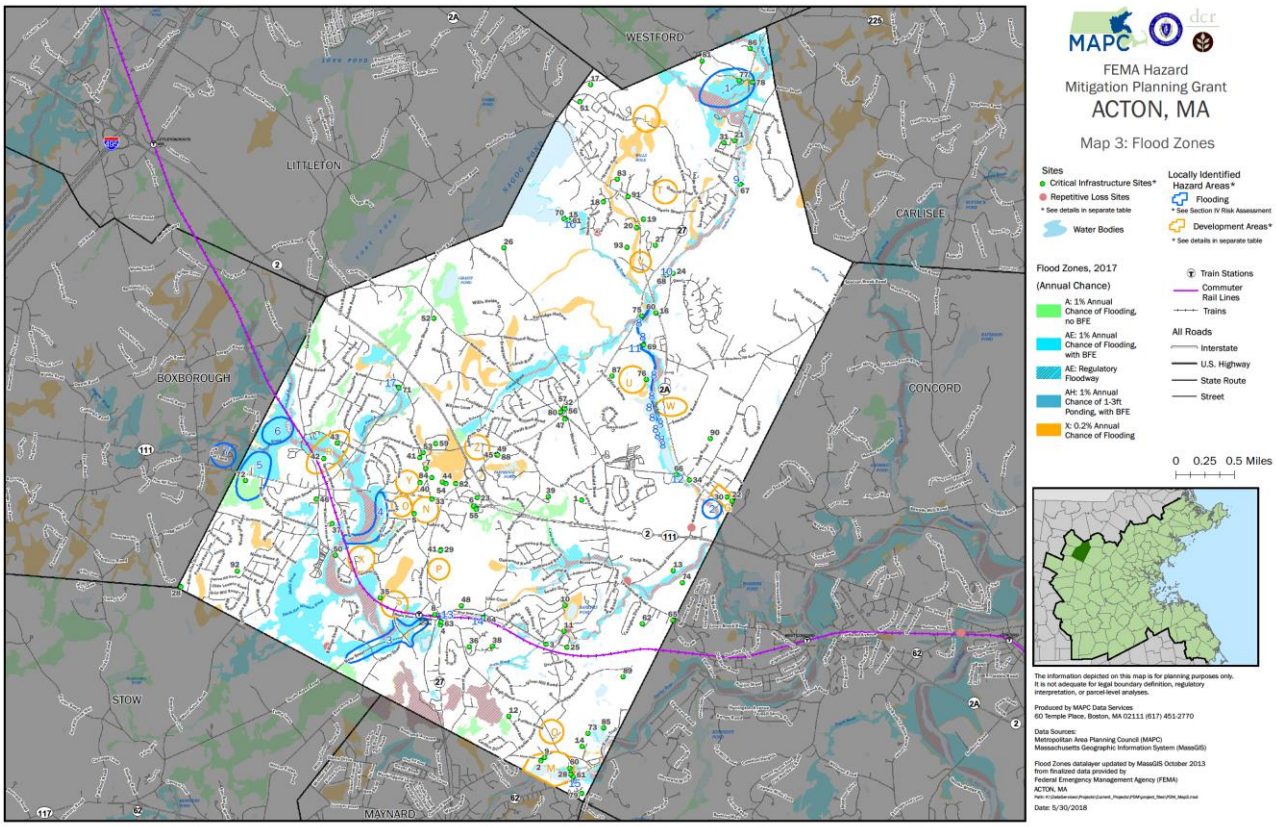
TOWN OF ACTON
HAZARD MITIGATION PLAN
2018 UPDATE



MAPC 50 YEARS
METROPOLITAN AREA PLANNING COUNCIL
SMART GROWTH AND REGIONAL COLLABORATION

Final Plan
Adopted by the Town
November 5, 2018

[This page intentionally left blank]

ACKNOWLEDGEMENTS & CREDITS

This plan was prepared for the Town of Acton 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.

MAPC Officers

President, Keith Bergman, Town of Littleton
Vice President, Erin Wortman, Town of Stoneham
Secretary, Sandra Hackman, Town of Bedford
Treasurer, Taber Keally, Town of Milton
Executive Director, Marc Draisen, MAPC

Credits

Project Manager and Lead Project Planner:	Anne Herbst
Environmental Planning Director	Martin Pillsbury
Mapping/GIS Services:	Eliza Wallace, Ryan Melendez

Massachusetts Emergency Management Agency

Director: Kurt Schwartz

Department of Conservation and Recreation

Commissioner: Carol I. Sanchez

Acton Local Hazard Mitigation Planning Team

Corey York	Public Works
Jim Cogan	Police
Richard Waite	Highway
Paul Campbell	Engineering
Andrea Ristine	Municipal Properties
Frank Ramsbottom	Building
Sheryl Ball	Health
Tom Tidman	Natural Resources
Matt Selby	Land Use
Chris Allen	Acton Water District
Stephen Petersen	Acton Water District
Kristin Alexander	IT/GIS
Aaron Green	IT/GIS
Robert Vanderhoef	Fire
Evan Carloni	Health
QinRui Pang	Engineering

[This page intentionally left blank]

TABLE OF CONTENTS

[This page intentionally left blank]

LIST OF TABLES & FIGURES

TABLES

FIGURES

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

Planning for the Hazard Mitigation Plan update was led by the Acton Local Hazard Mitigation Planning Team, composed of staff from a number of different Town Departments. This team met on November 30, 2017, January 30, 2018, and May 24, 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 Local Hazard Mitigation Planning Team hosted two public meetings, the first on April 18, 2018 and the second on June 18 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. Public comments were received on the final draft, see page 18.

RISK ASSESSMENT

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

The Acton Local Hazard Mitigation Planning Team identified 94 Critical Facilities. These are also shown on the map series and listed in Table 29, identifying which facilities are located within the mapped hazard zones.

A HAZUS-MH analysis provided estimates of property damages from Hurricanes of category 2 and 4 ($14 million to $51 million) as well as earthquakes of magnitudes 5 and 7 ($417 million to $3 billion) and flood damage for 100-year and 500-year storms ($33 to $45.6 million).

HAZARD MITIGATION GOALS

The Acton Local Multiple Hazard Community Planning Team endorsed the following nine hazard mitigation goals at the January 30, 2018 team meeting:

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

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

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

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

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

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

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

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

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

HAZARD MITIGATION STRATEGY

The Acton 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 Acton 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 Acton'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 Acton Board of Selectmen. The plan was also available on the Town's website for public comment. See public comments on page 18.
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 Acton 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 2018 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.

As indicated in Table 34, Acton made considerable progress implementing mitigation measures identified in the 2010 Hazard Mitigation Plan. Completed physical projects include drainage upgrades at Main and Parker Streets and more frequent maintenance of drainage, installation of bio-retention projects in town parks, purchase of diesel generators for critical facilities, upgraded radio and fiber optic communications, and installation of beaver deceivers. The Town strengthened stormwater treatment and infiltration requirements with the adoption of a new Stormwater Bylaw in 2015. In addition, the town purchased GIS software and has mapped 85% of the stormwater infrastructure. The town has been active in purchasing land for conservation, completing over $5 million in purchases in the past five years.

Several projects that were not completed will be continued into this plan update. These include completing GIS mapping and moving on to work that will facilitate MS4 compliance, completion of fiber optic installation, and on-going dam assessments. Funding for design of a new earthquake proof fire station was approved at the 2018 Town Meeting.

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 Acton Hazard Mitigation Implementation Team, as described in Section 9 Plan Adoption and Maintenance.

PLAN APPROVAL AND ADOPTION BY THE TOWN

The plan was found to be Approvable Pending Adoption by FEMA on September 24, 2018. The town formally adopted the final plan through a vote of the Board of Selectmen on November 5, 2018. The signed Certificate of Adoption follows on the next page.

TOWN OF ACTON
472 Main Street
Acton, Massachusetts, 01720
Telephone (978) 929-6611
Fax (978) 929-6350

Board of Selectmen

CERTIFICATE OF ADOPTION
BOARD OF SELECTMEN
TOWN OF ACTON, MASSACHUSETTS

A RESOLUTION ADOPTING THE
TOWN OF ACTON HAZARD MITIGATION PLAN 2018 UPDATE

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

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

WHEREAS, duly-noticed public meetings were held by the LOCAL HAZARD MITIGATION PLANNING TEAM on April 18, 2018 and June 18, 2018 and

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

NOW, THEREFORE BE IT RESOLVED that the Town of Acton BOARD OF SELECTMEN adopts the *Town of Acton Hazard Mitigation Plan 2018 Update*, in accordance with M.G.L. 40 §4 or the charter and bylaws of the Town of Acton.

ADOPTED AND SIGNED this Date. November 5, 2018

Name(s) Katie Green

Title(s) Chair, Board of Selectmen

Signature(s) [signature]

[This page intentionally left blank]

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 Acton 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

The Town of Acton 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)

Disaster Name (Date of Event)	Type of Assistance	Declared Areas
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
	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 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 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

Disaster Name (Date of Event)	Type of Assistance	Declared Areas
May Rainstorm/ Flood May 12-23, 2006	Hazard Mitigation Grant Program	Statewide
April Nor'easter April 15-27, 2007	Hazard Mitigation Grant Program	Statewide
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 8-9, 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 Acton has received funding from FEMA for four mitigation projects under the Hazard Mitigation Grant Program (HMGP) and the Pre-Disaster Mitigation Program (PDM). These projects totaled nearly $100,000 with over $70,000 covered by FEMA grants and over $23,000 by local funding. The projects are summarized in Table 3 below.

Table 3: FEMA-Funded Mitigation Projects

Grant	Project Title	Scope of Work	Total Cost	Federal Funding	Local Funding
HMGP 975-08	Ice House Pond	Install siltation control devices	$56,580	$42,435	$14,145
HMGP 914-10	Emergency Generators	Installation of two portable generators	$7,833	$5,875	$1,958
PDM 2005-13	Hazard Mitigation Planning	Development of first hazard mitigation plan	$12,000	$9,000	$3,000
PDM19-09	Hazard Mitigation Planning	Update of first hazard mitigation plan	$18,000	$13,500	$4,500

Source: MEMA 2016 Database

COMMUNITY PROFILE

Acton is located in Middlesex County and is bordered by Maynard, Stow, Boxborough, Littleton, Westford, Carlisle, Concord and Sudbury. Major roadways in Acton include Routes 2, 2A, 27, 111 and 119. A small segment of Route 62 runs through the southern tip of the town. Acton is served by the Fitchburg line of the commuter rail. A station is located in South Acton.

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

The town retains a connection to its historic settlement patterns with three village centers and aspects of rural landscapes with historic farms. The three villages are West Acton, South Acton and Acton Center. Like most communities in the larger region, Acton is faced with balancing pressures of growth and the desire to maintain its historic character. As described in the Open Space and Recreation Plan and Acton 2020 Plan, Acton has transitioned from a rural community to a bedroom suburb. Much of Acton's rural character has disappeared over the past twenty years. New settlement patterns, in the form of strip shopping centers and subdivisions have emerged. Businesses on Route 2A provided services to surrounding communities.

Commercial development is concentrated at the Nagog Office Park in North Acton. A significant new employer, Insulet, is scheduled to open its Global Headquarters and manufacturing facility in the Nagog Office Park.

According to the 2010 Census, nearly 22,000 people live in Acton. Table 4 provides statistics on potentially vulnerable populations, including the elderly and those without a car, and vulnerable housing units such as those built prior to 1940. These figures are estimates from the 2016 American Community Survey. Acton's own figures indicate there are currently 8,475 housing units in Acton.

The town maintains a website at www.acton-ma.gov

Table 4: Acton Characteristics

Population = 21,924

- 5.2% are under age 5
- 28.5% are under age 18
- 11.0% are over age 65
- 6.7% have a disability
- 6.2% of households are limited English-speaking
- 2.8% of households have no vehicle available

Number of Housing Units = 8,187

- 24.0% are renter-occupied housing units
- 10.0% of housing units were built before 1940

Sources: 2016 American Community Survey 5-Year Estimates

Important characteristics to keep in mind include:

- Acton serves as a small regional hub that draws people from nearby communities due to the retail services and restaurants and the presence of two important pieces of infrastructure for commuters – Route 2 and the MBTA commuter rail.
- Acton's small-town character and historic agricultural lands are still present, with a significant amount of open space preserved or in the process of acquisition.
- Acton is continuously growing and continues to face development, both residential and commercial.
- Acton relies solely on subsurface wells for drinking water and has a very active water district.

[This page intentionally left blank]

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.

Figure 1: Six-Step Planning Process

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:

    - General Bylaws of the Town of Acton
    - Town of Acton, Zoning Bylaw
    - Town of Acton Open Space and Recreation Plan 2014-2021
    - Acton 2020 Comprehensive Community Plan
    - Massachusetts State Hazard Mitigation Plan, 2013
    - FEMA, Local Mitigation Plan Review Guide, October 2011
    - FEMA, Flood Insurance Rate Maps for Middlesex County, MA, 2014
    - FEMA Flood Insurance Study, July 6, 2016
    - Massachusetts State Hazard Mitigation Plan, 2013
    - 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 Environmental Information Center
    - Northeast States Emergency Consortium, http://www.nesec.org/
    - USGS, National Water Information System, http://nwis.waterdata.usgs.gov/usa/nwis
    - US Census, 2010 and American Community Survey 2016 5-Year Estimates

3. Review Existing Mitigation – Municipalities in the Boston Metropolitan Region have an active history in hazard mitigation as most have adopted flood plain zoning districts, wetlands protection programs, and other measures as well as enforcing the State building code, which has strong provisions related to hazard resistant building requirements. All current municipal mitigation measures must be documented.

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 Section 7.

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 Section 9 and documentation of plan adoption can be found in Appendix E.

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. Section 9 includes more detailed information on plan implementation.

2010 PLAN IMPLEMENTATION & MAINTENANCE

The 2010 Town of Acton 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, progress has been made on implementation of the measures. The Town has advanced a number of projects for implementation, including stormwater drainage projects, open space purchases, and adoption of a stormwater bylaw.

THE LOCAL MULTIPLE HAZARD COMMUNITY PLANNING TEAM

MAPC worked with the local community representatives to organize a Local Hazard Mitigation Planning Team for Acton. 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 are listed below.

Name	**Representing**
Corey York	Public Works
Jim Cogan	Police
Richard Waite	Highway
Paul Campbell	Engineering
Andrea Ristine	Municipal Properties
Frank Ramsbottom	Building
Sheryl Ball	Health
Tom Tidman	Natural Resources
Matt Selby	Land Use
Chris Allen	Acton Water District
Stephen Petersen	Acton Water District
Kristin Alexander	IT/GIS
Aaron Green	IT/GIS
Robert Vanderhoef	Fire
Evan Carloni	Health
QinRui Pang	Engineering

The Acton Planning Board and the Acton 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 Director of Land Use and Economic Development and the Natural

Resources Director. In addition, MAPC, the State-designated regional planning authority for Acton, works with all agencies that regulate development in the region, including the listed municipal entities and state agencies, such as the MassDOT (Highway and MBTA).

The Local Hazard Mitigation Planning Team met on the following dates: November 30, 2017; January 30, 2018; and May 24, 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.

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 Acton hazard mitigation planning process during a meeting of the Conservation Commission on April 18, 2018 held in at Acton Town Hall. The draft plan update was presented at a Board of Selectmen meeting on June 18, 2018 at Acton Town Hall. Both meetings were publicized in accordance with the Massachusetts Public Meeting Law. The attendance list for each meeting can be found in Table 5. See public meeting notices in Appendix C.

Public comments on the draft plan were received from several individuals as follows:

1) Support for the proposed private well use regulations was expressed.
2) Focus should be on reducing our impacts. Land acquisition should be a high priority. Acton should form a Land Bank and charge a transfer fee of 2% on real estate transactions (Martha's Vineyard

model) to create a fund for land preservation. Projects in flood zones should not be approved. Water hook-ups should be restricted.

Table 5 Acton Public Meetings	
Meeting #1 April 18, 2018	
Name	**Representing**
Corey York	Public Works
Tom Tidman	Natural Resources
Members of the Acton Conservation Commission	
Meeting #2 June 18, 2018	
Corey York	Public Works
Matt Selby	Land Use
Members of the Board of Selectmen	
15 members of the public	

3) The **Community Resilience Building Workshop** was part of a 'concurrent planning process' not yet directly integrated into the actual hazard mitigation process I think this process separation was a mistake, and that the fine ideas discussed at the May 9 meeting belong in the Hazard Mitigation Plan, if only in a vastly expanded comments section if there is not time for a deeper integration. **Note: Appendix D contains all priorities from the Community Resilience Building Workshop.**

Suggestions to implement *GOAL 9: Consider the potential impacts of future climate change and incorporate climate sustainability and resiliency in hazard mitigation planning.*

1. One way to reduce climate change impact is to do less to impact the climate. The whole range of strategies for reducing our climate impact should be a part of this process.
2. Climate change will mean a tendency toward more droughts punctuated by large storms, so we are headed towards a stronger potential for water supply emergencies. Water supply issues are regional issues: Most urgently: we need to find a way to work effectively with Concord and Littleton on Nagog Pond issues.
3. Most of the MVP program material seemed oriented towards dealing with responses to first-order climate effects. But, as a small town in a populous region, with layers of state and federal government around us, we need to be just as concerned about second-order effects: how we cope with the responses other communities and governments are making to climate change. I see at least three areas of concern for Acton:
    a. As climate impacts increase globally, there will be more tendencies to system disruptions to key systems such as food production and distribution and other supply chains for energy and materials. Preparing for more community reliance will be important, including:
        i. Supporting more farms, and saving land for farming. Specific targets for how much farmland we would like to have would help drive this effort.
        ii. Supporting locally-controlled energy sources such as community solar.
        iii. Encouraging job creation with locally-owned businesses for local residents
        iv. Supporting greater community cohesion and communication, especially across social and ethnic lines that often keep people separated, so that we can be more socially resilient and thus more ready to cope with whatever lies ahead.
    b. Coastal flooding will create climate emigres. We need to anticipate a rise in the numbers of people looking for housing, and so we need a housing plan that is oriented to housing many more of the most vulnerable members of the urban communities along the coast, in cooperation with other towns and cities that are at higher elevations like us.
    c. As a policy approach to dealing with reducing climate change or as a consequence of fossil fuel depletion (or both), higher prices are very likely coming for fossil fuels. We need to plan for supporting an aggressive combination of "push" and "pull" policy approaches to

move us away from fossil fuels, including reducing single-occupant gas-vehicle commuting and a transition away from fossil fuels for heating (including methane "natural" gas, and heating fuel oil). Policy responses might include:

i. Completing safe bike passageways from South Acton train station (ARRT terminus) to both North- and South-bound Bruce Freeman Rail Trail entrances
ii. Continuing to expand on local & regional public transit support.
iii. Many public electric car charging stations at places where cars hang out for a few hours (train station, major retailing centers, schools)
iv. Find effective ways of supporting a faster transition away from fossil-fuel heating
v. Continue efforts to get the largest gas leaks fixed first
vi. Switch the municipal electric supply to all-renewable power.
vii. Continue efforts to encourage signups for the Acton Power Choice Green option, and make sure that future Acton Power Choice program contracts include as much renewable power as possible within the fiscal goals of the program.

Some of the MVP workshop involved a geographic focus on identifying particular areas of concern in town. Not having the actual notes in front of me, I want to highlight the following::

a. Protect undeveloped areas along our two main stream corridors, Fort Pond Brook and Nashoba Brook: These areas are more likely to be flooding, and undeveloped land can act like a helpful sponge in absorbing extra water.
b. Plan for moving risky activities currently located near these streams to less environmentally-sensitive locations. For example, I often cringe when I see Bursaw at Concord Road and 2A, with a wide variety of fossil fuel storage onsite, so close to Nashoba Brook.
c. Continuous undeveloped upland areas are rare and important. I'm thinking of the Springhill/Nashoba Brook/Robbins Mill/ Camp Acton areas, and the adjacent Carlisle conservation land. Some opportunities for expanding protections in adjacent unbuilt but unprotected areas still exist. It would be useful if Carlisle and Acton could map these out together. Similar opportunities exist along our other town boundaries.
d. Some of our roads cross into Zone 1 well-protection areas. We need better protections there. For example, Main Street near the Conant Wells.

Trees provide shade, carbon sequestration, water absorption, and homes for animals. Tree health will be challenged by climate change. Policy actions might include:

a. tree-preservation bylaw
b. Protecting more undeveloped forest land.
c. reviving tree hearing process
d. prioritizing the protection of large trees in project reviews.

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:

- The Discovery Museum
- Middlesex West Chamber of Commerce
- Haartz Corporation
- Rex Lumber
- Quail Ridge Country Club
- Sudbury Valley Trustees
- Suasco Watershed Community Council
- Town of Littleton
- Town of Boxborough
- Town of Carlisle
- Town of Concord
- Town of Sudbury
- Town of Maynard
- Town of Stow; Town of Westford

See Appendix C for public meeting notices. The draft Acton Hazard Mitigation Plan 2018 Update was posted on the Town's website for the second public meeting. Members of the public could access the draft document and submit comments or questions to the Town.

CONTINUING PUBLIC PARTICIPATION

Following the adoption of the plan update, the 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

November 130, 2017	Meeting of the Acton Local Hazard Mitigation Planning Team
January 30, 2018	Meeting of the Acton Local Hazard Mitigation Planning Team
April 18, 2018	First Public Meeting with Acton Conservation Commission
May 24, 2018	Meeting of the Acton Local Hazard Mitigation Planning Team
June 18, 2018	Second Public Meeting with Acton Board of Selectmen
July 31, 2018	Draft Plan Update submitted to MEMA
October 19, 2018	FEMA Notice of Approvable Pending Adoption
November 5, 2018	Final Plan adopted by the Town

[This page intentionally left blank]

SECTION 4: RISK ASSESSMENT

The risk assessment analyzes the potential natural hazards that could occur within the Town of Acton 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 Acton'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 6 below summarizes the hazard risks for Acton. 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 Acton using the definitions for hazard frequency and severity listed below. Based on this, the Town set an overall priority for each hazard.

Table 6: Hazard Risks Summary

Hazard	Frequency		Severity	
	Massachusetts	Acton	Massachusetts	Acton
Flooding	High	Medium	Serious to extensive	Serious
Dam failures	Low	Low	Extensive	Extensive
Coastal Hazards	High	N/A	Serious	N/A
Tsumani	Very Low	N/A	Extensive	N/A
Hurricane/Tropical Storm	Medium	Medium	Serious	Serious
Tornadoes	Medium	Low	Serious	Minor
Thunderstorms	High	High	Minor	Minor
Nor'easter	High	High	Minor	Minor
Winter-Blizzard/Snow	High	High	Minor	Minor
Winter-Ice Storms	Medium	Medium	Minor	Minor
Winter Ice Jams	Low	N/A	Serous	N/A
Earthquakes	Very Low	Very Low	Serious	Serious
Landslides	Low	Low	Minor	Minor
Brush fires	Medium	Low	Minor	Minor
Major Urban Fires	Low	N/A	Minor	N?A
Extreme Temperatures	Medium	Medium	Minor	Minor
Drought	Low	Low	Minor	Minor

Source: Massachusetts State Hazard Mitigation Plan, 2013, modified for Acton

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.

