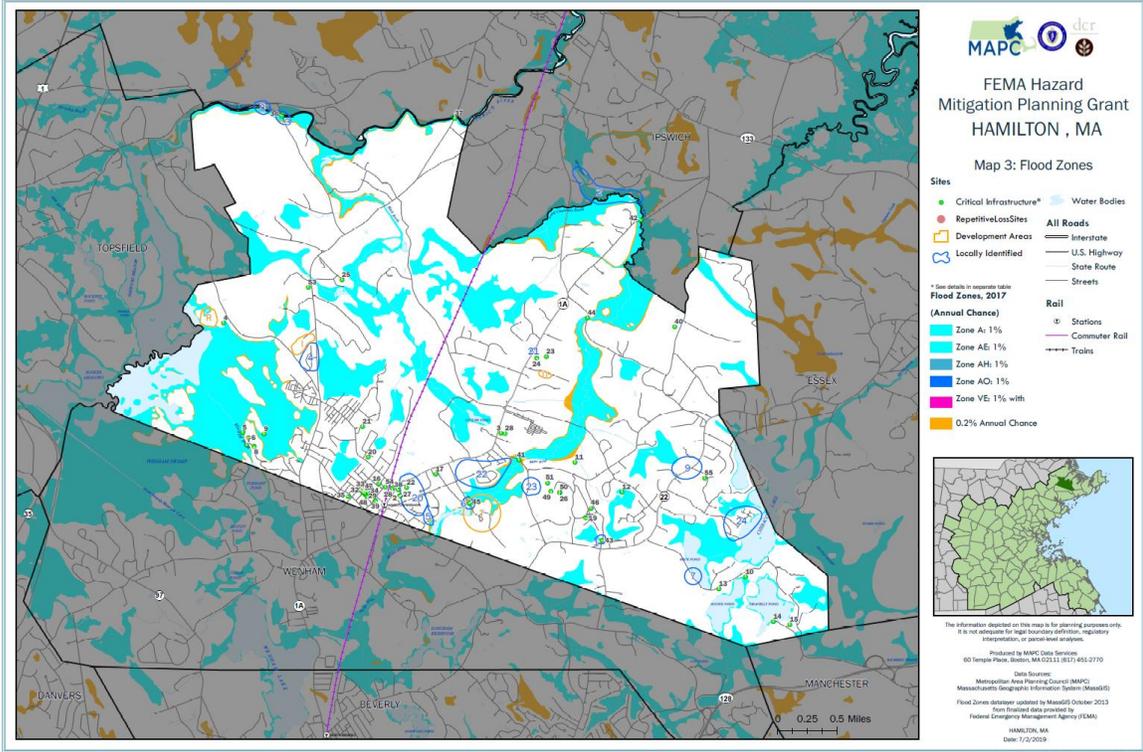


# TOWN OF HAMILTON DRAFT HAZARD MITIGATION PLAN 2019 UPDATE



**July 26, 2019**  
**Revised Draft Plan for review by MEMA and FEMA**



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## **ACKNOWLEDGEMENTS AND CREDITS**

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

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Patrick Reffett	Planning Department
Russ Stevens	Police Chief
Raymond Brunet	Fire Chief

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## I. EXECUTIVE SUMMARY

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

### Planning Process

This is an update of the original Hamilton Hazard Mitigation Plan, which was adopted by Hamilton on February 26, 2011. Planning for the Hazard Mitigation Plan update was led by the Hamilton Local Hazard Mitigation Planning Team, composed of staff from a number of different Town Departments. This team met on February 12, 2019 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 Community Planning and Development Commission hosted two public meetings, the first on April 23, 2019 and the second on July 23, 2019 and the draft plan update was posted on the Town's website for public review. Key Town stakeholders and neighboring communities were notified and invited to review the draft plan and submit comments.

### Risk Assessment

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

The Hamilton Local Hazard Mitigation Planning Team identified 55 Critical Facilities. These are also shown on the map series and listed in Table 20, identifying which facilities are located within the mapped hazard zones.

A HAZUS-MH analysis provided estimates of damages from Hurricanes of category 2 and 4 (\$8,332.94 thousand to \$29,746.56 thousand) as well as earthquakes of magnitudes 5 and 7 (\$143.13 million to \$1,127.30 million). Flood damage estimates range from



\$ 1.63 million to \$2.21 million for 100 and 500 year events respectively.