It should be noted that several of the hazards listed in the 2013 Massachusetts State Hazard Mitigation plan are not applicable to the Town of Acton. Due to its location, coastal hazards including Tsunamis and Storm Surge are not applicable. Due to the low density suburban/rural development pattern in Acton, Major Urban Fires are also not applicable to this town. In addition, ice jams are not a hazard for the town. The US Army Corps Ice Jam Database shows no record of ice jams in Acton.

FLOOD-RELATED HAZARDS

Flooding was the most prevalent serious natural hazard identified by local officials in Acton. Flooding is generally caused by hurricanes, nor'easters, severe rainstorms, and thunderstorms. Global climate change has the potential to exacerbate these issues over time with the potential for changing rainfall patterns leading to heavier storms.

REGIONALLY SIGNIFICANT FLOODS

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

- August 1954
- March 1968
- January 1979
- April 1987
- October 1996
- June 1998
- March 2001
- April 2004
- May 2006
- April 2007
- March 2010

Local data for previous flooding occurrences are not collected by the Town of Acton. The best available local data is for Middlesex County through the National Environmental Information Center (see Table 7). Middlesex County, which includes the Town of Acton, experienced 60 flood events from 1996 –2017. No deaths or injuries were reported and the total reported property damage in the county was $41.9 million dollars. Of that total, $35.2 million is attributed to the two major events of March 2010.

Table 7: Middlesex County Flood Events, 1996 to 2017

Date	Deaths	Injuries	Property Damage
1/29/1996	0	0	0
4/17/1996	0	0	0
9/18/1996	0	0	0
10/21/1996	0	0	0
10/22/1996	0	0	0
3/10/1998	0	0	0
3/11/1998	0	0	0
5/12/1998	0	0	0
6/14/1998	0	0	0
6/15/1998	0	0	0
6/17/1998	0	0	0
4/22/2000	0	0	0
4/23/2000	0	0	0
3/22/2001	0	0	0
3/23/2001	0	0	0
3/31/2001	0	0	0
4/1/2001	0	0	0
4/2/2004	0	0	0
4/15/2004	0	0	0
3/29/2005	0	0	0
10/15/2005	0	0	100,000
10/15/2005	0	0	100,000
10/15/2005	0	0	125,000
5/13/2006	0	0	5,000,000
7/11/2006	0	0	2,000
10/28/2006	0	0	5,000
4/16/2007	0	0	25,000
2/13/2008	0	0	0
5/27/2008	0	0	3,000
6/24/2008	0	0	10,000
6/29/2008	0	0	5,000
8/10/2008	0	0	15,000

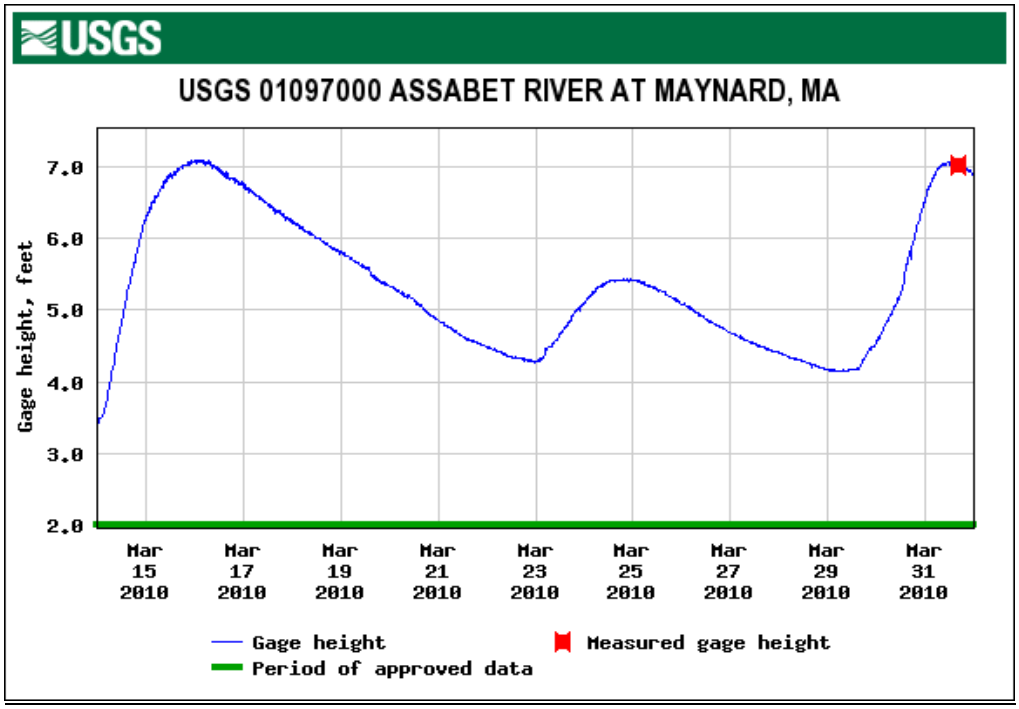
Date	Deaths	Injuries	Property Damage
8/10/2008	0	0	40,000
9/6/2008	0	0	15,000
12/12/2008	0	0	20,000
3/14/2010	0	0	26,430,000
3/29/2010	0	0	8,810,000
4/1/2010	0	0	0
8/28/2011	0	0	5,000
10/14/2011	0	0	0
6/8/2012	0	0	0
6/23/2012	0	0	15,000
7/18/2012	0	0	5,000
10/29/2012	0	0	0
6/7/2013	0	0	0
7/1/2013	0	0	0
7/23/2013	0	0	0
9/1/2013	0	0	10,000
3/30/2014	0	0	35,000
7/27/2014	0	0	0
8/31/2014	0	0	0
10/22/2014	0	0	20,000
10/23/2014	0	0	0
12/9/2014	0	0	5,000
12/9/2014	0	0	30,000
5/31/2015	0	0	0
8/4/2015	0	0	0
8/15/2015	0	0	50,000
8/15/2015	0	0	75,000
9/30/2015	0	0	0
4/6/2017	0	0	0
6/27/2017	0	0	1,000
7/12/2017	0	0	1,000,000
7/18/17	0	0	0
8/2/2017	0	0	5,000
10/25/17	0	0	0

Source: NOAA, National Environmental Information Center

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 31, 2010. Flood stage at this gage is 5 feet.

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



Source: United States Geological Survey, 2018

OVERVIEW OF TOWN-WIDE FLOODING

As with most of eastern Massachusetts the natural hazard threat that is most prevalent in the town of Acton, and therefore the focus of most of the Town's hazard mitigation efforts, is flooding. Acton is located entirely within the SuAsCo watershed (Sudbury – Assabet – Concord) and all of Acton's water drains to the Assabet River. Major brooks include Fort Pond Brook and Nashoba Brook and there are a number of tributaries. Because of Acton's topography many of the brooks flow very slowly and many historic farming drainage ditches have filled. These and other circumstances can result in flooding. Major water bodies include Nagog Pond (a water supply reservoir for Concord), Grassy Pond and Ice House Pond.

Map 3 shows that there are extensive areas of 100-year flood plain throughout the town, but particularly along Fort Pond Brook and Nashoba Brook, along the town's boundary with Boxborough and in the very northern tip of town. Flooding in Acton is occasional, usually within or near floodplain areas. Damage may consist of flooding of basements or yards. Today, an increasing amount of impervious surface from new development contributes to flooding issues, but since the 1970's and the issuance of floodplain

regulations, no new construction has occurred in flood plains. Flooding issues tend to be related to rising water rather than velocity.

In many areas of town, flooding occurs due to extensive beaver activity. Virtually every brook in town has had some degree of beaver activity in the past few years. Beaver mitigation is an important step in controlling flooding in Acton, and there is a need to strike a balance between allowing beavers to exist and reducing flooding.

Roadways in Acton tend to flood every other year, but this does not lead to many major hazards since usually the roads remain passable. Older pipes in town can pose problems if they are undersized or in poor condition, but the town has an ongoing maintenance program to upgrade drainage infrastructure. Flooding is exacerbated when freezing temperatures are followed by rain, causing catch basin blockage. Since most of the flooding in town tends to occur in the flood plains and not as a result of inadequate drainage infrastructure, structural solutions to flooding have not been the main focus.

With regard to private drainage facilities, one challenge the town faces is with maintenance. It often difficult to enforce maintenance and inspections of private facilities. This issue will become even more important as the town sees more development.

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 in Appendix B and their definitions are listed 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 X (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. 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

The town identified several other local areas of potential flooding with the corresponding map location.

Table 8: Other Locally Identified Areas of Flooding

Map ID	Name	Description
1	Water Department Well (Kennedy Wellfield, Route 27)	This town-owned and operated water well located off of Route 27 in the northeast part of Acton is vulnerable to flooding due to beaver dams on Butter Brook. In the past, if the water table was high enough, surface water will intrude into the well and potentially impact water quality. A filtration plant has been installed, the risk to water quality has been mitigated.
2	Great Road	Some properties at Great Road near Wetherbee Street flood occasionally. The parking lot and driveway of a private recreation club can be cut off; a house upstream has flooded as well as a parking lot at an apartment building next to gas station floods. No special action has been taken by Town. A house upstream does flood and the owner thinks the bridge at the club may be restricting flow. In addition, parts of the East Acton village may have pooling water, but this could be due to the associated with Nashoba Brook.
3	Stow Street/Martin Street	Properties at Stow Street and Martin Street flood once every 3 to 4 years. Beaver dams have been found near this location. Impacts include flooded basements and roads. The road is closed when it floods, but there is an easy detour around it. Emergency management assists residents with pumping out basements.
4	Flint Road	Homes in the Flint Road area south of Mass. Ave. have seen flooding once every few years due to beaver activity. The town has removed beaver dams at the end of Flint Road.
5	Water Department Well (Whit-Clapp, Route 111)	This town-owned and operated water well located off of Route 111 in the southwest part of Acton is vulnerable to flooding due to beaver dams near Inch Brook and Guggins Brook. If the water table is high enough, surface water will intrude into well and potentially impact water quality. A beaver deceiver has been installed here, this has reduced the potential for flooding.
6	Idylwilde Farms	The Idylwilde Farm area is near flood plain, and as a result agricultural fields have experienced flooding. The houses are uphill so they have not been impacted by flooding here. The landowners here have trapped a beaver here.

7	Condominiums in Boxborough	Flooding at a condominium complex in Boxborough has been caused by beaver activity in Acton. The flooding also impacted the functionality of the condo's septic system. The beaver deceiver installed for (5) (above) has also mitigated issues here.
8	Nashoba Brook	Flooding has occurred on a stretch from Route 2A to Concord Road along Nashoba Brook, often due to beaver activity, but also due to floodplain. The flooding affects properties, but not houses. A good portion of the land along this brook is town-owned. Beavers have been removed from this area.
18	Butter Brook at Route 27	Route 7, near route 225 experiences road flooding. There is a new culvert here, but flooding still happens periodically.

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 five (5) repetitive loss structures in Acton; they are all single-family homes located in or near flood zones associated with local brooks and wetlands. These repetitive loss properties had a total of thirteen (13) losses between 1987 and 2010, totaling $60,396 in damages. The state plan indicates that Massachusetts is one of the 10 states that cumulatively account for 76% of all repetitive loss buildings in the United States. For more information on repetitive losses, see http://www.fema.gov/nfip/replps.shtm.

Potential flooding damages to Acton have been estimated using HAZUS-MH. Total direct building-related economic losses are estimated at $32.9 million for a 100-year flood event and $45.6 million for a 500-year flood event. Other potential impacts are detailed in Table 32.

Based on the record of previous occurrences flooding events in Acton are a High frequency event as defined by the 2013 Massachusetts State Hazard Mitigation Plan. This hazard may occur more frequently than once in five years, or a greater than 20% chance per year.

DAMS AND DAM FAILURE

Dam failure can arise from two types of situations. Dams can fail because of structural problems independent of any storm event. Dam failure can follow an earthquake by causing structural damage. Dams can fail structurally because of flooding arising from a storm or they can overspill due to flooding.

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. An issue for dams in Massachusetts is that many were built in the 19th century without the benefits of modern engineering or construction oversight.

Dam failure is a highly infrequent occurrence but a severe incident could result in loss of lives and significant property damage. According to the Association of State Dam Safety Officials, three dams have failed in Massachusetts since 1984, one of which resulted in a death. There has not been a dam failure incident in Acton.

According to data provided by the Massachusetts Department of Conservation and Recreation there are five dams in Acton of various sizes. Acton identified the following nine dams and updated their status. The numbers correspond to the numbers on Map 8, "Local Hazard Areas."

Robbins Mill Pond Dam (9)
The Robbins Mill Pond Dam impounds the Nashoba Brook at Wheeler Lane in the Nashoba Brook Conservation Area. The town rebuilt this dam in 1990 by replacing an earthen dam with a new dam in 1990. This is identified as a low hazard dam. It has been inspected by Tighe and Bond and a management plan is in place. DCR calls this the Bellows Farm Mill dam and classifies it as a low hazard dam.

Pencil Factory Dam (10)
This dam is located on the Nashoba Brook. This dam is breached, while beaver activity is possible, it is not considered to be at risk for flooding.

Brook Street Dam (11)
This is a small private stone dam located on Nashoba Brook.

Ice House Pond Dam (12)
Also called the Allen Dam, this is a privately-owned stone dam on Nashoba Brook at Ice House Pond. The dam was rebuilt by the town in 1995 and now allows periodic drawdowns. If the dam were to breach, downstream impacts would be of concern. A new culvert has improved the functioning of the dam. The town draws down water in advance of storms. DCR refers to this as Allen dam and classifies it as a low hazard dam.

Erickson's Grain Mill Dam (13)
This dam, located on Fort Pond Brook, is privately owned, but is important for maintaining the water body as a scenic and recreational resource. It is made of stone masonry and is in poor condition. There are concerns about the downstream impacts if this dam is breached. There is downstream development and the commuter rail is also nearby. An assessment of potential downstream impacts would be warranted for this site. DCR classifies this as a significant hazard dam.

River Street Dam (14)
This dam is located at River Street on Fort Pond Brook. This dam does back up in the spring and floods. As with Erickson's Grain Mill Dam, there are concerns about the downstream impacts if this dam is breached. A development is occurring nearby and the commuter rail is also nearby. A large amount of water would be stored behind the dam during a large storm. An assessment of potential downstream impacts would be warranted for this site. The town has purchased the land and the dam. Planning to breach the dam is in the early stages.

Assabet River Dam (15)

This dam (also known as the Powder Mill Dam, or Old High Street Dam) is located on the Assabet River at Old High Street. It is privately-owned by the Acton Hydro Company. It has a hydro-electric component, is a wood crib dam, has a manual intake and sluice gates, and is partially dismantled. There are concerns about downstream impacts if the dam is breached. Downstream are a number of commercial uses, including at least two sites that may contain hazardous materials. However, work has been done to repair the dam. An Emergency Action Plan was prepared for the dam in 2004 that includes list of downstream properties to be evacuated. Routine measures include daily inspections by the owner, monitoring weather conditions, monitoring flow rates via upstream USGS gaging station, staffed 24-hours during extreme flood conditions, and an annual detailed inspection by the owner. DCR classifies this as a significant hazard dam.

Nagog Pond Dam (16)
This dam is located on Nagog Brook. Nagog Pond is owned by the Town of Concord as part of their water supply water supply. The dam appears to be in good condition and has not caused any concerns. DCR classifies this as a significant hazard dam.

Grassy Pond Brook Dam (17)
This dam is cement with a 24-foot opening on a brook segment between Freedom Farm Road and Arlington Street.

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)

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 Acton is a low frequency event as defined by the 2013 Massachusetts State Hazard Mitigation Plan. This hazard may occur less frequently than once in 50 years to once in 100 years (1% to 2% per year).

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 Acton. Information on wind related hazards can be found on Map 5 in Appendix B.

As shown in Map 5 in Appendix A, a tropical storm tracked through the southeast corner of Acton in 1996 and a Category 1 hurricane tracked through neighboring Boxborough in 1858. A hurricane or storm track is the line that delineates the path of the eye of a hurricane or tropical storm. However, the town does experience 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 also indicates that the 100-year wind speed is 110 miles per hour. No tornadoes have been recorded in Acton.

Winds during other storms also can cause damage. Downed trees and limbs can be a problem due to weather conditions such as strong wind or heavy snow and ice. Tree limbs can down power and communication lines and impact major roadways. The combination of wind and snow caused significant tree damage during the March 2018 blizzards.

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. Given its location not too distant from the coast, the Town of Acton's entire area is vulnerable to hurricanes, which occur between June and November. 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.

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 Acton 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

*Category 3
Source: National Oceanic and Atmospheric Administration

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

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: NOAA

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 Acton. Potential hurricane damages to Acton have been estimated using HAZUS-MH. Total damages are estimated at $18 million for a Category 2 hurricane and $51 million for a Category 4 hurricane. Other potential impacts are detailed in Table 30.

Based on records of previous occurrences, hurricanes in Acton are a medium frequency event as defined by the 2013 Massachusetts State Hazard Mitigation Plan. This hazard occurs from once in 5 years to once in 50 years, or a 2% to 20% chance 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 in Table 11 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

The frequency of tornadoes in eastern Massachusetts is low; on average, there are six tornadoes that touchdown somewhere in the Northeast region every year. The strongest tornado in Massachusetts history was the Worcester Tornado in 1953 (NESEC). The most recent tornado events in Massachusetts were in Springfield in 2011 and in Revere in 2014. The Springfield tornado caused significant damage and resulted in four deaths in June of 2011. The Revere tornado touched down in Chelsea just south of Route 16, moved north into Revere's business district along Broadway, and ended near the intersection of Routes 1 and 60. The path was approximately two miles long and 3/8 mile wide, with wind speeds up to 120 miles per hour. Approximately 65 homes had substantial damages and 13 homes and businesses were rendered uninhabitable.

There have been no recorded tornadoes in the Town of Acton. Since 1955 there have been 18 tornadoes in surrounding Middlesex County recorded by the Tornado History Project. Two of these were F3 tornados, and four were F2. These 18 tornadoes resulted in a total of one fatality and six injuries and $38.8 million in damages, as summarized in Table 12.

Table 12: Tornado Records for Middlesex County

Date	Fujita	Fatalities	Injuries	Width	Length	Damage
10/24/1955	1	0	0	10	0.1	$500-$5000
6/19/1957	1	0	0	17	1	$5K-$50K
6/19/1957	1	0	0	100	0.5	$50-$500
7/11/1958	2	0	0	17	1.5	$50K-$500K
8/25/1958	2	0	0	50	1	$500-$5000
7/3/1961	0	0	0	10	0.5	$5K-$50K
7/18/1963	1	0	0	50	1	$5K-$50K
8/28/1965	2	0	0	10	2	$50K-$500K
7/11/1970	1	0	0	50	0.1	$5K-$50K
10/3/1970	3	1	0	60	35.4	$50K-$500K
7/1/1971	1	0	1	10	25.2	$5K-$50K
11/7/1971	1	0	0	10	0.1	$50-$500
7/21/1972	2	0	4	37	7.6	$500K-$5M
9/29/1974	3	0	1	33	0.1	$50K-$500K
7/18/1983	0	0	0	20	0.4	$50-$500

Date	Fujita	Fatalities	Injuries	Width	Length	Damage
9/27/1985	1	0	0	40	0.1	$50-$500
8/7/1986	1	0	0	73	4	$50K-$500K
8/22/2016	1	0	0	400	.85	$10

Source: The Tornado History Project

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 Acton, tornado impacts are relatively localized compared to severe storms and hurricanes. Damages from any tornado in Acton would greatly depend on the track of the tornado.

Based on the record of previous occurrences since 1956, Tornado events in Acton are a low frequency event as defined by the 2013 Massachusetts State Hazard Mitigation Plan. This hazard may occur from once in 50 years to once in 100 years (1% to 2% 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, that are listed in the Massachusetts State Hazard Mitigation Plan from 2013 or have occurred since:

Table 13: Nor'easter Events for Massachusetts, 1978 to 2015

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
March 2015 Nor'easters	March 2015

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

Acton 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 Acton 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 Acton 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 Acton is for Middlesex County through the National Environmental Information Center (‘). Between the years 2006 and 2017 NEIC records show 72 thunderstorm events in Middlesex County (Table 14). These storms resulted in a total of $1,631,000 in property damages. There were no injuries or deaths reported.

Table 14: Middlesex County Thunderstorm Events, 2006 to 2017

Date	Type	Magnitude	Deaths	Injuries	Damage
4/1/2006	Thunderstorm Wind	50	0	0	8000
5/21/2006	Thunderstorm Wind	61	0	0	95000
6/23/2006	Thunderstorm Wind	50	0	0	30000
7/11/2006	Thunderstorm Wind	50	0	0	10000
7/21/2006	Thunderstorm Wind	50	0	0	35000
7/28/2006	Thunderstorm Wind	50	0	0	15000
8/2/2006	Thunderstorm Wind	50	0	0	15000
5/16/2007	Thunderstorm Wind	50	0	0	0
6/27/2007	Thunderstorm Wind	50	0	0	0
7/6/2007	Thunderstorm Wind	50	0	0	0
7/9/2007	Thunderstorm Wind	50	0	0	0

Date	Type	Magnitude	Deaths	Injuries	Damage
7/15/2007	Thunderstorm Wind	50	0	0	0
7/28/2007	Thunderstorm Wind	50	0	0	0
7/29/2007	Thunderstorm Wind	50	0	0	0
8/17/2007	Thunderstorm Wind	50	0	0	0
9/8/2007	Thunderstorm Wind	50	0	0	25000
5/27/2008	Thunderstorm Wind	50	0	0	8000
6/10/2008	Thunderstorm Wind	50	0	0	20000
6/23/2008	Thunderstorm Wind	50	0	0	5000
6/24/2008	Thunderstorm Wind	50	0	0	5000
6/27/2008	Thunderstorm Wind	50	0	0	5000
6/29/2008	Thunderstorm Wind	50	0	0	10000
7/1/2008	Thunderstorm Wind	50	0	0	20000
7/2/2008	Thunderstorm Wind	50	0	0	5000
7/3/2008	Thunderstorm Wind	50	0	0	15000
7/19/2008	Thunderstorm Wind	50	0	0	8000
7/20/2008	Thunderstorm Wind	50	0	0	5000
7/27/2008	Thunderstorm Wind	50	0	0	5000
8/3/2008	Thunderstorm Wind	50	0	0	5000
8/7/2008	Thunderstorm Wind	50	0	0	5000
9/9/2008	Thunderstorm Wind	50	0	0	8000
5/9/2009	Thunderstorm Wind	50	0	0	2000
5/24/2009	Thunderstorm Wind	50	0	0	15000
7/7/2009	Thunderstorm Wind	50	0	0	1000
7/8/2009	Thunderstorm Wind	50	0	0	20000
7/26/2009	Thunderstorm Wind	50	0	0	15000
7/31/2009	Thunderstorm Wind	50	0	0	30000
5/4/2010	Thunderstorm Wind	50	0	0	30000
6/1/2010	Thunderstorm Wind	50	0	0	5000
6/3/2010	Thunderstorm Wind	50	0	0	20000
6/5/2010	Thunderstorm Wind	50	0	0	40000
6/6/2010	Thunderstorm Wind	50	0	0	100000
6/24/2010	Thunderstorm Wind	50	0	0	30000
7/12/2010	Thunderstorm Wind	50	0	0	50000
7/19/2010	Thunderstorm Wind	50	0	0	25000
6/1/2011	Thunderstorm Wind	50	0	0	5000
6/9/2011	Thunderstorm Wind	50	0	0	15000
8/2/2011	Thunderstorm Wind	50	0	0	1000
8/19/2011	Thunderstorm Wind	50	0	0	15000
6/8/2012	Thunderstorm Wind	50	0	0	25000
6/23/2012	Thunderstorm Wind	45	0	0	5000
7/4/2012	Thunderstorm Wind	50	0	0	10000
7/18/2012	Thunderstorm Wind	70	0	0	350000
9/7/2012	Thunderstorm Wind	50	0	0	10000
9/8/2012	Thunderstorm Wind	40	0	0	3000

Date	Type	Magnitude	Deaths	Injuries	Damage
6/17/2013	Thunderstorm Wind	50	0	0	25000
6/18/2013	Thunderstorm Wind	45	0	0	10000
6/24/2013	Thunderstorm Wind	45	0	0	3000
7/23/2013	Thunderstorm Wind	50	0	0	20000
7/29/2013	Thunderstorm Wind	50	0	0	5000
7/3/2014	Thunderstorm Wind	50	0	0	75000
7/7/2014	Thunderstorm Wind	87	0	0	100000
7/15/2014	Thunderstorm Wind	50	0	0	25000
7/28/2014	Thunderstorm Wind	50	0	0	50000
9/6/2014	Thunderstorm Wind	50	0	0	15000
5/28/2015	Thunderstorm Wind	45	0	0	5000
8/4/2015	Thunderstorm Wind	50	0	0	40000
8/15/2015	Thunderstorm Wind	50	0	0	25000
2/25/2016	Thunderstorm Wind	50	0	0	30000
3/17/2016	Thunderstorm Wind	45	0	0	5000
8/22/2017	Thunderstorm Wind	50	0	0	14,000

*Magnitude refers to maximum wind speed
Source: NOAA, National Environmental Information Center

Severe thunderstorms are a town-wide hazard for Acton. 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 Acton 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 Acton. The average annual snowfall Acton is 48-72 inches (see Map 6 in Appendix B). A number of public safety issues 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. In addition, transit operations may be impacted, as they were in the 2015 blizzard which caused the closure of the MBTA system for one day and limited services on several transit lines for several weeks.

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 in Table 15below:

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 Acton, blizzards and severe winter storms have occurred in the following years, shown in Table 16:

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 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
Severe Snow Storm	March 2018

Source: National Oceanic and Atmospheric Administration

The Town of Acton does not keep local records of winter storms. Data for Middlesex County, which includes Acton, is the best available data to help understand previous occurrences and impacts of heavy snow events. According to National Climate Data Center (NEIC) records, from 1996 to 2016, Middlesex County experienced 75 heavy snowfall events, resulting in no injuries or deaths, and $229,000 in property damage. See Table 17 for and heavy snow events and impacts in Middlesex County.

Table 17: Heavy Snow Events and Impacts in Middlesex County, 2000 to 2017

Date	Type	Deaths	Injuries	Property Damage
1/13/2000	Heavy Snow	0	0	0
1/25/2000	Heavy Snow	0	0	0
2/18/2000	Heavy Snow	0	0	0
12/30/2000	Heavy Snow	0	0	0
1/20/2001	Heavy Snow	0	0	0
2/5/2001	Heavy Snow	0	0	0
3/5/2001	Heavy Snow	0	0	0
3/9/2001	Heavy Snow	0	0	0
3/30/2001	Heavy Snow	0	0	0
12/8/2001	Heavy Snow	0	0	0
3/20/2002	Heavy Snow	0	0	0
3/16/2004	Heavy Snow	0	0	0
2/24/2005	Heavy Snow	0	0	0
12/13/2007	Heavy Snow	0	0	0
12/16/2007	Heavy Snow	0	0	0
12/19/2007	Heavy Snow	0	0	0
1/14/2008	Heavy Snow	0	0	28000
1/14/2008	Heavy Snow	0	0	20000
1/14/2008	Heavy Snow	0	0	20000
2/22/2008	Heavy Snow	0	0	0
3/1/2008	Heavy Snow	0	0	0
12/19/2008	Heavy Snow	0	0	0
12/20/2008	Heavy Snow	0	0	8000

12/21/2008	Heavy Snow	0	0	0
12/31/2008	Heavy Snow	0	0	0
1/10/2009	Heavy Snow	0	0	0
1/11/2009	Heavy Snow	0	0	0
1/18/2009	Heavy Snow	0	0	0
3/1/2009	Heavy Snow	0	0	0
3/2/2009	Heavy Snow	0	0	0
12/9/2009	Heavy Snow	0	0	15000
12/9/2009	Heavy Snow	0	0	500
12/19/2009	Heavy Snow	0	0	0
12/20/2009	Heavy Snow	0	0	0
1/18/2010	Heavy Snow	0	0	0
2/16/2010	Heavy Snow	0	0	15000
2/23/2010	Heavy Snow	0	0	8000
1/12/2011	Heavy Snow	0	0	0
1/26/2011	Heavy Snow	0	0	0
10/29/2011	Heavy Snow	0	0	30000
12/29/2012	Heavy Snow	0	0	0
2/8/2013	Heavy Snow	0	0	0
2/8/2013	Heavy Snow	0	0	0
2/23/2013	Heavy Snow	0	0	0
3/7/2013	Heavy Snow	0	0	0
3/18/2013	Heavy Snow	0	0	0
12/14/2013	Heavy Snow	0	0	0
12/17/2013	Heavy Snow	0	0	0
1/2/2014	Heavy Snow	0	0	0
1/18/2014	Heavy Snow	0	0	0
2/5/2014	Heavy Snow	0	0	0
2/13/2014	Heavy Snow	0	0	0
2/18/2014	Heavy Snow	0	0	0
11/26/2014	Heavy Snow	0	0	10000
1/24/2015	Heavy Snow	0	0	0
1/26/2015	Heavy Snow	0	0	0
2/2/2015	Heavy Snow	0	0	0
2/8/2015	Heavy Snow	0	0	0
2/14/2015	Heavy Snow	0	0	0
2/5/2016	Heavy Snow	0	0	70000
2/5/2016	Heavy Snow	0	0	5000
3/21/2016	Heavy Snow	0	0	0
4/4/2016	Heavy Snow	0	0	0
12/29/2016	Heavy Snow	0	0	0
3/14/2017	Heavy Snow	0	0	0

Source: NOAA, National Environmental Information Center

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, shown in Table 18.

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 Acton. The best available local data is for Middlesex County through the National Environmental Information Center. Middlesex County, which includes the Town of Acton, experienced 46 events from 2000 to 2017 (see Table 19).

Table 19: Middlesex County Hail Events, 2000-2017

Date	Event	Magnitude	Deaths	Injuries	Damage
7/18/2000	Hail	1	0	0	0
6/20/2001	Hail	1.75	0	0	0
7/12/2001	Hail	1.5	0	0	0
5/27/2002	Hail	0.75	0	0	0
6/2/2002	Hail	0.75	0	0	0
8/13/2003	Hail	0.75	0	0	0
7/2/2004	Hail	0.75	0	0	0
8/20/2004	Hail	0.88	0	0	75,000
5/21/2006	Hail	0.75	0	0	0
7/11/2006	Hail	1	0	0	0
7/28/2006	Hail	0.75	0	0	0
6/5/2007	Hail	1.25	0	0	0
6/22/2007	Hail	0.75	0	0	0

7/9/2007	Hail	1	0	0	0
7/28/2007	Hail	0.88	0	0	0
6/23/2008	Hail	0.75	0	0	0
6/24/2008	Hail	0.75	0	0	0
7/1/2008	Hail	0.88	0	0	0
7/2/2008	Hail	0.75	0	0	0
8/3/2008	Hail	0.75	0	0	0
8/7/2008	Hail	1	0	0	0
8/10/2008	Hail	0.75	0	0	0
5/24/2009	Hail	1	0	0	0
6/27/2009	Hail	0.88	0	0	0
7/7/2009	Hail	0.75	0	0	0
7/8/2009	Hail	1.75	0	0	0
5/4/2010	Hail	0.75	0	0	0
5/7/2011	Hail	0.75	0	0	0
6/1/2011	Hail	0.75	0	0	0
8/2/2011	Hail	0.75	0	0	0
8/19/2011	Hail	0.75	0	0	0
3/13/2012	Hail	1.25	0	0	0
3/14/2012	Hail	1	0	0	0
6/23/2012	Hail	0.75	0	0	0
7/18/2012	Hail	1	0	0	0
10/30/2012	Hail	1	0	0	0
6/17/2013	Hail	0.75	0	0	0
5/25/2014	Hail	0.75	0	0	0
7/3/2014	Hail	1	0	0	0
8/7/2014	Hail	0.75	0	0	0
9/6/2014	Hail	0.88	0	0	0
8/4/2015	Hail	1	0	0	0
8/15/2015	Hail	0.75	0	0	0
7/23/2016	Hail	.75	0	0	0
6/27/2017	Hail	1.00	0	0	0
8/2/2017	Hail	.75	0	0	0

*Magnitude refers to diameter of hail stones in inches
Source: NOAA, National Environmental Information Center

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 Acton 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 in Table 20 below:

Table 20: Richter Scale and Effects

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

Source: Nevada Seismological Library (NSL), 2005

According to the State Hazard Mitigation Plan, New England experiences an average of five earthquakes per year. From 1668 to 2007, 355 earthquakes were recorded in Massachusetts (NESEC). Most have originated from the La Malbaie fault in Quebec or from the Cape Anne fault located off the coast of Rockport. The region has experienced larger earthquakes in the distant past, including a magnitude 5.0 earthquake in 1727 and a 6.0 earthquake that struck in 1755 off the coast of Cape Anne. More recently, a pair of damaging earthquakes occurred near Ossipee, NH in 1940. A 4.0 earthquake centered in Hollis, Maine in October 2012 was felt in the Boston area. Historic records of some of the more significant earthquakes in the region are shown in Table 21.

Table 21: 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

Location	Date	Magnitude
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

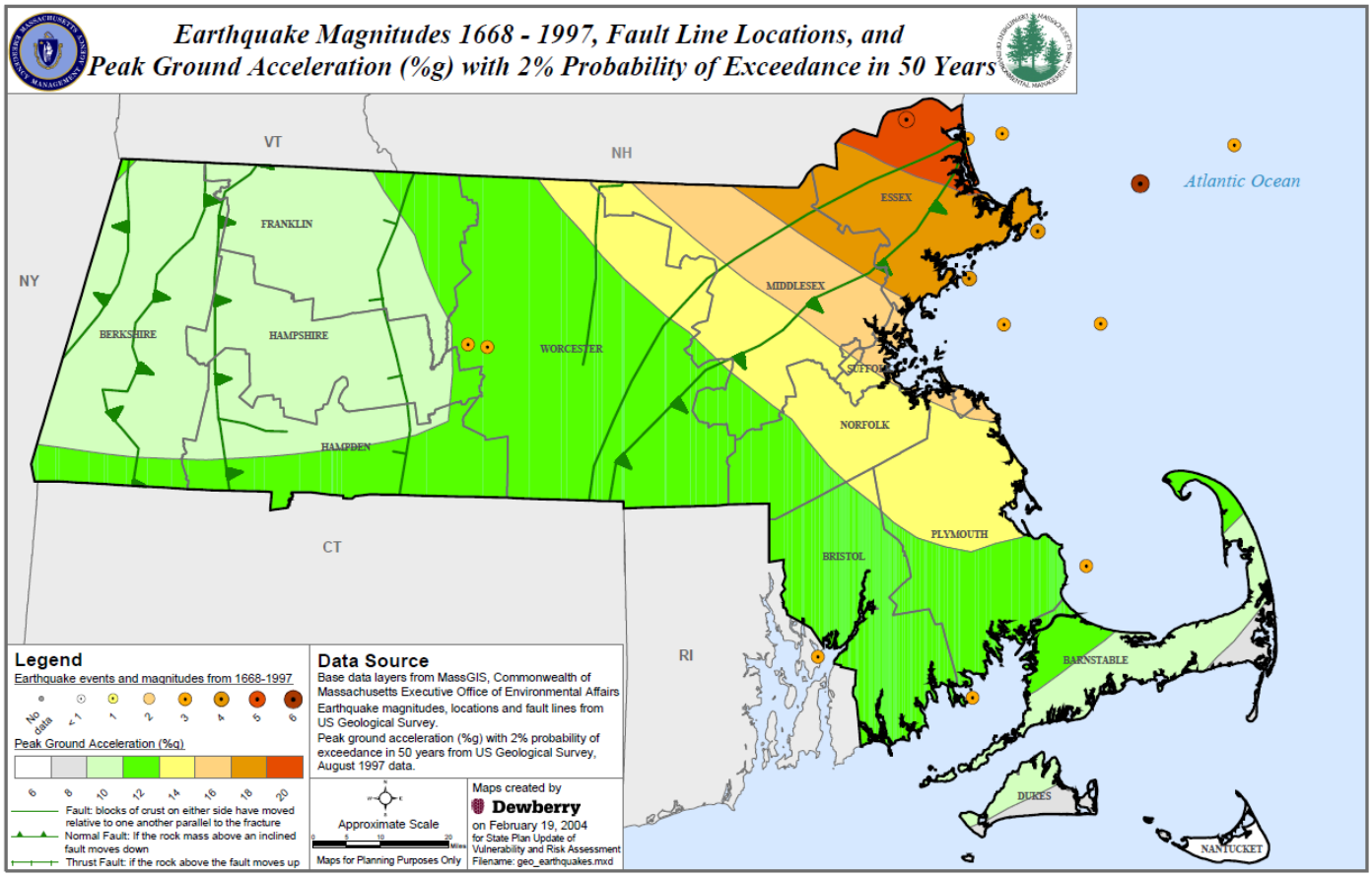
One measure of earthquake risk is ground motion, which is measured as maximum peak horizontal acceleration, expressed as a percentage of gravity (%g). The range of peak ground acceleration in Massachusetts is from 10 %g to 20 %g, with a 2% probability of exceedance in 50 years (see Figure 3).

Acton is in the middle part of the range for Massachusetts, at 14 %g to 16 %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 has been one earthquake with an epicenter in Acton. See Map 4 in Appendix B.

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

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

Figure 3: State of Massachusetts Earthquake Probability Map



Source: Massachusetts State Hazard Mitigation Plan

Much of the development in town pre-dates the current building code and could be vulnerable in the event of a severe earthquake. Potential earthquake damages to Acton have been estimated using HAZUS-MH. Total building damages are estimated at $417 million for a 5.0 magnitude earthquake and $3 billion for a 7.0 magnitude earthquake. Other potential impacts are detailed in Table 31.

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 Acton.

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. Table 22 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 22: 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: *A Geomorphological Approach to the Estimation of Landslide Hazards and Risks in Umbria, Central Italy*, M. Cardinali et al, 2002

Acton has been classified as having a low risk for landslides (see Map 4, Appendix B). Local officials did not identify any significant issues related to landslides.

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 Acton. Based on past occurrences and the Massachusetts Hazard Mitigation Plan, landslides are low frequency events that can occur once in 50 to100 years (a 1% to 2% chance of occurring each year).

FIRE-RELATED HAZARDS

A 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

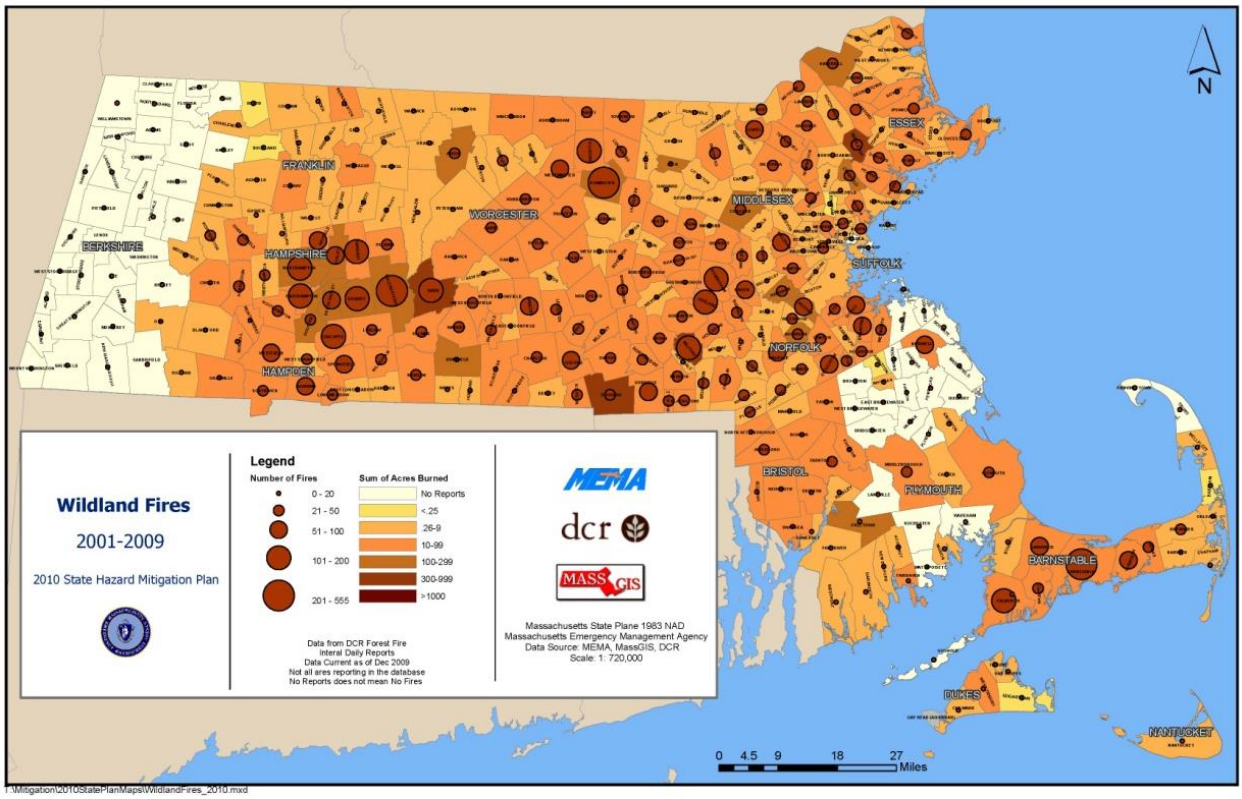
Wildfire season can begin in March and usually ends in late November. The majority of wildfires typically occur in April and May, when most vegetation is void of any appreciable moisture, making them highly flammable. Once "green-up" takes place in late May to early June, the fire danger usually is reduced 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 acres burned. The most recent data available for wildfires in Massachusetts, shown in Figure 4 below, indicates that the wildfire extent in Acton consists of .25 to 9 to 26 acres burned, with zero to 20 recordable fires from 2001 to 2009.

Figure 4: Massachusetts Wildfires, 2001 to 2009



Source: Massachusetts State Hazard Mitigation Plan

According to local officials, natural fires in Acton are not a significant issue. The town sees several brush fires annually, but these fires do not usually cause property damage or injuries. It is important, however, to remember that fire can also be a result of other events such as from the aftermath of an earthquake. Based on past occurrences and the Massachusetts Hazard Mitigation Plan 2013, brushfires are of Medium frequency, events that occur from once in 5 years to once in 50 years (2% to 20% probability per year).

EXTREME TEMPERATURES

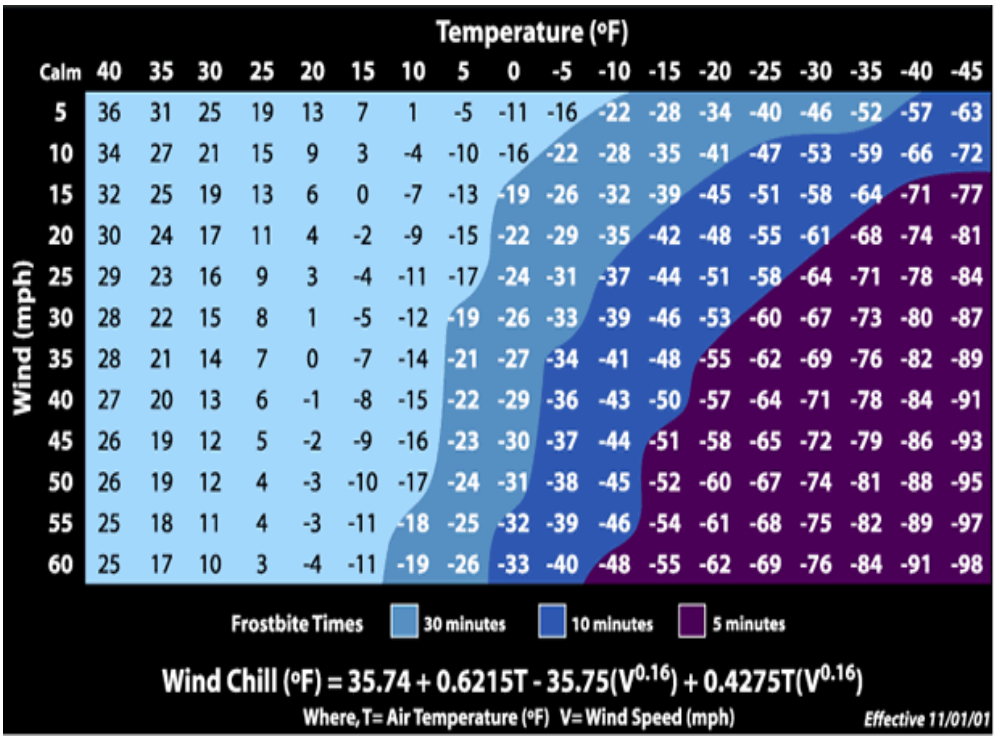
Extreme temperatures occur when either high temperature or low temperatures relative to average local temperatures occur. These can occur for brief periods of time and be acute, or they can occur over long periods of time where there is a long stretch of excessively hot or cold weather.

Acton 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 below.

Figure 45: Wind Chill Temperature Index and Frostbit 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 Acton, 9.4 percent of the population are over 65 and 5.2 percent of the population has a disability

The Town of Acton does not collect data for previous occurrences of extreme cold. The best available local data are for Middlesex County, through the National Environmental Information Center (NEIC). There are three extreme cold events on record since 2000 for the county, which caused no deaths, no injuries, or property damage.

Table 23: Middlesex County Extreme Cold and Wind Chill Occurrences

Date	Deaths	Injuries	Damage
2/15/2015	0	0	0
2/16/2015	0	0	0
2/14/2016	0	0	0

Source: NOAA, National Environmental Information Center

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 (5) 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)																
Relative Humidity (%)		80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
	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. In Acton children under 5 years old make up 4.8 percent of the population, and 9.4 percent are over 65 years old. However, even young and healthy individuals can succumb to heat if they participate in strenuous physical activities during hot weather. 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 Acton does not collect data on excessive heat occurrences. The best available local data are for Middlesex County, through the National Environmental Information Center. Since 200, there has been one excessive heat day, which did not result in injury, death, or property damage (see Table 24).

Table 24: Middlesex County Extreme Heat Occurrences

Date	Deaths	Injuries	Damage ($)
7/6/2010	0	0	0
Total	**0**	**0**	**0**

Source: NOAA, National Environmental Information Center

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. Acton is located in the Northeast region. Drought is a potential town-wide hazard in Acton.

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:

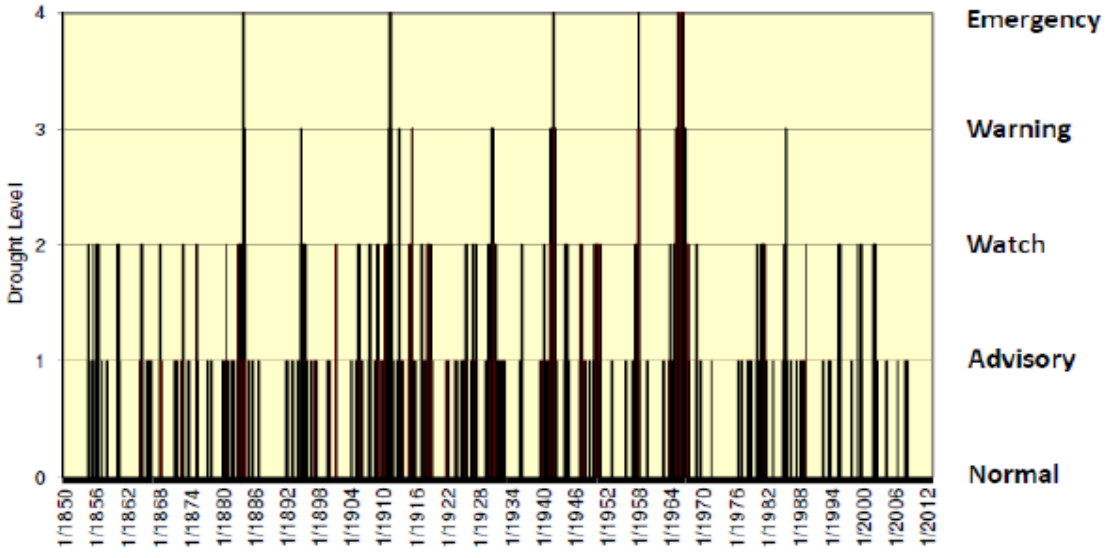
1. Standardized Precipitation Index (SPI) reflects soil moisture and precipitation.
2. Crop Moisture Index (CMI) reflects soil moisture conditions for agriculture.
3. Keetch Byram Drought Index (KBDI) is designed for fire-potential assessment.
4. Precipitation Index is a comparison of measured precipitation 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.

Acton does not collect data relative to drought events. 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 25 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 25: Chronology of Major Droughts in Massachusetts

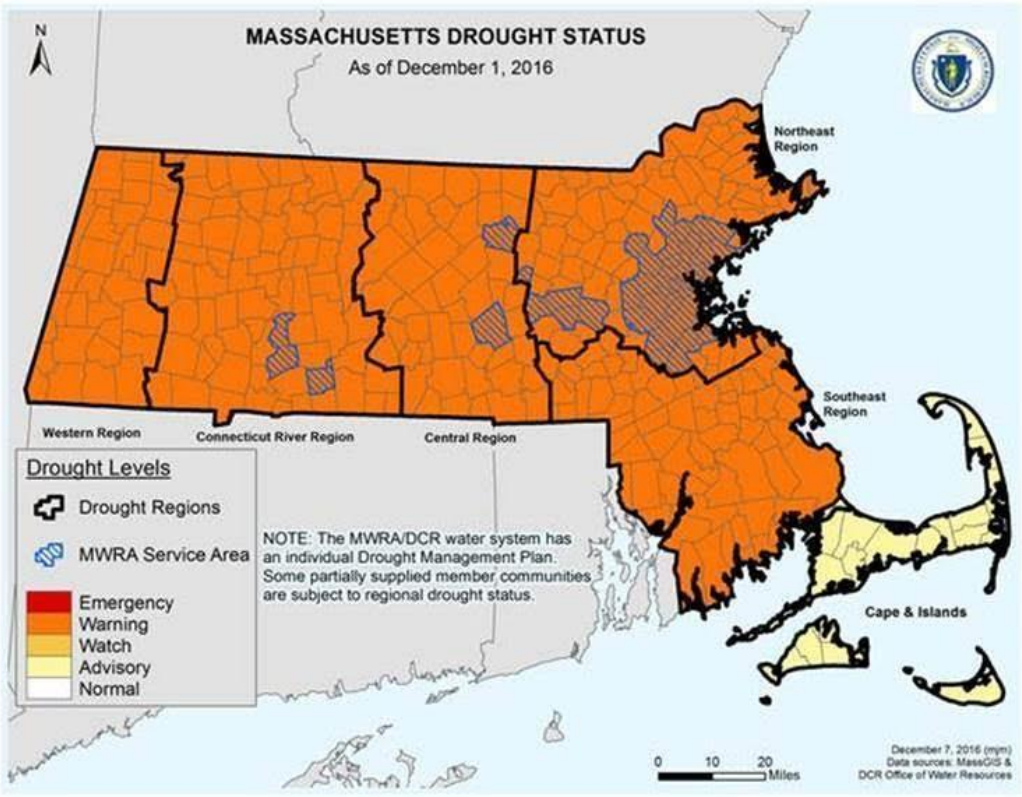
Date	Area Affected	Recurrence Interval (years)	Remarks
1929 to 1932	Statewide	10 to >50	Water-supply sources altered in 13 communities. Multistate.
		15 to >50	More severe in eastern and extreme western Massachusetts. Multistate.
1957 to 1959	Statewide	5 to 25	Record low water levels in observation wells, 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.
2016-2017	Statewide	N/A	Drought declaration began in June 2016 with a Drought Watch which was upgraded to a Drought Warning in August 2016. The Central and Northeast regions were the most severely affected.

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 levels not associated with drought emergencies have occurred five times, in 1894, 1915, 1930, 1985, and 2016. As of July 2016, a Drought Warning had been declared for the Northeast region, which includes the Town of Acton. 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 XX).. Conditions returned to normal by April 2017. Acton was under a Drought Warning from July to December 2016. On a monthly basis over the 162-year period of record, there is a 2% chance of being in a drought warning.

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, and 1999). In the 2000s, drought watches occurred in 2001 and 2002. The overall frequency of being in a drought watch is 8% 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 Acton 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 and potential loss of business revenues if water supplies were severely restricted for a prolonged period. As this hazard has never occurred to such a severe degree in Acton, there are no data or estimates of potential damages, but under a severe long term drought scenario it would be reasonable to expect a range of potential damages from several million to tens of millions of dollars. Another potential vulnerability of droughts could be increased risk of wildfires.

The state has experienced emergency droughts five times between 1850 and 2012. Even though regional drought conditions may occur at a different interval than state data indicates, droughts remain primarily regional and state phenomena in Massachusetts. Emergency drought conditions over the 162 period of record in Massachusetts 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.

Impacts of Climate Change

Many of the natural hazards that Acton has historically experienced are likely to be exacerbated by climate change in future years. This is particularly true for flooding caused by extreme precipitation and extreme heat. These are described in more detail below.

Climate Change Impacts: Extreme Precipitation

Acton's average annual precipitation is 42 inches. While total annual precipitation has not changed significantly, according to the 2012 report *When It Rains It Pours – Global Warming and the Increase in Extreme Precipitation from 1948 to 2011* intense rainstorms and snowstorms have become more frequent and more severe over the last half century in the northeastern United States. Extreme downpours are now happening 30 percent more often nationwide than in 1948 (see Figure 9). In other words, large rain or snow storms that happened once every 12 months, on average, in the middle of the 20th century, now happen every nine months.

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

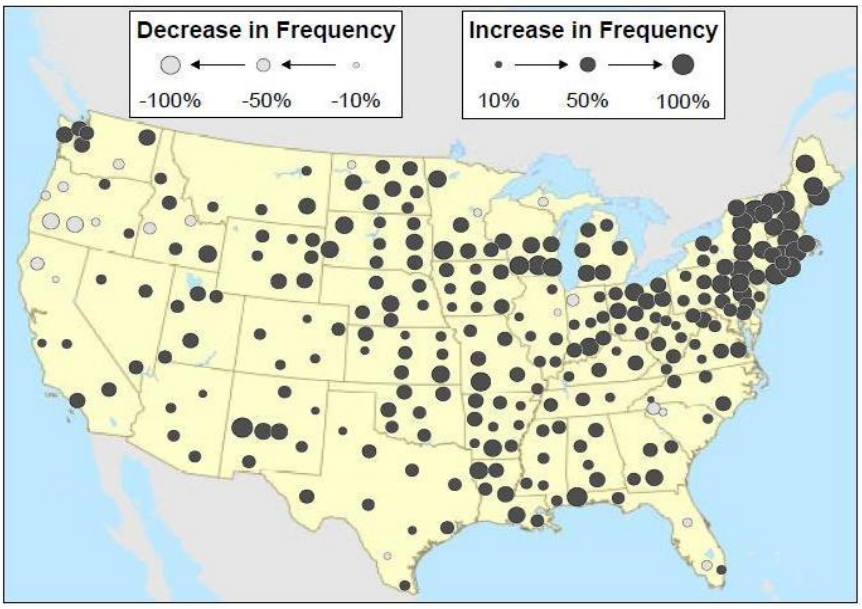
Recent temperature trends suggest greater potential impacts to come due to climate change. In the report "Confronting Climate Change in the U.S. Northeast," (2007), the Union of Concerned Scientists presented temperature projections to 2099 based on two scenarios, one with lower carbon dioxide emissions, and the other with high emissions.

Climate Change Impacts: Extreme Heat

Between 1961 and 1990, Boston experienced an average of 11 days per year over 90°F. That could triple to 30 days per year by 2095 under the low emissions scenario, and increase to 60 days per year under the high emissions scenario. Days over 100°F could increase from the current average of one day per year to 6 days with low emissions or 24 days with high emissions. By 2099, Massachusetts could have a climate similar to Maryland's under the low emissions scenario, and similar to the Carolinas' with high emissions (see Figure 10). Furthermore, the number of days with poor air quality could quadruple in Boston

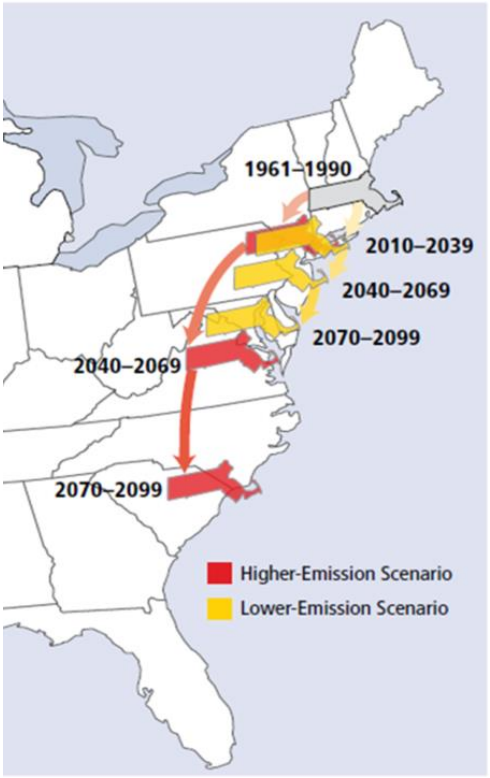
by the end of the 21st century under higher emissions scenario, or increase by half under the lower emissions scenario. These extreme temperature trends could have significant impacts on public health, particularly for those individuals with asthma and other respiratory system conditions, which typically affect the young and the old more severely.

Figure 9 Changes in Frequency of Extreme Downpours, 1948 – 2011



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

Figure 10 Mass. Extreme Heat Scenarios



Source: Union of Concerned Scientists

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. Change has certainly occurred in Acton since then, but this data still provides the most detailed description of Land Use available. Table 26 shows the acreage and percentage of land in 24 categories. If the five residential categories are aggregated, residential uses make up 26% of the area of the town (3,384.2 acres). Commercial and industrial combined make up 5.1% of the town, or 662.8 acres. Forest and wetlands make up the largest categories in town with 58% (7,534.8 acres) of town land.

Table 26: Town of Acton, MA 2005 Land Use

Land Use Type	Acres	Percent
Crop Land, Pasture, Orchard, Nursery	331.5	2.55%
Forest	5858.9	45.12%
Non-Forested Wetlands	407.0	3.13%
Forested Wetland	1268.9	9.77%
Brushland/Successional	43.8	0.34%
Mining	41.1	0.32%
Open & Urban Open Land	302.1	2.33%
Participation Recreation	110.3	0.85%
Spectator Recreation	1.9	0.01%
Water-based Recreation	1.2	0.01%
Multi-family Residential	292.3	2.25%
High Density Residential	40.9	0.31%
Medium Density Residential	1160.1	8.93%
Low Density Residential	1710.6	13.17%
Very Low Density Residential	180.3	1.39%
Commercial	458.9	3.53%
Industrial	203.9	1.57%
Transportation	115.8	0.89%
Waste Disposal	29.3	0.23%
Junkyards	5.4	0.04%
Water	253.5	1.95%
Golf Course	1.4	0.01%
Urban Public	125.1	0.96%
Cemetery	41.0	0.32%
Total Acres	**12,985.2**	**100.0%**

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.

Economic Elements

Commercial activity is located primarily along Routes 2, 2A, and 27 as well the village centers. According to the Acton 2020 plan, Acton serves as a retail and employment hub for neighboring towns. The plan highlights health care, social assistance and computer systems design as the fastest growing employment categories. As of 2010 there were nearly 12,000 people employed in nearly 800 companies in Acton.

Insulet Corporation, which manufactures insulin pumps, will become a major employer in Acton. Their new corporate headquarters and manufacturing plant could add 1,000 jobs in Acton over the next few years.

NATURAL, CULTURAL, AND HISTORIC RESOURCE AREAS

Among its natural resources, Acton possesses over 7,000 acres of forest and forested wetlands, which comprise over 50% of the town's acreage. According to the Open Space and Recreation Plan, there are 23 certified vernal pools, and 142 potential vernal pools in Acton. The Open Space and Recreation Plan details the many and varied parks and natural areas protected by state, local and private entities. The Natural Heritage and Endangered Species Program identifies 8 rare species in Acton. Acton has three Historic Districts located in Acton Center, South Acton, and West Acton. Cultural assets include the Discovery Museum.

DEVELOPMENT TRENDS

Development trends throughout the metropolitan region are tracked by MassBuilds, MAPC's Development Database, which provides an inventory of new development over the last decade. The database tracks both completed developments and those currently under construction. The database includes 17 developments completed in Acton between 2010 and 2017.

The database also includes attributes of the new development, including housing units and commercial space. The completed projects are a mix of commercial, housing, office, and retail. The 17 developments in Acton include a total of 608 housing units and more than 113,000 square feet of commercial space. See Table 27 below.

Table 27: Summary of Acton Developments, 2010-2017

Name	Status	Year	Housing Units	Commercial Square Feet	Project Type
288 Main Street	Completed	2010	4	0	Residential
Brookside Shops	Completed	2010		76,000	Retail
Ledge Rock Way	Completed	2010	3	0	Residential
Avalon Acton	Completed	2010	296	0	Residential
Grassy Pond Place (Ft. Pond Place)	Completed	2010	4	0	Residential
Nara Ridge Road	Completed	2010	10	0	Residential
Ellsworth Village	Completed	2011	33	0	Residential
Old High School Commons	Completed	2012	15	0	Residential
Micmac Lane	Completed	2013	5	0	Residential
Faulkner Mills	Completed	2014	30	0	Residential
Spruce Corner	Completed	2014	7	4,400	Mixed Use
WAVE project	Completed	2015		33,000	Retail/Commercial
CVS Pharmacy	Completed	2015		-	Retail
Residences at Constitution Drive	Completed	2015	5	0	Residential
267 Great Road	Completed	2016		-	Office
The Meadows at Acton	Completed	2016	26	0	Residential
Residences at Quail Ridge	Completed	2016	174	0	Residential

In order to characterize any change in the town's vulnerability associated with new developments, a GIS mapping analysis was conducted which overlaid the development sites with the FEMA Flood Insurance Rate Map. The analysis shows that one development, the Residences at Constitution Drive, is partially within a 0.2% Annual Chance (500 Year) Flood Zone. With respect to other hazards, there is no geographic variation across the Town of Acton. All development is within the zone of low incidence for landslides and the zone of 48 to 72 inches average annual snowfall. The entire town is in the zone of 100-year wind maximum speed of 110 miles per hour. Overall, Acton's new development does not significantly increase the town's vulnerability to natural hazards.

POTENTIAL FUTURE DEVELOPMENT

MAPC consulted with the Local Hazard Mitigation Planning Team to determine areas that may be developed in the future, based on the Town's comprehensive planning efforts and current trends and projects. The Town identified 16 potential new development sites, which are listed below and shown on Map 8 in Appendix B.

Potential future development projects:

- **East Acton Village**: 7-29 Great Road. "First Village" is a mixed use project is permitted for 12 single family homes and 5 commercial facilities.
- **100 Nagog Park** is a 300,000 sq./ft project that will be the Insulet Corp. Global Headquarters and manufacturing facility.
- **Powdermill Place** is a 40-B project with 254 units, 170 units are in Acton and the rest of the units are in Maynard.
- **252-256 Main Street** is a mixed use re-development at the K-Mart site at the intersection of Routes 111 and 27.
- **180 Skyline Drive** is a proposed 9,000 sf Concord Water Treatment Facility.
- **146 Prospect Street** – is a 4-unit 40B project for single family homes.
- **184 Main Street** is a 40-B project with 8 units (2 quadplexes).
- The town is considering combining the **Gates and Douglas elementary schools**. This would be a redevelopment project.
- **Martin Street** is a 28-unit 40B development including 2 duplexes and single family homes at 31, 39, and 45 Martin Street currently under construction.
- **62-68 Harris Street** a new N. Action fire station is being considered.
- **6 Post Office Sq.** is a 12 unit 40-B project.
- **429 Great Road** will be a new car dealership.
- **178 Great Road** Alpha Cars, new car dealership.
- **117 Central Street** is a potential 40-unit 40B project.
- **446 Mass Ave** is a potential 31-unit 40B for seniors/disabled persons.
- **348-364 Main Street** – has potential for a 30-unit 40B or possible boutique hotel/restaurant.

In order to characterize any change in the town's vulnerability associated with new developments, a GIS mapping analysis was conducted which overlaid the development sites with the FEMA Flood Insurance Rate

Map. The analysis shows that eight of the sixteen sites are partially located in flood zones, typically a portion of the site that is not built on (see Table 28).

With respect to landslide risk, all of the development sites are located in the area designated as "Low Incidence" for landslides. Other hazards such as wind speed and snowfall rates do not vary across Acton. None of the potential development sites coincide with hazard areas identified by the local team. (See hazard maps in Appendix C). Overall, Acton's potential future development would not significantly increasing the town's vulnerability.

Table 28: Relationship of Potential Development to Hazard Areas

Map ID	Potential Future Project	Flood Zones
G	East Acton Village	NA
L	100 Nagog Park	23.65% in X: 0.2% Annual Chance of Flooding
M	Powdermill Place	9.28% in AE: 1% Annual Chance of Flooding, with BFE , and 24.55% in AE: Regulatory Floodway , and 4.96% in X: 0.2% Annual Chance of Flooding
N	252-256 Main St.	NA
O	146 Prospect St.	NA
P	184 Main St.	NA
Q	Skyline Drive	NA
R	Elementary Schools	23.23% in AE: 1% Annual Chance of Flooding, with BFE , and 10.64% in AE: Regulatory Floodway
S	Martin Street	5.71% in AE: 1% Annual Chance of Flooding, with BFE , and 2.39% in X: 0.2% Annual Chance of Flooding
T	62-68 Harris St.	NA
U	6 Post Office Sq.	0.45% in X: 0.2% Annual Chance of Flooding
V	429 Great Rd.	12.33% in X: 0.2% Annual Chance of Flooding
W	178 Great Rd.	2.87% in AE: 1% Annual Chance of Flooding, with BFE , and 0.57% in AE: Regulatory Floodway
X	117 Central St.	1.91% in AE: 1% Annual Chance of Flooding, with BFE , and 0.72% in X: 0.2% Annual Chance of Flooding
Y	446 Mass Ave.	NA
Z	348-364 Main St.	NA

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 96 facilities identified in Acton. These are listed in Table 29 and are shown on the maps in Appendix B.

Explanation of Columns in Table 29

- ***Column 1: ID #:*** The first column in Table 29 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: FEMA Flood Zone*:** The fourth 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. as follows:
  Zone AE (1% annual chance) **-** Zones AE is the flood insurance rate zone 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 X: Ares of 0.2% annual chance of flood.
  Floodway: The channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.
- ***Column 5: Locally-Identified Area of Flooding*:** The fifth 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.

Table 29: Critical Facilities and Relationship to Hazard Areas

ID	Name	Type	FEMA Flood Zone	Locally-Identified Flood Area
1	Acton Department of Public Works Garage	Municipal	No	No
2	Acton Wastewater Treatment Plant	Wastewater Treatment Plant	No	No
3	Pump Station 1	Wastewater Treatment Facility	No	No
4	Pump Station 2	Wastewater Treatment Facility	AE	No
5	Pump Station 3	Wastewater Treatment Facility	No	No
6	Pump Station 4	Wastewater Treatment Facility	No	No

ID	Name	Type	FEMA Flood Zone	Locally-Identified Flood Area
7	Pump Station 5	Wastewater Treatment Facility	No	No
8	Pump Station 6	Wastewater Treatment Facility	No	No
9	Pump Station 7	Wastewater Treatment Facility	No	No
10	Pump Station 8	Wastewater Treatment Facility	No	No
11	Pump Station 9	Wastewater Treatment Facility	No	No
12	Pump Station 10	Wastewater Treatment Facility	No	No
13	School Street Water Treatment Plant	Water Treatment Plant	No	No
14	Assabet Water Treatment Plant	Water Treatment Plant	No	No
15	Hazelnut Street Ozonation Plant	Water Treatment Plant	No	No
16	Concord Water Pump Station	Water Pump Station	No	No
17	North Acton Wastewater Treatment Plant	Wastewater Treatment Plant	No	No
18	Acorn Park Wastewater Treatment Plant	Wastewater Treatment Plant	No	No
19	Woodvale Wastewater Treatment Plant	Wastewater Treatment Plant	No	No
20	Great Road Condos Wastewater Trmt. Plant	Wastewater Treatment Plant	X .2% chance	No
21	Robbins Brook Wastewater Treatment Plant	Wastewater Treatment Plant	No	No
22	Life Care Center Wastewater Trmt. Plant	Wastewater Treatment Plant	No	No
23	Yankee Village Wastewater Trmt. Plant	Wastewater Treatment Plant	No	No
24	Farmbrook Wastewater Treatment Plant	Wastewater Treatment Plant	No	No
25	Brookside Apts. Wastewater Trmt. Plant	Wastewater Treatment Plant	No	No
26	Nagog Hill Water Tower	Water Storage Tank	No	No
27	Wampus Hill Water Tower	Water Storage Tank/Cell Tower	No	No
28	Flagg Hill Water Tower	Water Storage Tank/Cell Tower	No	No
29	Great Hill Water Tower	Water Storage Tank/Cell Tower	No	No
30	Life Care Center	Elder Housing	No	No
31	Robbins Brook Assisted Living Facility	Elder Housing	No	No
32	Acton Town Hall	Municipal	No	No

ID	Name	Type	FEMA Flood Zone	Locally-Identified Flood Area
33	Baker-Whitney Oil Company	Hazardous Material Site	No	No
34	Bursaw Gas and Oil	Hazardous Material Site	No	No
35	Concord Oil	Hazardous Material Site	No	No
36	Recreation Department	Municipal	No	No
37	Windsor Green Apartments	Elder Housing	No	No
38	Audubon Hill Condominiums	55+ Apartments Private	No	No
39	Conant School	School	No	No
40	RJ Grey Junior High School	School	No	No
41	Acton-Boxborough Regional High School	School	No	No
42	Gates School	School	No	No
43	Douglas School	School	No	No
44	Merriam School	School	No	No
45	Acton Public Safety Building	Police/Fire Communications	No	No
46	West Acton Fire Station	Fire Station	No	No
47	Center Acton Fire Station	Fire Station	No	No
48	South Acton Fire Station	Fire Station	No	No
49	Acton Public Safety Building	Fire Department Headquarters	No	No
50	Infant Toddler Children's Center	Child Care	No	No
51	Acton Barn Cooperative Nursery School	Child Care	No	No
52	Montessori Country Day School	Child Care	No	No
53	Children's World Learning Center	Child Care	No	No
54	McCarthy-Towne	School	No	No
55	The Victor School	School	No	No
56	Community Notification Ctr.	Telecommunications	No	No
57	Library/IT	Municipal	No	No
58	Cell Tower	Communication Tower	No	No
59	Haartz Auto Fabric	Hazardous Material Site	No	No
60	RH Products	Hazardous Material Site	No	No
61	Assabet River Dam	Dam	AE: Floodway	No
62	BOC Gases	Hazardous Material Site	No	No
63	Erikson's Grain Mill Dam	Dam	AE	No
64	River Street Dam	Dam	AE: Floodway	No
65	Keyspan/Tennessee Gas Regulator Station	Hazardous Material Site	No	No
66	Ice House Pond Dam	Dam	AE 1%	No
67	Robbins Mill Pond Dam	Dam	AE: Floodway	No
68	Pencil Factory Dam	Dam	AE: Floodway	Pencil Factory Dam

ID	Name	Type	FEMA Flood Zone	Locally-Identified Flood Area
69	Brook Street Dam	Dam	AE: Floodway	Brook Street Dam
70	Nagog Pond Dam	Dam	AE 1%	Nagog Pond Dam
71	Grassy Pond Brook Dam	Dam		Grassy Pond Brook Dam
72	Whit-Clapp Wellfield	Dam	No	White-Clapp Wellfield (off of Route 111)
73	Assabet Wellfield	Dam	No	No
74	School Street Wellfield	Dam	No	No
75	Conant I Well	Dam	No	No
76	Conant II Wellfield	Dam	No	No
77	Kennedy Wellfield	Dam	AE 1%	Kennedy Wellfield (off of Route 27)
78	Marshall Well	Dam	AE 1%	Kennedy Wellfield (off of Route 27)
79	Rte 2A Water Pump Station	Water Pump Station	No	No
80	Nagog Water Treatment Plant	Drinking Water Treatment	No	No
81	Assabet River Dam	Dam	No	No
82	Human Services and Senior Center	Municipal	No	No
83	Municipal Properties and Engineering	Municipal	No	No
84	N. Acton Water Treatment	Water District	No	No
85	S. Acton Water Treatment	Water District	No	No
86	McCarthy Village	Elder Housing	No	No
87	Colbrook High School	School	No	No
88	Cell Tower	Communication Tower	No	No
89	Cell Tower	Communication Tower	No	No
90	Cell Tower	Communication Tower	No	No
91	Cell Tower	Communication Tower	No	No
92	Grace Superfund Site	Hazardous Material Site	No	No
93	55+ Housing	Elder Housing	No	No
94	Private Wastewater Treatment	Waste Water Treatment	No	No
95	Private Wastewater Treatment	Waste Water Treatment	No	No
96	Private Wastewater Treatment	Waste Water Treatment	No	No

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 Acton, 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 30: Estimated Damages from Hurricanes

	Category 2	Category 4
Building Characteristics		
Estimated total number of buildings	7,081	
Estimated total building replacement value (2014 $)	$3,054,000,000	
Building Damages		
# of buildings sustaining minor damage	123	795
# of buildings sustaining moderate damage	11	134
# of buildings sustaining severe damage	0	4
# of buildings destroyed	0	1
Population Needs		
# of households displaced	0	11
# of people seeking public shelter	0	2
Debris		
Building debris generated (tons)	501	8,082
Tree debris generated (tons)	1,886	5,133
# of truckloads to clear building debris	20	118
Value of Damages		
Total property damage (buildings and content)	$13,728,200	$ 48,727,970
Total losses due to business interruption	$276,920	$ 2,5567,250

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 31: Estimated Damages from Earthquakes

	Magnitude 5.0	Magnitude 7.0
Building Characteristics		
Estimated total number of buildings	7,081	
Estimated total building replacement value (2014 $)	$3,054,000,000	
Building Damages		
# of buildings sustaining slight damage	2,062	237
# of buildings sustaining moderate damage	1,109	1,499
# of buildings sustaining extensive damage	306	2,204
# of buildings completely damaged	78	3,303
Population Needs		
# of households displaced	348	4,617
# of people seeking public shelter	173	2,324
Debris		
Building debris generated (tons)	80,000	600,000
# of truckloads to clear debris (@ 25 tons/truck)	3,120	24,320
Value of Damages		
Total property damage	$353,630,000	$2,667,990,000
Total losses due to business interruption	$64,000,000	$381,590,000

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 32: Estimated Damages from Flooding

	100-Year Flood	500-Year Flood
Building Characteristics		
Estimated total number of buildings	7,081	
Estimated total building replacement value (2014 $)	$3,054,000,000	
Building Damages		
# of buildings sustaining moderate damage	0	2
# of buildings sustaining extensive damage	0	1
# of buildings substantially damaged	1	3
Population Needs		
# of households displaced	214	267
# of people seeking public shelter	249	345
Value of Damages		
Total property damage	$32,900,000	$45,580,000
Total losses due to business interruption	$130,000	$170,000

[This page intentionally left blank]

SECTION 5: HAZARD MITIGATION GOALS

The Acton Local Hazard Mitigation Planning Team reviewed and discussed the goals from the 2010 Hazard Mitigation Plan for the Town of Acton. All of the goals are considered critical for the Town and they are not listed in order of importance. Concurrent with the Hazard Mitigation Plan update process, the Town of Acton held a workshop to plan for future climate change. The local team chose to incorporate climate considerations as noted in Goal 9.

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.

[This page intentionally left blank]

SECTION 6: EXISTING MITIGATION MEASURES

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

The Town's existing mitigation measures, which were in place prior to the original 2010 Plan, are listed by hazard type here and are summarized in Table 33 below. Many upgrades to existing measures are noted in the following sections.

EXISTING TOWN-WIDE MITIGATION FOR FLOOD-RELATED HAZARDS

Acton 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:

Participation in the National Flood Insurance Program (NFIP) – Acton participates in the NFIP with 129 policies in force as of the November 30, 2017. 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 Acton:

Flood insurance policies in force (January 31, 2018)	128
Coverage amount of flood insurance policies	$35,386,000
Premiums paid	$101,907
Total losses (all losses submitted regardless of the status)	44
Closed losses (losses that have been paid)	33
Open losses (losses that have not been paid in full)	0
CWOP losses (losses that have been closed without payment)	11
Total payments (total amount paid on losses)	$219,645.10

On-going Drainage Improvement Program – The Department of Public Works (DPW) routinely maintains and replaces old and failing pipes and drainage infrastructure (such as disintegrating aluminum pipes up to 70 years old). This program is part of DPW's operating budget.

Wetlands Protection Bylaw and Regulations – The town has a wetlands protection bylaw to protect resource areas in and around wetlands, including land subject to flooding. The Bylaw also has requirements for setbacks ranging from 0-100 feet depending upon the activity. The wetland regulations provide more detail with regards to submittal requirements and performance standards. The Conservation Commission reviews development plans with potential impacts to water resources.

The Massachusetts Stormwater Policy – This Policy is applied to developments within the jurisdiction of the Conservation Commission.

Floodplain Overlay District – The town has a floodplain overlay district (Zoning Section 4.1) that restricts certain activities and requires a special permit for activities located within a flood zone. Floodplain regulations have been effective at preventing new construction in the flood plains

Subdivision Development Drainage Design Controls – The subdivision regulations require that the proposed drainage system is approved in writing by the appropriate town entity (Section 5.3.17) and the stormwater calculations must be provided by a licensed engineer (Section 5.3.18). The applicant must include provisions for handling drainage that flows off-site (5.3.20). Finally, an Erosion and Sediment Control plan is required (5.3.22). The Board of Health must review and approve or disapprove subdivision plans (5.5). Section 8.2 provides drainage/stormwater standards for subdivisions. The subdivision regulations encourage a preliminary submission to discuss development issues up-front with the Planning Board prior to a significant investment in design efforts. Runoff from subdivision developments may not increase in proposed conditions more than in existing conditions for the 10-year storm, and drainage facilities must be designed for the 10-year storm. The Subdivision Regulations also require the preparation of Development Impact Reports. Applicants must provide information on impacted resources, such as flood plains.

Site Plan Development Drainage Design Controls - For uses requiring site plans special permits, the peak rate of storm water runoff from the development site shall not exceed the rate existing prior to the new construction based on a 10-year design storm. Commercial and industrial developments must treat first inch of rainfall onto impervious surfaces.

Reviews and Inspections of New Developments - Town staff provides drainage reviews and the Engineering Department inspects streets and drainage once construction is completed of a site.

Cluster Developments – The town residential zoning provides provisions for cluster developments (open space developments in Zoning section 4.2) for all residential zones.

Groundwater Protection Overlay District - The town has a Groundwater Protection District (Zoning section 37) with stringent development controls, including recharge requirements, open space requirements, and maximum allowable impervious areas based upon proximity to the public wells. These regulations are designed to protect the town's sole drinking water supply.

Land acquisition efforts: Community Preservation Act - The town adopted the Community Preservation Act with a 1.5% surcharge in 2002.

Land acquisition efforts: Priority list of parcels by Open Space Committee – Town will be updating its Open Space Plan and the Conservation Commission has an Open Space Committee that is working on a list of priority parcels. They have not targeted properties solely based on flood protection purposes, but flood storage may be one of several important environmental features on a piece of conserved land.

Public Education – The town continues to implement its NPDES Phase II stormwater program which includes public education programs. Elements of the public education program include: partnering with SuAsCo for media toolkits, stormwater business flyers, educational signs adjacent to a constructed wetland, teacher lesson plans, traveling stormwater display at town buildings, and storm drain stenciling. In addition, the Acton Stream Team raises community awareness regarding issues facing water resources in the town.

Pilot Project with MIT students on reducing runoff – MIT graduate students developed a low-impact design (LID) for reducing runoff effects at Jones Field consisting of a rain garden. The town expects to focus on municipally-owned land and have a few pilot projects at other locations.

Beaver Mitigation – The town hires a trapper to mitigate beaver activity as necessary. A permit to do so is required by state law through the local Board of Health per state law. The mitigation includes removal of the dam and beaver and possibly installation of pipes to when property owners call to complain about flooding. The town usually uses its own staff and equipment to address the issue, and the cost can reach $1,000 for each incident. To trap a beaver, the town is usually charged around $150 to $200 per animal.

Drainage System Maintenance - The town strives to clean all catch basins annually. They no longer use sand, which has made a tremendous impact by allowing less frequent cleaning of the basins. The Public Works and Health Departments track catch basin and outfall cleanings. Maintenance of the storm drain system is scheduled based on known problem areas. The town has mapped its drainage system on paper maps and hopes to eventually set up in GIS if the town obtains GIS. The town owns two street sweepers.

EXISTING DAM FAILURE MITIGATION MEASURES

DCR dam safety regulations – All dams are subject to the Division of Conservation and Recreation's dam safety regulations. Dams are required to be inspected regularly with reports filed to the DCR Office of Dam Safety.

Permits required for construction – State law requires a permit for the construction of any dam.

The Comprehensive Emergency Management Plan – The CEMP addresses dam safety.

EXISTING TOWN-WIDE MITIGATION FOR WIND-RELATED HAZARDS

Tree Trimming and Removal by the Town - The town has a Tree Warden that oversees trimming and tree removal on public properties, and contractors are hired to help with maintenance. The tree warden does try to identify hazardous trees on private property and will contact the landowner. Approximately 6 times per year the town will removes private trees, but it is up to the landowner to remove the debris. When a new subdivision is created, the Subdivision Rules and Regulations require that all vegetation be removed from the entire width of the Right of Way, and that new trees be planted as replacements at the edge of the Right of Way. This work is done by the developer, not the Town. Once the street has been accepted, the trees growing within the Right of Way are protected under MGL Chapter 87. Full clearing of the Right of Way is required since the construction impacts of building the roadway condemn the existing trees to failure and death.

Tree Trimming and Removal by NSTAR - In recent years, NSTAR has adopted a policy of inspection and trimming on circuit by circuit basis (there are about a half dozen circuits servicing Acton). Thus, in any given cycle, it is possible that only some portions of town will be inspected and trimmed. Additionally, trimming is usually focused only on primary circuits, so certain small sections of neighborhoods that are serviced only by secondary power might receive no trimming. Removal of problem trees by NSTAR has been occasional at best, therefore causing concern in the town that timely removal of problems trees endangering the wires will not be performed on a consistent and comprehensive basis.

Hurricane resistant glass - The town buildings are robust with hurricane-resistant glass. The Police Station is new and up to the most recent building codes. However, the state building code does not address tornadoes.

EXISTING TOWN-WIDE MITIGATION FOR WINTER-RELATED HAZARDS

Snow plowing and sanding - The town provides standard snow plowing operations, and uses outside contractors as necessary. They have moved away from using sand, which helps reduce catch basin clogging. Mass DOT clears Routes 2, 2A, and 111.

Tree maintenance - Both the town and NSTAR provide tree trimming and removal in order to prevent limbs from coming down during heavy and wet snow events. (See more detailed description above under the Wind section)

EXISTING TOWN-WIDE MITIGATION FOR FIRE-RELATED HAZARDS

Burn permits - Town bylaws allow controlled open burning, in accordance with state regulations, but a permit is required from the Fire Chief for each day of intended burning.

Development Review - The Fire department reviews all subdivision and site plans for compliance with site access, water supply needs, and all other applicable regulations.

EXISTING TOWN-WIDE MITIGATION FOR EARTHQUAKE HAZARDS

Police Station is reinforced - The Police Station is new, steel-framed, and up to earthquake standards
Evacuation plan - The town has an evacuation plan as specified in its Comprehensive Emergency Management Plan (CEMP).

Tanker availability - A tanker task force is available through State Fire mobilization. FEMA has 8-12 tankers that can be deployed anywhere in the US within 72 hours.

Gas line preparedness - The El Paso gas company provides educational information and training on hazard mitigation for its Tennessee Gas Pipeline located in several communities, including Acton.

EXISTING TOWN-WIDE MITIGATION FOR LANDSLIDE HAZARDS

Design standards - Town design standards in the subdivision and site plan regulations address erosion and sediment controls for temporary and permanent slopes.

EXISTING MULTI-HAZARD MITIGATION MEASURES

Multi-Department Review of Developments – Multiple departments, such as Planning, Zoning, Health, Public Works, Engineering, Fire, Police, Water District, Building and Conservation, review all subdivision and site plans prior to approval.

Comprehensive Emergency Management Plan (CEMP) – Every community in Massachusetts is required to have a Comprehensive Emergency Management Plan. These plans address mitigation, preparedness, response and recovery from a variety of natural and man-made emergencies. These plans contain important information regarding flooding, dam failures and winter storms. Therefore, the CEMP is a mitigation measure that is relevant to many of the hazards discussed in this plan. The CEMP is available online through secure access for town personnel.

Enforcement of the State Building Code – The Massachusetts State Building Code contains many detailed regulations regarding wind loads, earthquake resistant design, flood-proofing and snow loads.

Acton is also part of the CrossRoads Regional Emergency Management Planning Committee (REPC) that consists of the towns of Acton, Lincoln, Weston, Wayland, Sudbury and Concord.

Emergency generators - The town has emergency generators for the public safety building, fire stations, public works facility, town hall, sewer treatment plant, schools, Water District, 468 Main Street, 50 Audubon, Memorial Library, and also has portable generators. However, some of the generators used in town and for town buildings rely on natural gas. If the natural gas lines are impacted, the generators will not function. The list below shows the status of the town's existing generator inventory:

Town Hall: Diesel
Memorial Library: Diesel
Public Safety Facility: Diesel
West Fire Station: Diesel
Center Fire Station: Diesel
South Fire Station: Diesel
Public Works: Natural Gas
Red House: Diesel
Recreation Department: Natural Gas

Emergency notification - The town has reverse 911 and public announcements in the event of an emergency. The emergency communications system has limited capacity, and communications systems in town are highly dependent on cell phones (cell tower is located on Great Hill). The town looks to have a program to have proper communications facilities and fiber optics.

COMPILATION OF EXISTING MITIGATION

The following table summarizes the many existing natural hazard mitigation measures already in place in Acton when the first Hazard Mitigation Plan was adopted in 2010.

Table 33: Existing Natural Hazard Mitigation Measures in Acton

Type of Existing Mitigation Measure	Effectiveness Improvements/Changes Needed
FLOOD HAZARDS	
The town participates in the NFIP and has adopted the effective FIRM maps. The town actively enforces the floodplain regulations.	Effective
On-going DPW Drainage Improvement Program	Effective
Wetlands Protection Bylaw and Regulations	Effective
Massachusetts Stormwater Policy	Effective, added 2015 SW Mgmt. and Sediment Erosion By-law
Floodplain Overlay District	Effective
Subdivision Development Drainage Design Controls	Effective
Site Plan Development Drainage Design Controls	Effective
Reviews and Inspections of New Developments	Effective
Cluster Developments	Effective, the town has also adopted Planned Conservation Residential Community which encourages open space preservation
Groundwater Protection Overlay District	Effective
Land Acquisition Efforts: Community Preservation Act	Effective, since adoption of the CPA, Acton has made over $5 million in land purchases.
Land Acquisition: Priority List of Parcels	Effective, the 2016 Open Space plan identifies priority parcels
Public Education – NPDES Phase II	Effective
Jones Field LID rain garden	Effective, this project was not implemented, but several others have been constructed
Beaver Mitigation	Effective
Drainage System Maintenance	Effective
DAM HAZARDS	
DCR Dam Safety Regulations	Effective
Construction permits required	Effective
Comprehensive Emergency Management Plan	Effective
WIND HAZARDS	
Tree Maintenance Program by the Town	Effective
Tree Maintenance Program by NSTAR	Effective, performance has improved
Town buildings have hurricane resistant glass	Effective for the public safety building and the library
WINTER HAZARDS	
Standard snow operations, reduced sand usage	Effective
MassHighway clears state roads 2, 2A, and 111	Effective
Tree maintenance by town and by NSTAR	Effective
FIRE HAZARDS	
Open burning permits required	Effective
Fire Department reviews all development plans	Effective
EARTHQUAKE HAZARDS	

Type of Existing Mitigation Measure	Effectiveness Improvements/Changes Needed
Police station is steel-framed and up to most recent building codes	Effective
Evacuation plan outlined in CEMP	Effective
Tanker task force available through state fire mobilization	Effective
El Paso gas company provides training and education on hazard mitigation for its Tennessee Gas pipeline	Effective
LANDSLIDE HAZARDS	
Slope stabilization requirements in subdivision and site plan regulations	Effective
MULTI-HAZARDS	
Multi-department review of developments	Effective
Comprehensive Emergency Management Plan (CEMP)	Effective
Enforcement of State Building Code	Effective
Regional Emergency Management Planning Committee (REPC)	Not functioning optimally currently
Emergency generators available for municipal facilities	Effective
Reverse 911 and public announcements in the event of an emergency	Effective
Emergency communications system, but highly dependent on cell phone service	Now have radios and radio station, have started installing fiber optic

MITIGATION CAPABILITIES AND LOCAL CAPACITY FOR IMPLEMENTATION

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

Several departments including Engineering, Public Works, Municipal Properties, Land Use and Fire will address planned infrastructure projects. Natural Resources and DPW will collaborate on dam assessments and potential upgrades or breaches. A number of measures will require bylaw changes; Engineering, Land Use and Health will lead those efforts. Finally, efforts to improve emergency communications to vulnerable populations will likely be a collaborative effort across many departments.

[This page intentionally left blank]

SECTION 7: MITIGATION MEASURES FROM PREVIOUS PLAN

IMPLEMENTATION PROGRESS ON THE PREVIOUS PLAN

At a meeting of the Acton Hazard Mitigation Planning Committee, Town staff reviewed the mitigation measures identified in the 2010 Acton 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 34 summarizes the status of mitigation measures, and mitigation projects completed are described in more detail below.

Table 34: Mitigation Measures from the 2010 Plan

Mitigation Measure	Priority in 2010 Plan	Lead Implementation	Current Status	Include in 2018 Plan?
Long-Term Management Plan to Control Beaver Activity	High	Health, Highway	Significant progress has been made with beaver management. Plan no longer necessary.	NO
Post-Construction Stormwater Bylaw Revisions	High	Planning/ Conservation/ Engineering	Addressed in 2015 Stormwater Bylaw.	NO
Land Acquisition / Protection of Open Space	High	Conservation	The town has an active program. $5M in purchases have been made.	YES
Ongoing Culvert and Drainage Upgrades	Medium	Engineering/ Highway	Main Street and Parker Street projects have been completed.	YES
More Frequent Maintenance of Town-Owned Drainage Facilities	Medium	Highway	Much work has been done, but on-going work is needed.	YES
Acquire GIS and Create an Inventory of Drainage Infrastructure	Medium	Engineering	Acquired, and 85% of mapping is 85% done. The next step is GIS work for MS4 compliance.	YES
Assessment of River Street Dam	High	Engineering	Town acquired dam, next step is assessment/partial breach for safety.	YES
Overall Town-Wide Dam Study	High	Engineering	Not complete, gathering information from DCR	YES
Assessment of Erickson's Grain Mill Dam	Medium	Engineering	Not done. Dam is private, town is assisting in planning.	YES
Tree maintenance program funding	High	Highway	Still needed	YES
Secure fire stations from major earthquake damage	High	Fire	Not done. 2018 Town Meeting approved funding for design.	YES

Mitigation Measure	Priority in 2010 Plan	Lead Implementation	Current Status	Include in 2018 Plan?
Acquire generators that run on fuels other than natural gas	High	Municipal Properties	Mostly done, critical facilities are diesel	NO
Upgrade communications for reliability	High	Fire and Police	Now have radio and radio station, fiber optic is underway. The town wants to explore GETS cards.	YES
Solution to Boxborough Condominium flooding from beaver activity in Acton	NA	Health, Highway	Done, beaver deceiver installed.	NO
Expand MIT LID pilot project (rain garden/bio-retention)	High	Planning, Highway	Never done, but other bio-retention projects have been completed.	NO
Find fire water service option in event of earthquake	High	Fire	The town has a tanker, this is not a current concern.	NO

As indicated in Table 34, Acton made considerable progress implementing mitigation measures identified in the 2010 Hazard Mitigation Plan. Completed physical projects include drainage upgrades at Main and Parker Streets and more frequent maintenance of drainage, installation of bio-retention projects in town parks, purchase of diesel generators for critical facilities, upgraded radio and fiber optic communications, and installation of beaver deceivers. The Town strengthened stormwater treatment and infiltration requirements with the adoption of a new Stormwater Bylaw in 2015. In addition, the town purchased GIS software and has mapped 85% of the stormwater infrastructure. The town has been active in purchasing land for conservation, completing over $5 million in purchases in the past five years.

Several projects that were not completed will be continued into this plan update. These include completing GIS mapping and moving on to work that will facilitate MS4 compliance, completion of fiber optic installation, and on-going dam assessments. Funding for design of a new earthquake proof fire station was approved in a town meeting vote.

Overall, ten mitigation measures from the 2010 plan will be continued in the plan update. Most will retain the same priority in this 2018 update. A number of these are ongoing projects such as public land acquisition, drainage maintenance and upgrades, GIS mapping and communication upgrades. Three projects are not complete and will not be carried forward into current plan. Town success with beaver management makes long-term planning unnecessary, the town determined that the availability of a tanker addresses the concern about fire service in the event of an earthquake, and although the MIT rain garden was not installed, the town has completed other bioretention projects.

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

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.

https://www.fema.gov/hazard-mitigation-grant-program
https://www.fema.gov/pre-disaster-mitigation-grant-program
https://www.fema.gov/flood-mitigation-assistance-grant-program

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)

REGIONAL AND INTER-COMMUNITY CONSIDERATIONS

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

REGIONAL PARTNERS

In many communities, mitigating natural hazards, particularly flooding, is more than a local issue. The drainage systems that serve these communities are complex systems of storm drains, roadway drainage structures, pump stations and other facilities owned and operated by a wide array of agencies including the Town, Massachusetts Department of Transportation (MassDOT) and the Massachusetts Bay Transportation Authority (MBTA). 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. In the sections that follow, the plan includes recommendations for activities where cooperation with these other agencies may be necessary. Implementation of these recommendations will require that all parties work together to develop solutions. Major facilities owned, operated and maintained by state or regional entities include: state Routes 2, 2A, 27, and 111 (MassDOT), and Commuter Rail (MBTA).

INTER-COMMUNITY CONSIDERATIONS

Mitigation measures for the following regional issues should be taken into account as Acton develops its own local plan:

A) Coordinate and Review Developments on a Regional Basis

As Acton and the surrounding communities are undergoing development, it is vital that these communities communicate and provide input during the review processes. When addressing housing, transportation, and economic development projects, the impacts to neighbors must be addressed.

B) Regional Management Plan To Control Beaver Activity

One regional issue of significance is the widespread effects of beaver dams in the area. Most streams, wetland areas, and ponds in the region have had some degree of beaver activity in the past several years. Much of the localized flooding that occurs is due to beaver activity. The Town will mitigate the problem temporarily by hiring trappers, removing dams, or installing pipes, but regional cooperation could be considered.

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 adopted in recent years,

priorities for the future include bylaw updates for stormwater management, drought management, and snow removal on private ways.

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.

Table 35 below demonstrates the prioritization of the Town's recommended hazard mitigation measures. For each mitigation measure, the geographic extent of the potential benefiting area is identified as is an estimate of the overall benefit and cost of the measures. The benefits, costs, and overall priority were evaluated in terms of:

Estimated Benefits	
High	Action will result in a significant reduction of hazard risk to people and/or property from a hazard event
Medium	Action will likely result in a moderate reduction of hazard risk to people and/or property from a hazard event
Low	Action will result in a low reduction of hazard risk to people and/or property from a hazard event
Estimated Costs	
High	Estimated costs greater than $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: Mitigation Prioritization

Mitigation Action	Geographic Coverage	Estimated Benefit	Estimated Cost	Priority
FLOOD				
Land Acquisition/ Protect Open Space	Town-wide	High	High	Medium
Ongoing culvert and drainage upgrades	Site-specific	High	High	Medium
More frequent maintenance of town-owned drainage facilities	Town-wide	Medium	Low	Medium
Complete GIS stormwater mapping, prepare for MS4 compliance	Town-wide	Medium	Low	Medium
Assess River Street dam , consider partial breach for safety	Medium	High	High	High
Complete town-wide dam study – gain information from DCR	Site-specific	High	Low	High
Assess Erickson's Grain Mill Dam, facilitate consideration of wider breach to reduce risk	Site-specific	High	High	High
Amend Stormwater Bylaw to reflect updated 10-year 24-hour rain data	Town-wide	High	Low	Medium
BRUSHFIRE				
Provide education on outdoor fire regulations and risks utilizing town website	Town-wide	High	Low	Low
DROUGHT				
Adopt a bylaw with guidelines for drought tolerant landscaping and site design	Town-wide	High	Low	Medium
Establish drought regulations for private well users	Town-wide	High	Low	High
Provide public education on water conservation and on the potential for water contamination due to large storms	Town-wide	High	Low	Medium
EXTREME TEMPERATURES				
Promote green and cool roofs and cooler paving products.	Town-wide	Medium	Low	Low
WINTER STORMS				
Adopt a bylaw that requires snow removal from fire hydrants on private ways	Town-wide	High	Low	Medium

Mitigation Action	Geographic Coverage	Estimated Benefit	Estimated Cost	Priority
WIND				
Continue to fund tree maintenance program	Town-wide	High	High	High
EARTHQUAKE				
Construct new fire station	N. Acton	High	High	High
MULTIHAZARDS				
Upgrade communications for flexibility – finish fiber optics, explore GETS card	Town-wide	High	Low	High
Upgrade Arlington Street bridge – weight restriction affects emergency response time	Site-specific	High	High	High
Upgrade Laws Brook Road bridge	Site-specific	High	High	High
Improve emergency communication, particularly with difficult to reach populations (non-English speakers, isolated individuals)	Town-wide	High	Low	High

RECOMMENDED MITIGATION MEASURES

Flood

Land Acquisition/ Protect Open Space: The town will continue to purchase or protect open space to ensure that future development does not increase flooding.

Ongoing Culvert and Drainage Upgrades: The DPW will continue efforts to identify culvert and drainage areas most in need of upgrades to prevent flooding.

More frequent maintenance of town drainage: This item was a focus of the last plan. The DPW will continue efforts for frequent maintenance.

Complete GIS stormwater mapping: The project is 85% complete. The next town focus will be on GIS work needed to comply with EPA stormwater management requirements (MS4).

Assess River Street dam: Consider partial breach: The town is pursuing efforts to assess dam safety and options for improvement.

Complete town-wide dam study: The town will continue efforts to gain available information from the Department of Conservation and Recreation which has responsibility for inspections.

Facilitate assessment of Erickson's Grain Mill dam: Consider wider breach to reduce flood risk. This is a privately owned dam, the town will attempt to work with the owner to improve safety.

Amend the town Stormwater bylaw: Reflect updated 10-year, 24-hour rainfall amounts provided by the Northeast Regional Climate Center at Cornell.

Brushfire

Brushfire education: Utilize the town website to inform the public of restrictions on outdoor fires as well as the hazards of outdoor burning.

Drought

Drought tolerant landscaping: Adopt a bylaw that establishes standards for site design and landscaping.
Private well use: Adopt a bylaw or regulations that address restrictions on private well use during droughts.
Public education: Develop educational materials for water conservation and to identify potential pollutant threats to drinking water.

Extreme Temperatures

Use of cooler materials: Promote green or cool roofs. Investigate cooler paving products.

Winter Storms

Hydrant protection: Adopt a bylaw that requires owners of private ways to remove snow from around fire hydrants.

Wind

Tree maintenance: continue to focus efforts on tree maintenance as power outages from downed tree limbs have been a significant issue.

Earthquake

Construct new fire station: 2018 Town Meeting approved funds for design of a new station. The town will need to fund construction in subsequent years. A new station will be built to appropriate building code standards.

Multihazards

Communications upgrades: Complete the installation of fiber optic town-wide. Obtain GETS card that provides phone access when cell phone service is not available.
Bridge upgrades: Both the Arlington Street and the Laws Brook Road bridges are in poor condition. Loss of bridge use would have a significant impact on emergency response time.
Improve emergency communication: Focus on strategies to ensure capacity to communicate emergency information to various difficult to reach populations.

Climate

Concurrent with the Hazard Mitigation Planning process the Town of Acton received a grant to conduct a climate vulnerability analysis. A number of the mitigation measures proposed here were also identified as important solutions for climate resilience. These include updating the stormwater bylaw, drought and extreme temperature measures, and a focus on communication with vulnerable and isolated populations.

INTRODUCTION TO RECOMMENDED MITIGATION MEASURES TABLE 36

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 35, 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 https://www.mass.gov/hazard-mitigation-assistance-grant-programs describes the various Hazard Mitigation Assistance Program.

Abbreviations Used in Table 36

FEMA Mitigation Grants includes:
- FMA = Flood Mitigation Assistance Program
- HMGP = Hazard Mitigation Grant Program
- PDM = Pre-Disaster Mitigation Program

ACOE = Army Corps of Engineers.
CPA = Community Preservation Act

Table 36: Recommended Hazard Mitigation Measures

Mitigation Action	Priority in 2010 Plan	Priority	Lead Implementation	Time Frame	Estimated Cost	Potential Funding Source
Land Acquisition/ Protect Open Space	High	Medium	Open Space Committee, Natural Resources	On-going	>$100,000	Town General Fund, CPA, gifts
Ongoing culvert and drainage upgrades	Medium	Medium	DPW, Engineering GIS	On-going	>$100,000	Town General Fund, FEMA, ACOE
More frequent maintenance of town-owned drainage facilities	Medium	Medium	DPW	On-going	<$10,000	Town General Fund
Complete GIS stormwater mapping, prepare for MS4 compliance	Medium	Medium	Engineering	2022	<$10,000	Town General Fund
Assess River Street dam , consider partial breach for safety	High	High	Land Use, Natural Resources	2019	>$100,000	State grant
Complete town-wide dam study – gain information from DCR	High	High	DPW	2022	<$10,000	Town General Fund
Assess Erickson's Grain Mill Dam, facilitate consideration of wider breach to reduce risk	Medium	High	Land Use, Natural Resources	2019	>$100,000	State grant
Amend Stormwater Bylaw to reflect updated 10-year 24-hour rain data	N/A	Medium	Engineering	2020	<$10,000	Town General Fund
Provide education on outdoor fire regulations and risks utilizing town website	N/A	Low	Fire	2020	<$10,000	Town
Adopt a bylaw with guidelines for drought tolerant landscaping and site design	N/A	Medium	Land Use	2020	<$10,000	Town General Fund
Establish drought regulations for private well users	N/A	High	Health	2019	<$10,000	Town General Fund
Provide public education on water conservation and on the potential for water contamination due to large storms	N/A	Medium	Water District, Health	On-going	<$10,000	Town General Fund

Mitigation Action	Priority in 2010 Plan	Priority	Lead Implementation	Time Frame	Estimated Cost	Potential Funding Source
Promote green and cool roofs and cooler paving products.	N/A	Low	Land Use	2022	<$10,000	Town General Fund
Adopt a bylaw that requires snow removal from fire hydrants on private ways	N/A	Medium	Engineering	2020	<$10,000	Town General Fund
Continue to fund tree maintenance program	High	High	Municipal Properties	On-going	>$100,000	Town General Fund
Construct new fire station	High	High	Municipal Properties, Fire	2021	<$10,000	Town General Fund
Upgrade communications for flexibility – finish fiber optics, explore GETS card	N/A	High	IT	2019	<$10,000	Town General Fund
Upgrade Arlington Street bridge – weight restriction affects emergency response time	N/A	High	DPW	2022	>$100,000	Town General Fund State (Ch. 91)
Upgrade Laws Brook Road bridge	N/A	High	DPW	2022	>$100,000	Town General Fund State (Ch. 91)
Improve emergency communication, particularly with difficult to reach populations (non-English speakers, isolated individuals)	High	High	Land Use, Health, Disabilities, Emergency	2019	<$10,000	Town General Fund

[This page intentionally left blank]

SECTION 9: PLAN ADOPTION & MAINTENANCE

PLAN ADOPTION

The Acton Hazard Mitigation Plan 2018 Update was adopted by the Board of Selectmen on November 5, 2018. See Appendix D for documentation. The plan was approved by FEMA on [*ADD DATE*] for a five-year period that will expire on [*ADD DATE*].

PLAN MAINTENANCE

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

The Hazard Mitigation Implementation Team will use the information from the Mid-Term progress review to identify the needs and priorities for the plan update and seek funding for the plan update process. Potential sources of funding may include FEMA Pre-Disaster Mitigation grants and the Hazard Mitigation

Grant Program. Both grant programs can pay for 75% of a planning project, with a 25% local cost share required.

Prepare and Adopt an Updated Local Hazard Mitigation Plan – Once the resources have been secured to update the plan, the Hazard Mitigation Implementation Team may decide to undertake the update themselves, contract with the Metropolitan Area Planning Council to update the plan or to hire another consultant. However the Hazard Mitigation Implementation Team decides to update the plan, the group will need to review the current FEMA hazard mitigation plan guidelines for any changes. The Acton 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 Acton 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/Emergency Management
- Police
- Public Works/Highway
- Engineering
- Land Use
- Conservation
- Parks and Recreation
- Health
- Building
- Municipal Properties
- IT/GIS
- Natural Resources

Other groups that will be coordinated with include large institutions, Water District, Chamber 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

General Bylaws of the Town of Acton

Town of Acton Open Space and Recreation Plan 2014-2021

Acton 2020 Comprehensive Community Plan

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

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

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

FEMA, HAZUS, https://www.fema.gov/hazus

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

MA Department of Conservation and Recreation, Office of Water Resources

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

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

U.S. Army Corps of Engineets, Ice Engineering Group, Ice Jam Database

U. S. Census, 2010, and American Community Survey, 2013

USGS, National Water Information Center, website

[This page intentionally left blank]

APPENDIX A: MEETING AGENDAS

Acton Hazard Mitigation Plan 2018 Update

Thursday, November 30 2017

9:30-11:00

Meeting #1

AGENDA

1. Introductions

2. Overview of Planning Process

3. Identify/update local hazards:

    a) Flood Hazard Areas
    b) Dam Hazards

4. Identify/Update Potential New Development Sites

5. Update Critical Facilities Inventory and Mapping

Acton Hazard Mitigation Plan 2018 Update

Tuesday, January 30, 2018

10:30 -12:00

Meeting #2

AGENDA

1. Introductions

2. Review original existing mitigation measures from 2010 plan
- confirm effectiveness
- note any needed changes

3. Review recommended mitigation measures from 2010 plan
- current status
- decide which to carry forward into 2018 plan
- evaluate priority

4. Review Mitigation Goals and update as needed

5. Next Steps

AGENDA

Acton Local Hazard Mitigation Planning Team
Meeting #3

Thursday, May 24th
10:00 am

UPDATE ON WHERE WE ARE IN THE PLANNING PROCESS

MVP REVIEW

PROPOSE NEW MITIGATION MEASURES FOR THE 2018 PLAN

Mitigation categories:

Flood
Brushfire
Drought
Earthquakes
Extreme Temperatures
Wind
Winter Storms
Climate Resilience/Adaptation (optional)

NEXT STEPS

Final meeting before the Board of Selectmen – June 18

[This page intentionally left blank]

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.nesec.org/. 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/Acton/

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

Map1: 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: Development – This map 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 future. The map also depicts current land use.

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 Middlesex County 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 Acton 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.

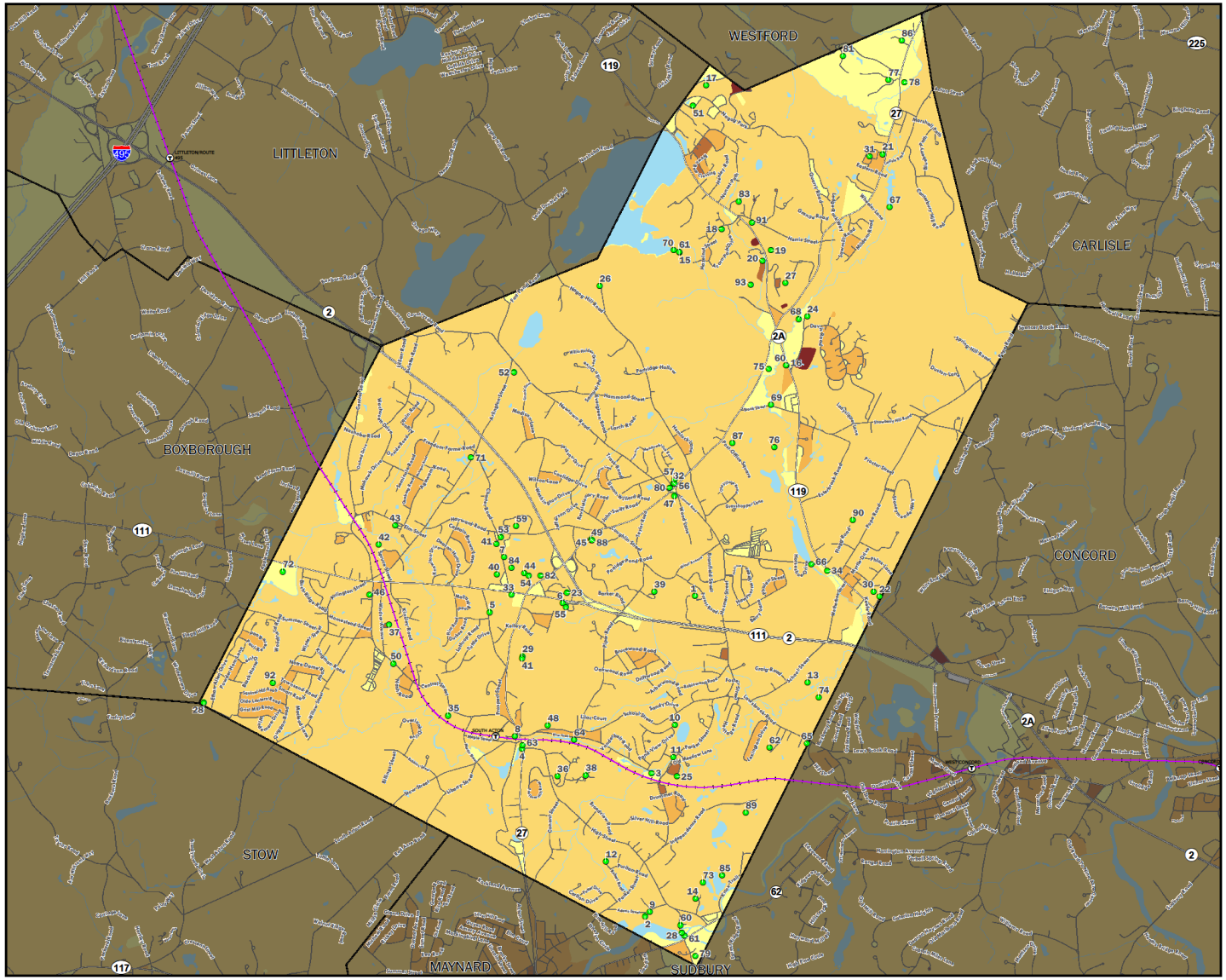
Map 4: Earthquakes and Landslides – This information came from NESEC. For most communities, there was no data for earthquakes because only the epicenters of an earthquake are mapped. The landslide information shows areas with either a low susceptibility or a moderate susceptibility to landslides based 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, 2008. The critical infrastructure sites are also shown. The source of the aerial photograph is Mass GIS.



MAPC dcr

FEMA Hazard Mitigation Planning Grant

ACTON, MA

Map 1: Population Density

Sites
- Critical Infrastructure Sites*

* See details in separate table

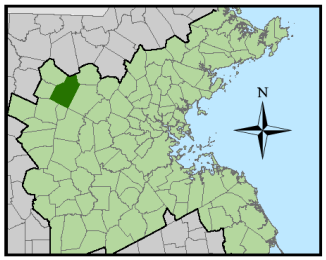
Water Bodies

Train Stations
Commuter Rail Lines
Trains

All Roads
- Interstate
- U.S. Highway
- State Route
- Street

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

0 0.25 0.5 Miles



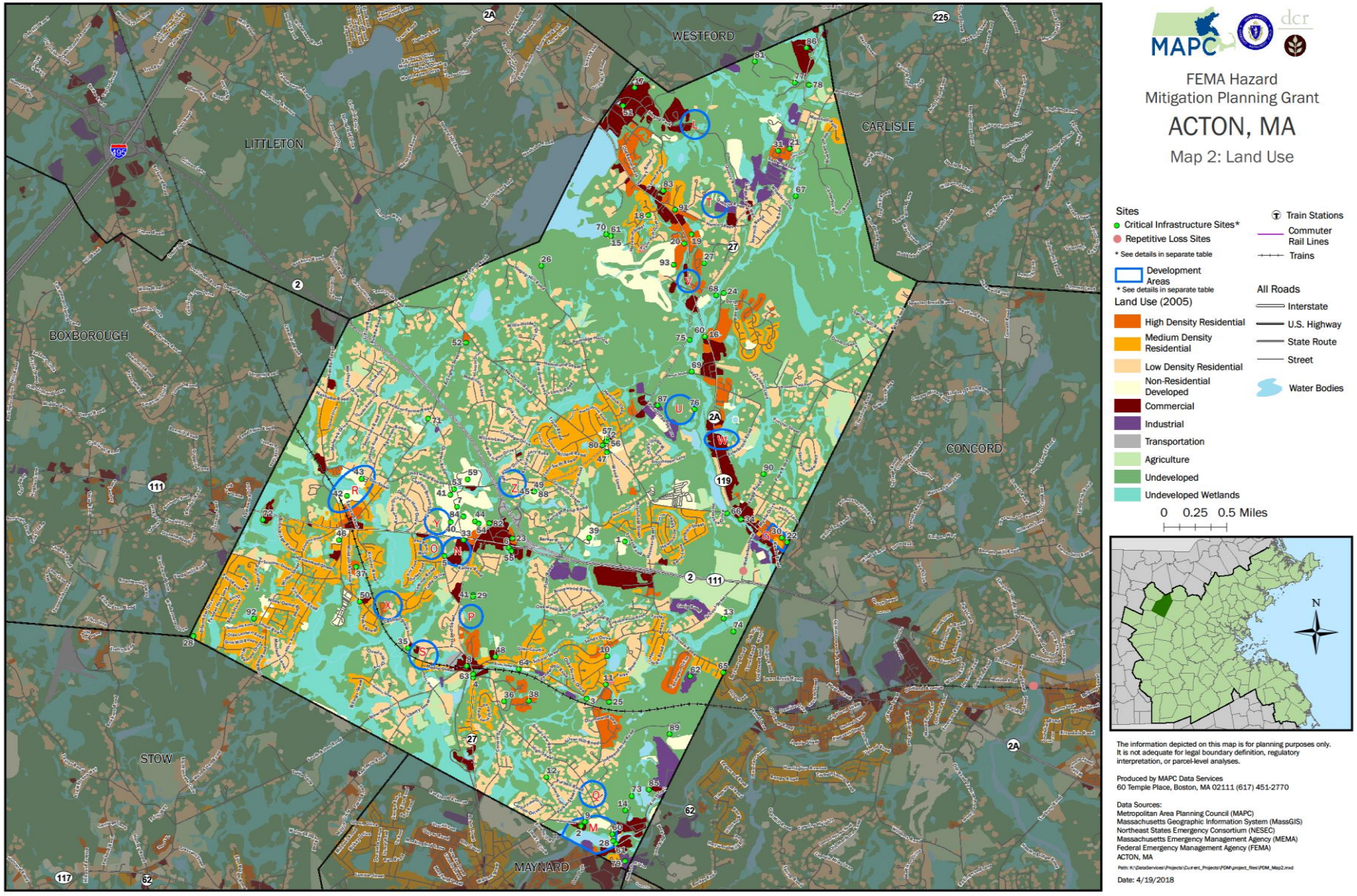
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analyses.

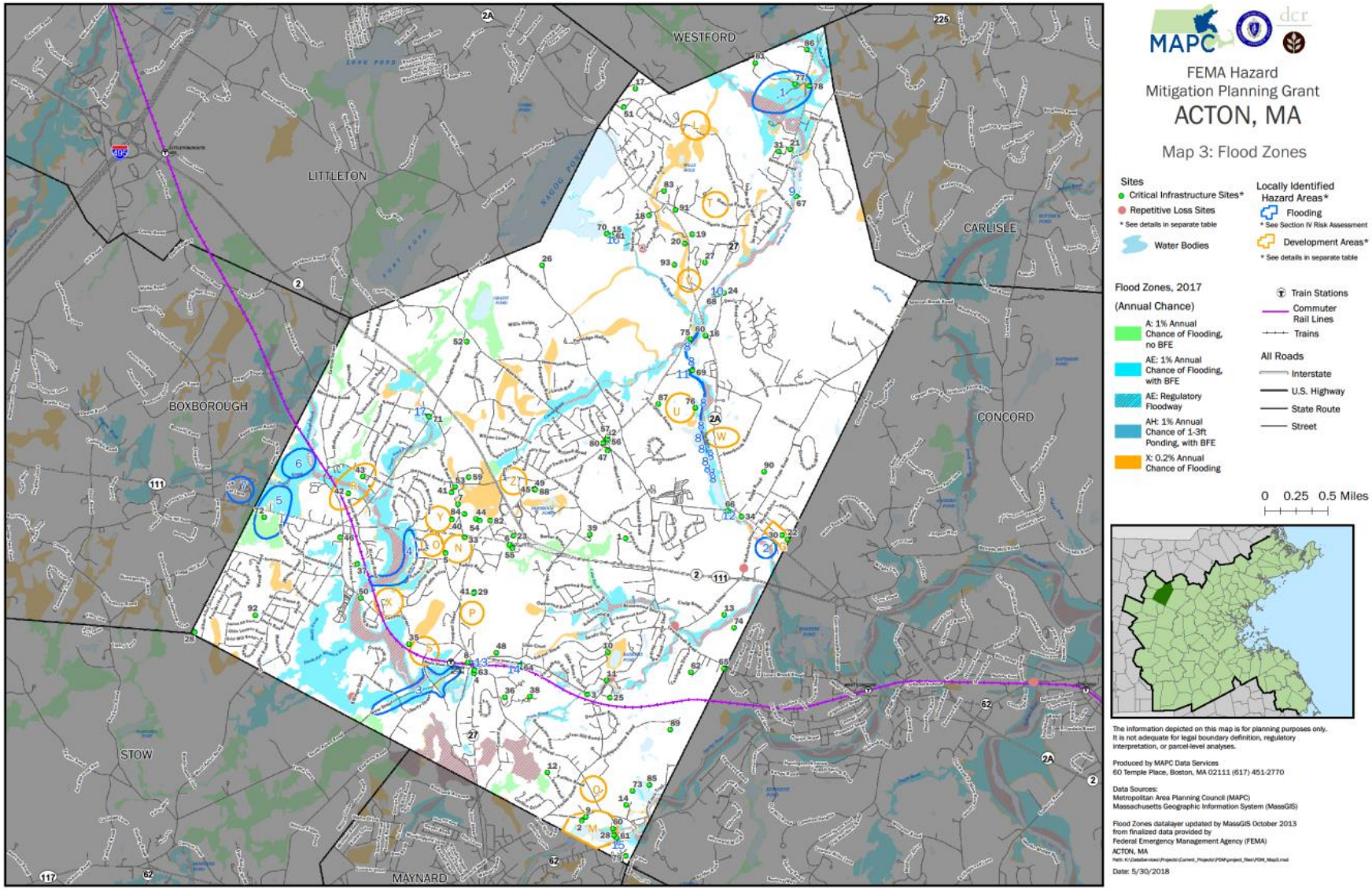
Produced by MAPC Data Services
60 Temple Place, Boston, MA 02111 (617) 451-2770

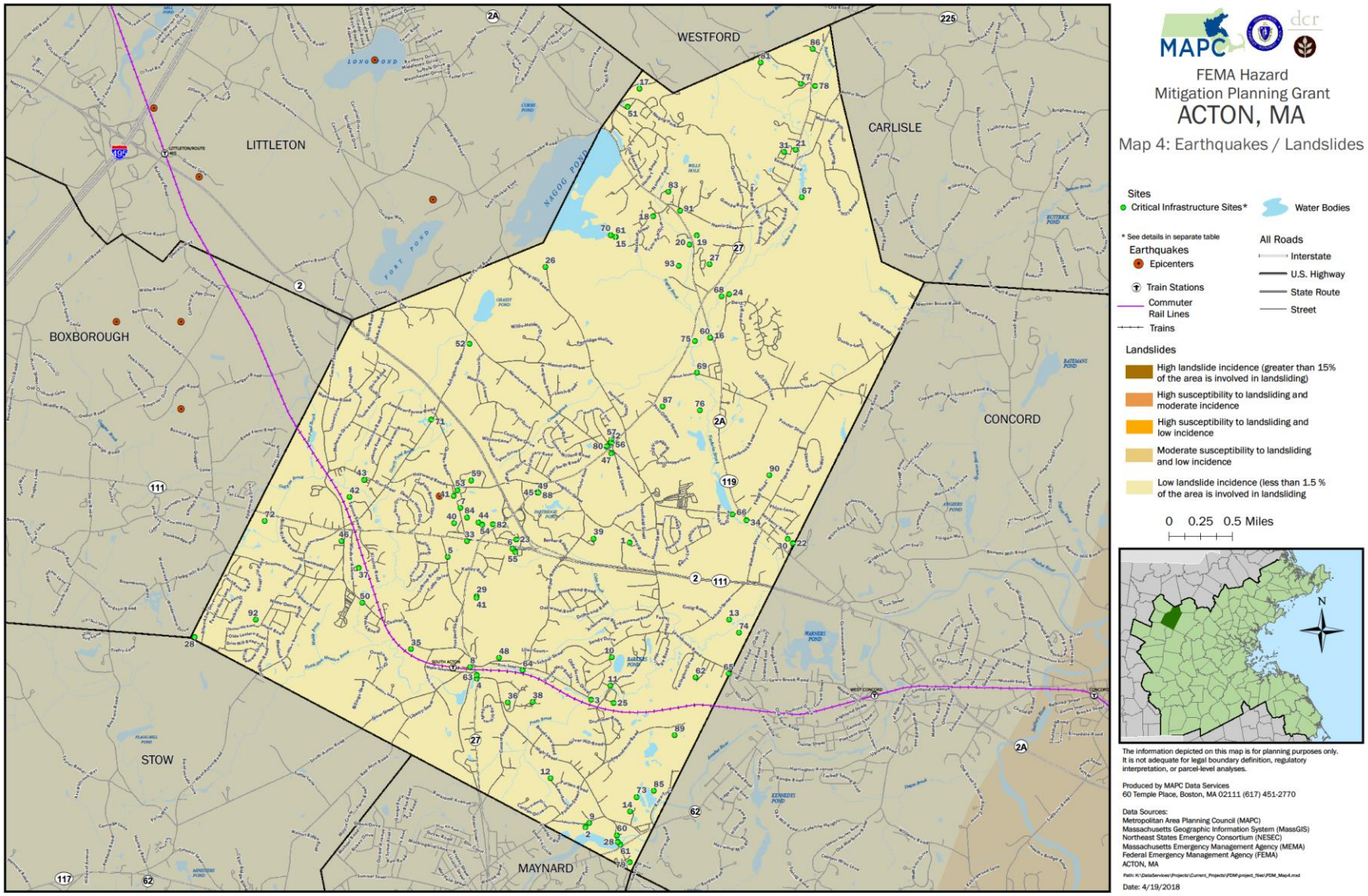
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
ACTON, MA

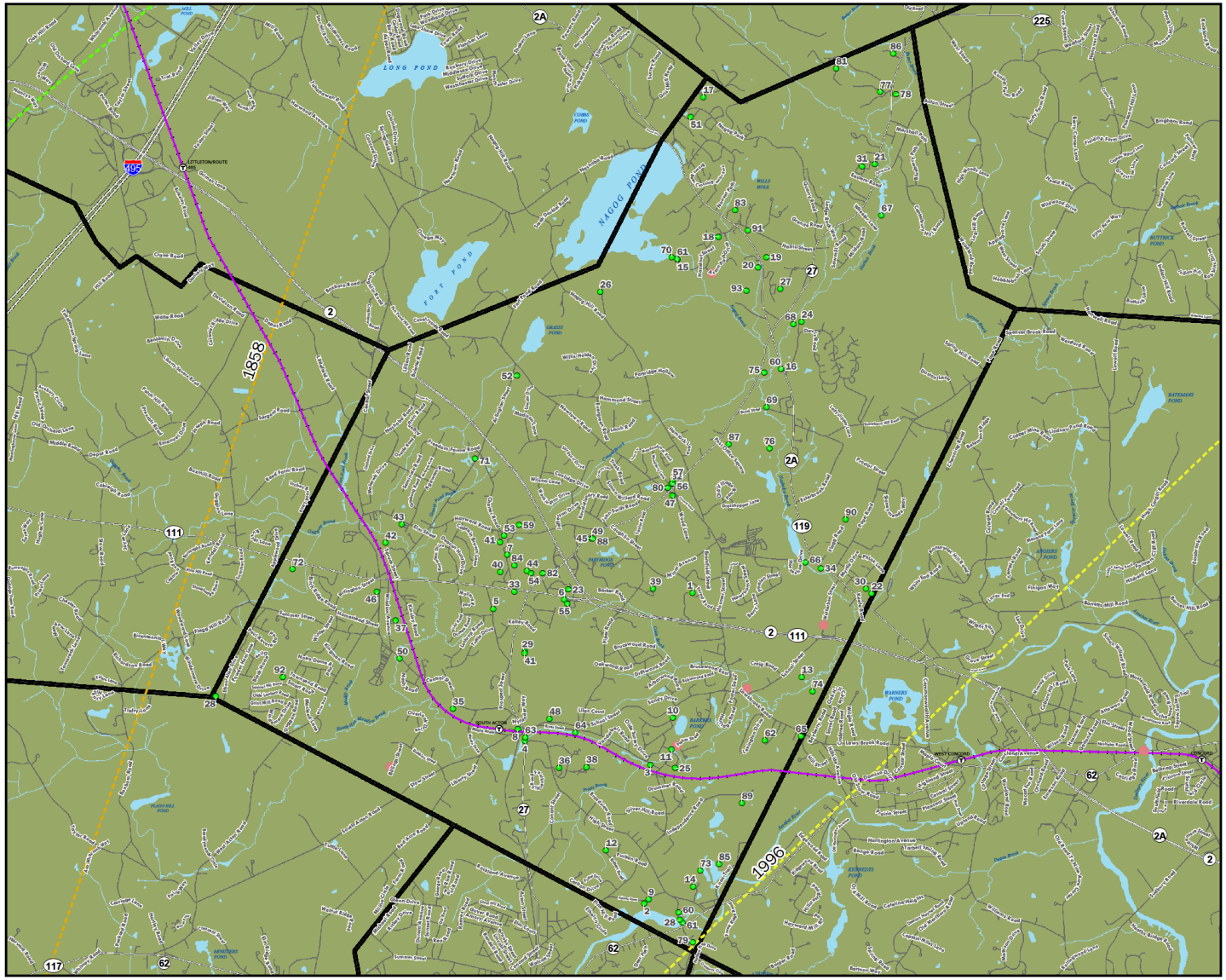
Path: K:\DataServices\Projects\Current_Projects\PDM\project_files\PDM_Map1.mxd

Date: 4/11/2018


WESTFORD
LITTLETON
CARLISLE
BOXBOROUGH
CONCORD
STOW
MAYNARD
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
ACTON, MA
Map 2: Land Use
Sites
Critical Infrastructure Sites*
Repetitive Loss Sites
* See details in separate table
Development Areas
* 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
Train Stations
Commuter Rail Lines
Trains
All Roads
Interstate
U.S. Highway
State Route
Street
Water Bodies
0 0.25 0.5 Miles
N
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)
ACTON, MA
Date: 4/19/2018


WESTFORD
LITTLETON
CARLISLE
BOXBOROUGH
CONCORD
STOW
MAYNARD
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
ACTON, MA
Map 3: Flood Zones
Sites
Critical Infrastructure Sites*
Repetitive Loss Sites
* See details in separate table
Water Bodies
Locally Identified
Hazard Areas*
Flooding
* See Section IV Risk Assessment
Development Areas*
* See details in separate table
Flood Zones, 2017
(Annual Chance)
A: 1% Annual Chance of Flooding, no BFE
AE: 1% Annual Chance of Flooding, with BFE
AE: Regulatory Floodway
AH: 1% Annual Chance of 1-3ft Ponding, with BFE
X: 0.2% Annual Chance of Flooding
Train Stations
Commuter Rail Lines
Trains
All Roads
Interstate
U.S. Highway
State Route
Street
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)
ACTON, MA
Date: 5/30/2018


MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
ACTON, MA
Map 4: Earthquakes / Landslides
Sites
Critical Infrastructure Sites*
Water Bodies
* See details in separate table
Earthquakes
Epicenters
Train Stations
Commuter Rail Lines
Trains
All Roads
Interstate
U.S. Highway
State Route
Street
Landslides
High landslide incidence (greater than 15% of the area is involved in landsliding)
High susceptibility to landsliding and moderate incidence
High susceptibility to landsliding and low incidence
Moderate susceptibility to landsliding and low incidence
Low landslide incidence (less than 1.5 % of the area is involved in landsliding
0 0.25 0.5 Miles
N
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)
ACTON, MA
Date: 4/19/2018
LITTLETON
WESTFORD
CARLISLE
BOXBOROUGH
CONCORD
STOW
MAYNARD



MAPC dcr

FEMA Hazard Mitigation Planning Grant

ACTON, 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

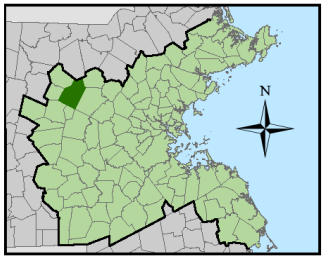
Year of storm noted on map

- Hurricane Surge Innudation Ares
- 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

0 0.25 0.5 Miles



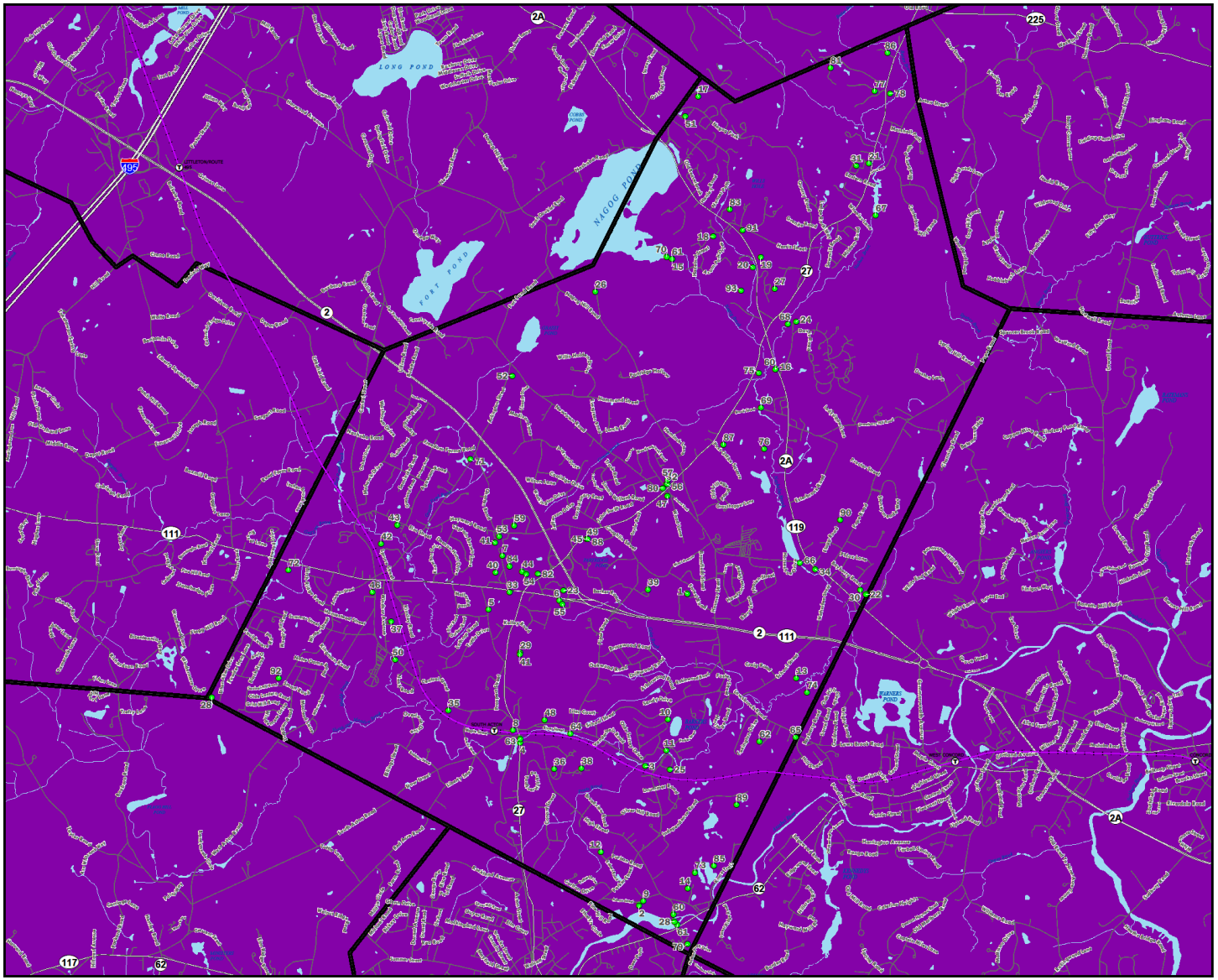
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analyses.

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)
ACTON, MA

Path: K:\DataServices\Projects\Current_Projects\PDM\project_files\PDM_Map5.mxd

Date: 5/30/2018



MAPC dcr

FEMA Hazard
Mitigation Planning Grant
ACTON, MA

Map 6: Average Snowfall

Sites
- Critical Infrastructure Sites*

* See details in separate table

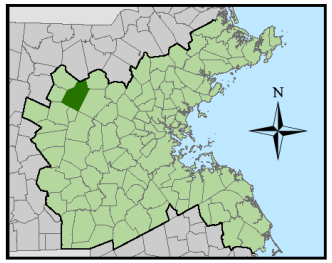
Average Annual Snowfall
- 36.1 to 48.0 inches
- 48.1 to 72.0 inches

Water Bodies

Train Stations
Commuter Rail Lines
Trains

All Roads
- Interstate
- U.S. Highway
- State Route
- Street

0 0.25 0.5 Miles



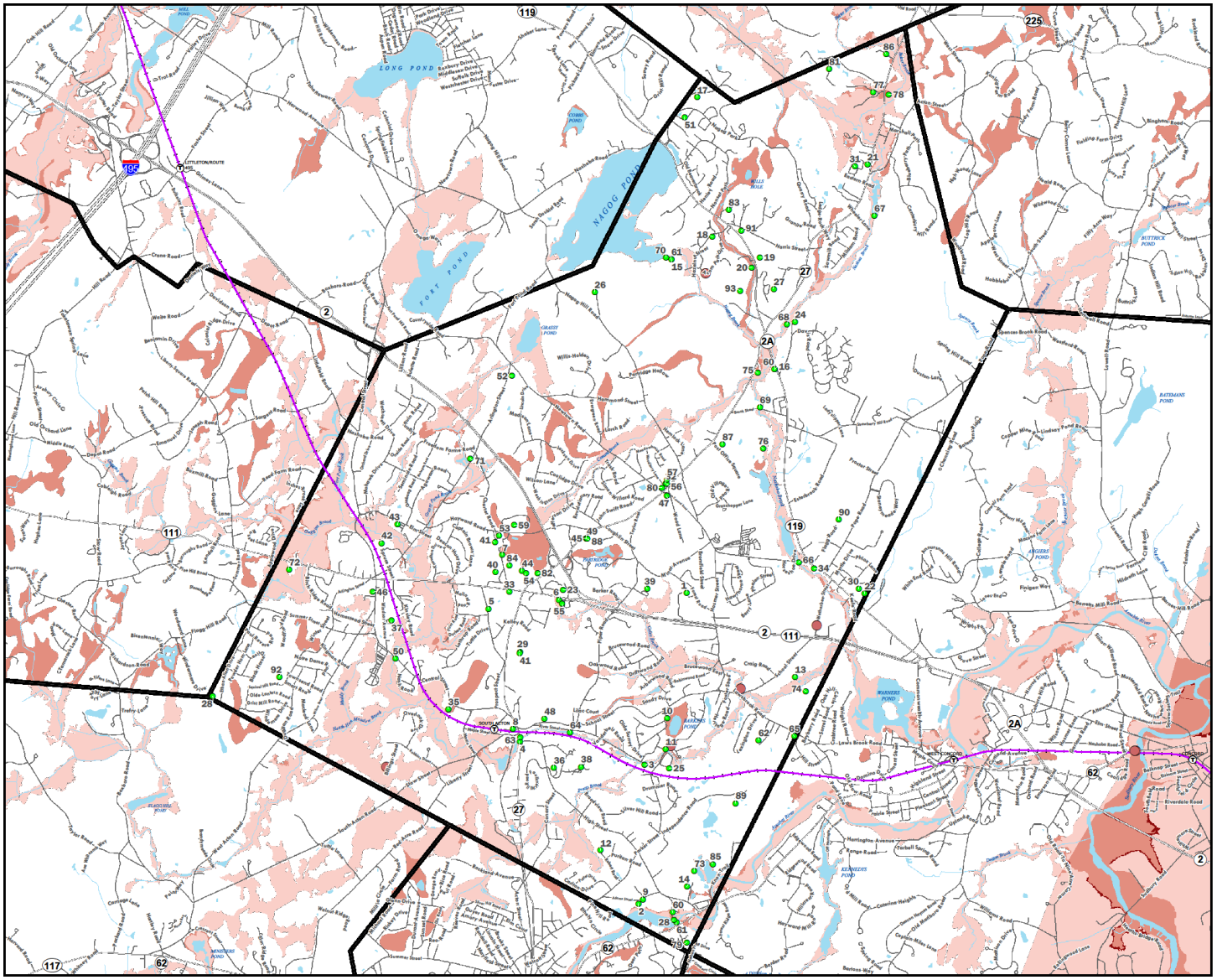
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analyses.

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)
ACTON, MA

Path: K:\DataServices\Projects\Current_Projects\FDM\project_files\FDM_Map6.mxd

Date: 4/19/2018



MAPC

FEMA Hazard Mitigation Planning Grant

ACTON, MA

Map 7: Composite Natural Hazards

Composite Natural Hazards

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

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

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

Sites

- Critical Infrastructure Sites*
- Repetitive Loss Sites

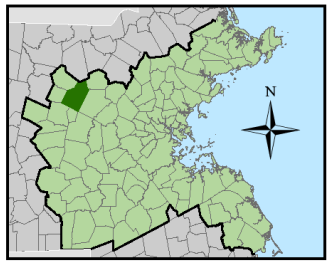
* See details in separate table

- Water Bodies

All Roads

- Interstate
- U.S. Highway
- State Route
- Street
- Train Stations
- Commuter Rail Lines
- Trains

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

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

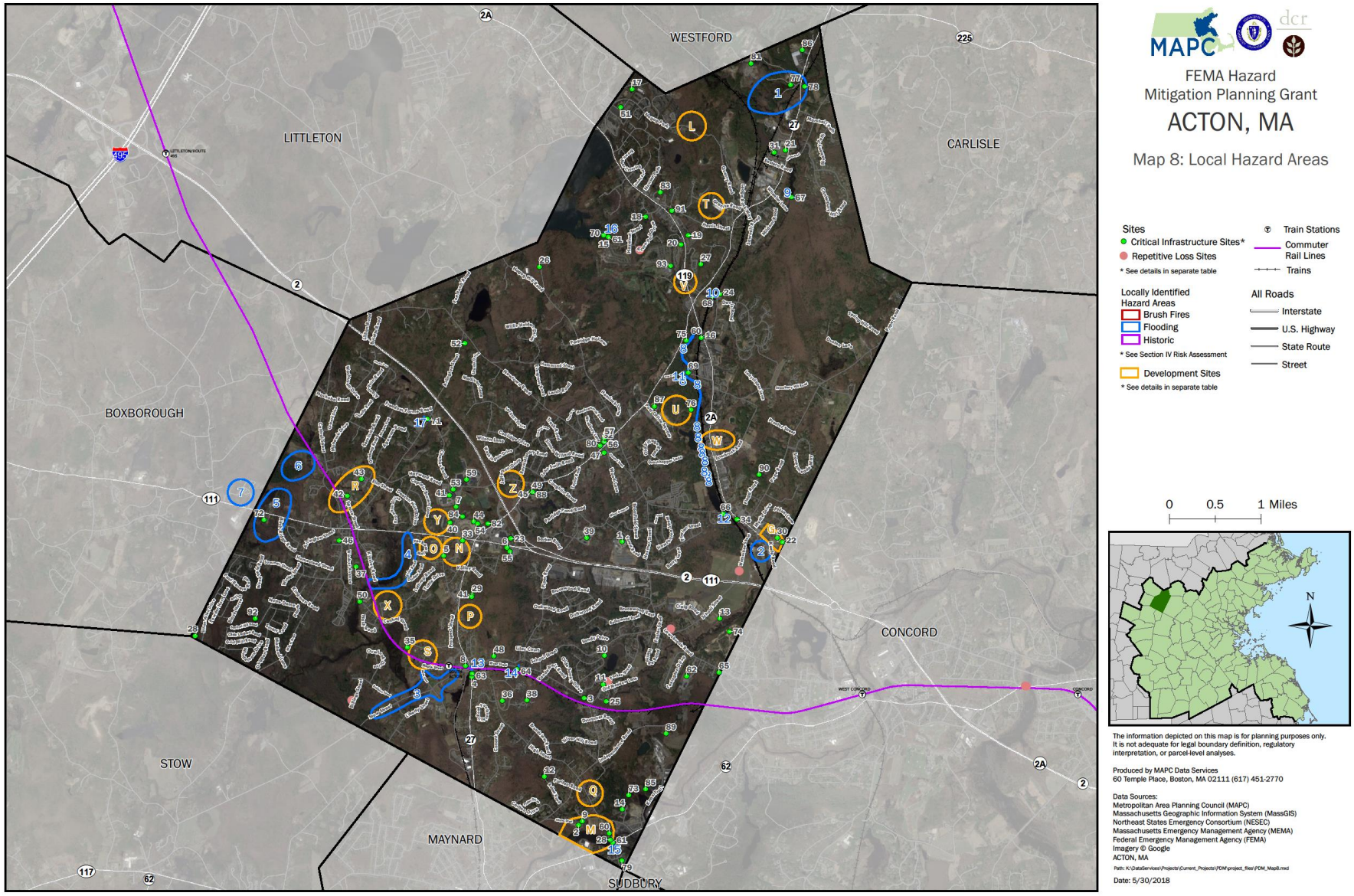
Roads/Trains: MassDOT/ CTPS

Repetitive Loss Sites: DCR/Office of Flood Hazard Management

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

Path: K:\DataServices\Projects\Current_Projects\FDM\project_files\FDM_Map7.mxd

Date: 5/30/2018


WESTFORD
LITTLETON
CARLISLE
BOXBOROUGH
CONCORD
STOW
MAYNARD
SUDBURY
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
ACTON, MA
Map 8: Local Hazard Areas
Sites
Critical Infrastructure Sites*
Repetitive Loss Sites
* See details in separate table
Train Stations
Commuter Rail Lines
Trains
Locally Identified Hazard Areas
Brush Fires
Flooding
Historic
* See Section IV Risk Assessment
Development Sites
* See details in separate table
All Roads
Interstate
U.S. Highway
State Route
Street
0 0.5 1 Miles
N
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
ACTON, MA
Date: 5/30/2018

APPENDIX C: PUBLIC MEETINGS

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

CALENDAR LISTING / MEDIA ADVISORY

ACTON'S DRAFT HAZARD MITIGATION PLAN TO BE PRESENTED AT APRIL 18 PUBLIC MEETING

Meeting to present the 2018 update of Acton's Hazard Mitigation Plan and solicit public comments

Who: Acton 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 Acton Conservation Commission meeting on Wednesday, April 18 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 Acton adopted its first Hazard Mitigation Plan in 2010, which was approved by the Federal Emergency Management Agency (FEMA). This plan will update the 2010 plan. The plan identifies natural hazards affecting Acton such as floods, hurricanes, winter storms, and earthquakes, as well as actions that the Town can take to reduce its vulnerability to these hazards.

When: Wednesday, April 18 at 7:15 PM

Where: Acton Town Hall
472 Main Street
Room 204

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.

##

HAZARD MITIGATION PLAN PUBLIC MEETING

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



The Acton 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 Acton Hazard Mitigation Plan at a public meeting of the Planning Board:

Date: **Wednesday, April 18 2018**
Time: **7:15 PM**
Location: **Acton Town Hall, Room 204**
472 Main Street, Acton, MA

For more information, please contact Anne Herbst via phone at (617) 933-0781 or email aherbst@mapc.org

MAPC
METROPOLITAN AREA PLANNING COUNCIL

CONSERVATION COMMISSION
AGENDA
April 18, 2018
7:15 PM
ACTON TOWN HALL
472 MAIN STREET
Room 9

Note meeting in Room 9.

7:15 Discussion: Like Structures

7:45 Presentation: Hazard Mitigation Plan (MAPC)

8:00 Discussion: Bruce Freeman Rail Trail

Additional impacts to Bordering Vegetated Wetlands have been identified that were not included in the original Notice of Intent. A Massachusetts Department of Transportation representative will provide information to the Commission, and is requesting direction as to the need to file an amended Notice of Intent.

Certificate of Compliance

Quail Ridge DEP File #85-986 (pending)

Minutes:

April 4, 2018: Reviewed by TM, PG, AG

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

CALENDAR LISTING / MEDIA ADVISORY

ACTON'S DRAFT HAZARD MITIGATION PLAN TO BE PRESENTED AT JUNE 18 PUBLIC MEETING

Meeting to present the 2018 update of Acton's Hazard Mitigation Plan and solicit public comments

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

What: The Acton Hazard Mitigation Team will hold a public meeting to present an overview of the draft Acton Hazard Mitigation Plan Update 2018. The Metropolitan Area Planning Council (MAPC) is assisting the Town on the plan update, and a representative of MAPC will present an overview of the plan update.

The Town of Acton adopted its first Hazard Mitigation Plan in 2010, which was approved by the Federal Emergency Management Agency (FEMA). The plan identifies natural hazards affecting Acton such as floods, hurricanes, winter storms, and earthquakes, as well as actions that the Town can take to reduce the impacts of these hazards. FEMA requires that plans be updated regularly, so MAPC is assisting the Town prepare a 2018 updated plan.

When: Monday, June 18, 2018, 7:00 PM
Acton Select Board meeting

Where: Acton Town Hall, Room 204

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.

##

HAZARD MITIGATION PLAN PUBLIC MEETING

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



The Acton Hazard Mitigation Plan is being updated to help the town reduce its vulnerability to natural hazard events such as flooding, hurricanes and winter storms.

Join the town's Hazard Mitigation Team for a presentation and discussion about the draft 2018 update to the Acton Hazard Mitigation Plan at a public meeting of the Acton Board of Selectmen:

Date: **Monday, June 18, 2018**
Time: **7:00 PM**
Location: **Room 204, Acton Town Hall**
Acton, MA

For more information, please contact Anne Herbst via phone at (617) 933-0781 or email aherbst@mapc.org

MAPC
METROPOLITAN AREA PLANNING COUNCIL

Board of Selectmen

MEETING AGENDA *Amended*
Monday, June 18, 2018
Regular Meeting 7:00 PM
Francis Faulkner Hearing Room 204
Acton Town Hall
The docushare link for additional material can be found by **clicking here**

I. Citizens' Concerns

II. Chairman's Update / Operational Update
The Chairman will briefly update the Board. The Town Manager will provide a brief report

III. Public Hearings and Appointments
1. 7:10 PM Traffic Rules and Orders, Strawberry Hill Road, Parking Prohibition

IV. Selectmen's Business
2. Hazard Mitigation Plan Update
3. Transfer Station Bag Replacement and Cost
4. Appraisal Discussion for 252, 252R and 256 Main Street
5. RHSO Amendment and FY19 Budget
6. Committee Reappointments

V. Consent Agenda
7. Letter of Support for Grant from Division of Fish and Wildlife's River Ecological Restoration Fund for 53 River Street
8. Request to Dispose of Obsolete Items, Acton Memorial Library
9. Farmer Winery License, Pony Shack Cider, Acton-Boxborough Farmers Market
10. One Day Alcoholic Beverage License, Cory Loder, NARA Park, July 1, 2018
11. One Day Alcoholic Beverage License, Frances Bean, NARA Park, July 15, 2018
12. One Day Alcoholic Beverage License, House Rabbit Network, NARA Park, July 29, 2018
13. Committee Appointments, Vivian Birchall and Jin Hong Yang, Full Members, Acton Boxborough Cultural Council
14. Committee Appointment, Chunsheng Fu, Full Member, Council on Aging
15. Committee Appointment, Nirpana Velankar, Associate Member, Council on Aging
16. Committee Appointment, R. Luke Evans, Full Member, Transportation Advisory Committee
17. Committee Appointment, Ye Emilie Ying, Associate Member, Board of Appeals
18. Right of Way Construction Requests
19. Accept Gift, Recreation Department

Board to accept a gift totaling $250.00 in donations for funding a new recreation facility and playground at Jones Field

VI. Selectmen Reports
20. Selectmen Reports are now included in the docushare file.

Future Agendas
To facilitate scheduling for interested parties, the following items are scheduled for discussion on future agendas.
This is not a complete agenda and is subject to change
• July 2, 2018

APPENDIX D: CLIMATE WORKSHOP

The Town of Acton received a grant from the Commonwealth of Massachusetts to conduct a "Community Resilience Building Workshop". Town leaders, staff, and citizen activists gathered for a one-day workshop to consider Acton's strengths and vulnerabilities with regard to projected climate changes. Listed below are all of the priorities that were identified by the workshop participants. As is evident, many of the suggested priorities are highly relevant to natural hazard mitigation.

TOP RECOMMENDATIONS TO IMPROVE RESILIENCE

Highest Priorities

Emergency communications: Develop an emergency communications network, use multiple sources, have redundancy. Specific suggestions include: enhance the FM station, improve reverse 911 (register cell phones), use text messaging, use social media, do translation, use the ham radio network. Have a live link for emergency communications from town hall, utilize local residents for backup support.
Outreach to vulnerable populations: Encourage neighborhood networking, focus on harder to reach populations (non-English speakers, isolated seniors, renters). Reinvigorate the Acton neighborhood network, develop a communication system. Make sure people will have access to food and medicine. Utilize cultural resources. Do outreach through the Acton Disabilities Commission. Activate volunteers, connect with the Junior High student volunteer network.
Groundwater protection for water supply: Consider new and innovative recharge options, pursue conservation, new storage and new sources. Address septic issues. Coordinate regionally and among town governments. Educate residents. Consider the need for deeper wells.
Tree maintenance: Develop a tree maintenance plan for removal and replacement of trees to address the risk of power outages. The plan should address utilities, street trees and private trees. Include citizen education. Staff is needed to keep up with the workload. Address gas leak impacts on trees.
Flooding: maintain or remove dams, utilize green infrastructure, implement beaver diversion strategies.
Bury power lines: To reduce the risk of outages, place powerlines underground when doing roadwork.
Strengthen civic engagement: establish a CERT team (note: Acton has a CERT team), environmental groups should be more efficient with their resources.
Update bylaws for climate change: Specifically look at stormwater and groundwater bylaws, scrutinize the cost/benefit associated with new growth. Develop more green infrastructure. Focus on post-construction enforcement.
Secure water rights to Nagog Pond: Maintain pressure for Acton's water rights for long-term security.
Emergency communications task force: Establish a task force for emergency communications to all populations.
Emergency Shelters: Better equip and prepare municipal buildings for emergency use. Utilize the Human Service building and Senior Center.
Funding for N. Acton Fire Station: Town meeting approved funding for design. Follow up with construction funds when design is complete.

High Priorities

- Elevate pump stations, understand commercial water user demand, and address culvert flooding issues.
- Encourage sustainable landscaping to address water and fertilizer use.
- Work on beaver management for flooding issues.
- Fix natural gas leaks (National Grid).
- Protect land strategically to maintain biodiversity.
- Protect Nagog Pond as a resource.
- Increase emergency food supplies at shelters.
- Protect open space, plan the direction of development.
- Human Service facility needs generator and emergency food supply for sheltering.
- Do more public outreach for utilization of the new Human Service facility.

Medium Priorities

- Do more outreach for Discovery Museum to support healthy outdoor activity.
- Restrict campfires on conservation lands.
- Promote regional coordination of water supply. Permit solar arrays and microgrids.
- Provide DPW resources needed to clear bike paths of downed trees and branches.
- Confirm generators and shelter capacity for assisted living facilities, public housing, and Avalon.
- Consider risk of water borne illnesses from septic systems, study wastewater needs.
- Encourage groundwater recharge with pervious surfaces, green infrastructure, reduce use of waivers.
- For single access subdivisions, assess the risk of falling trees.
- Encourage translation, networking, and volunteer efforts for communication with residents who don't speak English.
- Expand focus on senior population and those isolated or on limited incomes. Focus on their needs, including medical. Establish a buddy system.
- Establish communication with apartment renters who may be more temporary. Work with landlords and the fire department.
- Use conservation restrictions to protect lands suitable for farming.
- Add showers and backup generators to shelters where needed. Ensure ADA compliance.
- Encourage transportation alternatives and emergency transportation planning.
- Improve collaboration among environmental organizations.
- Increase visibility of the town Nursing Service.
- Encourage emergency planning for families that include members who commute out of town.
- Connect local ham radio network to town emergency planning.
- Encourage the state to reduce salt use on state roadways in Acton.

Low Priorities

- Assess the 53 River Street dam for possible removal.
- Upgrade privately owned sewage treatment where possible.
- Identify emergency measures for private wells that need pumps.
- Increase parking at the S. Acton commuter rail station.
- Expand use of sewage treatment.
- Have a generator at the transfer station.
- Ensure availability of equipment and storage space for snow management.

APPENDIX E: PLAN ADOPTION

TOWN OF ACTON
472 Main Street
Acton, Massachusetts, 01720
Telephone (978) 929-6611
Fax (978) 929-6350

Board of Selectmen

CERTIFICATE OF ADOPTION
BOARD OF SELECTMEN
TOWN OF ACTON, MASSACHUSETTS

A RESOLUTION ADOPTING THE
TOWN OF ACTON HAZARD MITIGATION PLAN 2018 UPDATE

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

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

WHEREAS, duly-noticed public meetings were held by the LOCAL HAZARD MITIGATION PLANNING TEAM on April 18, 2018 and June 18, 2018 and

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

NOW, THEREFORE BE IT RESOLVED that the Town of Acton BOARD OF SELECTMEN adopts the *Town of Acton Hazard Mitigation Plan 2018 Update*, in accordance with M.G.L. 40 §4 or the charter and bylaws of the Town of Acton.

ADOPTED AND SIGNED this Date. November 5, 2018

Name(s) Katie Green

Title(s) Chair, Board of Selectmen

Signature(s)

APPENDIX F: PLAN REVIEW TOOL

LOCAL MITIGATION PLAN REVIEW TOOL - APA
Town of Acton, 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 Acton, MA	**Title of Plan:** Draft Town of Acton Hazard Mitigation Plan 2018 Update	**Date of Plan:** July 31, 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:** Corey York, Director, Department of Public Works 14 Forest Road Acton, MA 01720 (978) 929-7740; cyork@acton-ma.gov

State Reviewer:	**Title:**	**Date:**
Jeffrey Zukowski	Hazard Mitigation Planner	9/05/2018

FEMA Reviewer:	**Title:**	**Date:**
Gabriella Spitzer Brigitte Ndikum-Nyada	CERC FEMA Community Planner	9/21/2018 9/25/2018
Date Received in FEMA Region I	9/05/2018	
Plan Not Approved		
Plan Approvable Pending Adoption	9/25/2018	
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 Met**
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))	Ack., p. i; Exec., p. 1; Sec. 3, pp. 11-17 App. A, pp. 92-94	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. 11-17 App. A, pp.	X	
A3. Does the Plan document how the public was involved in the planning process during the drafting stage? (Requirement §201.6(b)(1))	Exec., pp. 1-3; Sec. 3, pp. 14-17 App. C, pp. 105-110	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. 12; Sec. 10, p. 91	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. 9, pp. 89-90	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. 89-90	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. 19-51 App. B, pp. 96-104	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. 2, pp. 5-7; Sec. 4, pp. 19-53	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. 19-65	X	

Regulation (44 CFR 201.6 Local Mitigation Plans)	**Location in Plan** (section and/or page number)	**Met**	**Not Met**
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. 26	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. 69-75	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. 69-71	X	
C3. Does the Plan include goals to reduce/avoid long-term vulnerabilities to the identified hazards? (Requirement §201.6(c)(3)(i))	Exec., p. 2; Sec. 5, p. 67	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. 80-87	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. 80-87	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. 90	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. 55-57; Sec. 8, pp. 80-81	X	
D2. Was the plan revised to reflect progress in local mitigation efforts? (Requirement §201.6(d)(3))	Sec. 2, p. 7; Sec. 7, pp. 77-78	X	
D3. Was the plan revised to reflect changes in priorities? (Requirement §201.6(d)(3))	Sec. 7, pp. 77-78	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))	App. E, p. 113		
E2. For multi-jurisdictional plans, has each jurisdiction requesting approval of the plan documented formal plan adoption? (Requirement §201.6(c)(5))			

Regulation (44 CFR 201.6 Local Mitigation Plans)	Location in Plan (section and/or page number)	Met	Not Met
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:

- Community is encouraged to consider inserting or placing the adopted final certificate of adoption within the first 3 or 4 pages of the final approved Hazard Mitigation Plan. Having the Adoption Certificate so strategically located in the HMP, celebrate the community's successes & highlights ownership.

Element A: Planning Process

Strengths:

- A range of existing studies, reports, and plans were reviewed and incorporated, resulting in a plan that is comprehensive and current.
- Community officials were effectively engaged in the planning process. Their feedback shaped the content of the plan. A great accomplishment to have 15 members of the public attend the June 18th, 2018, the second public meeting. Kudos!
- A diverse group of stakeholders were involved in the planning process, ensuring a range of perspectives and comprehensive analysis.
- The plan includes a summary of the content of public feedback and how it was incorporated into the plan.

Opportunities for Improvement:

- Describe any limitations in the available data. Identifying limitations will help inform plan updates and help identify the need for additional studies.
- Consider incorporating specific mitigation measure evaluation criteria into the plan monitoring procedures so that progress can be better quantified.

Element B: Hazard Identification and Risk Assessment

Strengths:

- Hazard profiles are well-defined, with detailed information about the context of the hazard and the risk it presents to the community.
- The plan contains a thorough hazard identification and risk assessment. When quantitative data was not available at the local level, data from the county or state was used and a qualitative discussion was provided.
- 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.
- Identify dams in upstream communities that may pose a risk to neighborhoods and assets.

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 plan includes of a variety of different types of mitigation actions (local plans and regulations, structure and infrastructure projects, natural system protections, and education and awareness programs).
- 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.
- The plan Integrates and aligns the plan's goals with the goals of other current planning initiatives within the community.

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.).

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 includes a projection of planned and/or potential future development.
- Progress on mitigation actions is clear and comprehensive.

Opportunities for Improvement:

- Including a discussion of lessons learned about implementing mitigation actions would strengthen the plan, as would a short narrative on some “success stories” about their implementation.
- Clearly state what the changes in priorities are from the previous plan.

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 Webliography: 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.