## **Hazard Mitigation Goals**

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

1. Prevent and reduce the loss of life, injury, public health impacts and property damages resulting from all identified natural hazards.
2. Build and enhance local mitigation capabilities to ensure individual safety, reduce damage to public and private property and ensure continuity of emergency services.
3. Increase cooperation and coordination among private entities, Town officials and Boards, State agencies and Federal agencies.
4. Increase awareness of the benefits of hazard mitigation through outreach and education.
5. Consider the potential impacts of future climate change. Incorporate climate sustainability and resiliency in hazard mitigation planning.



### Hazard Mitigation Strategy

The Hamilton Local Hazard Mitigation Planning Team identified a number of mitigation measures that would serve to reduce the Town’s vulnerability to natural hazard events. Hamilton would like to complete important drainage infrastructure upgrades, complete a vegetation management plan for the Miles River, complete updating backup generation capacity at the Winthrop and Cutler Schools, and create a Medivac site for multi-hazard response. In addition the Town is committed to completing the MS4 Stormwater Permit and continuing to add resources to address flooding and stormwater issues as well as adding a new water standpipe and increasing resources towards tree and vegetation management. The Town is currently updating its Open Space and Recreation Plan and will be holding a climate resilience workshop in 2019 through the state’s Municipal Vulnerability and Preparedness Program (MVP). The Town also is planning to update its current Master Plan.

Overall, the hazard mitigation strategy recognizes that mitigating hazards for Hamilton 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. 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 and Update Process

Table 1- Plan Review and Update

Chapter	Reviews and Updates
III – 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 Community Planning and Development Commission. The plan was also available on the Town’s website for public comment.
IV – 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.
V - Goals	The Hazard Mitigation Goals were reviewed and endorsed by the Hamilton Local Hazard Mitigation Planning Team.
VI – Existing Mitigation Measures	The list of existing mitigation measures was updated to reflect current mitigation activities in the Town.



VII & VIII – Hazard Mitigation Strategy	Mitigation measures from the 2011 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 2019 Plan Update or modify or delete them. The Plan Update's hazard mitigation strategy reflects both new measures and measures carried forward from the 2011 plan. The Local Hazard Mitigation Team prioritized all of these measures based on current conditions.
IX – 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 on Table 27, Hamilton made progress on implementing mitigation measures identified in the 2011 Hazard Mitigation Plan. Several projects have been completed, including:

- Culvert upgrades at Bridge Street bridge and Linden and Howard Streets;
- Extension of water mains on Winthrop Street;
- Elevating a low section of Gregory Island Road;
- Upgrades of its emergency generation, communications, GPS and fire-fighting capacity;
- Upgrades to its FEMA flood maps, CEMP, stormwater management regulations and wetlands database;
- The completion of the Sagamore Hill open space acquisition;
- Ongoing beaver control flood management.

Other projects were partially completed, most notably drainage upgrades at Patton Pond, adding backup generating capacity, work on the MS4 stormwater permit, investigating options to make all older public buildings earthquake resistant and updating its tree database and maintenance program to prevent damage from high wind events. These mitigation measures will be continued in this 2019 Plan Update.

Moving forward into the next five year plan implementation period there will be many more opportunities to incorporate hazard mitigation into the Town’s decision making processes.

Though not formally done in the 2011 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 Hamilton Hazard Mitigation Implementation Team, as described in Section IX, Plan Adoption and Maintenance.

## II. INTRODUCTION

### **Planning Requirements under the Federal Disaster Mitigation Act**

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

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

The Metropolitan Area Planning Council (MAPC) subcontracted with the Town of Hamilton to update its local Hazard Mitigation Plans, which was first adopted in 2011. The local Hazard Mitigation Plan update produced under this grant is designed to individually meet the requirements of the Disaster Mitigation Act for each community while listing regional concerns and hazards that impact the Town or City creating the plan.

### **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 Hamilton, a part of Essex County, has experienced 28 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**

<b>DISASTER NAME (DATE OF EVENT)</b>	<b>TYPE OF ASSISTANCE</b>	<b>DECLARED AREAS</b>
Hurricane Bob (August 1991)	FEMA Public Assistance Project Grants	Counties of Barnstable, Bristol, Dukes, Essex, Hampden, Middlesex, Plymouth, Nantucket, Norfolk, Suffolk
	Hazard Mitigation Grant Program	Counties of Barnstable, Bristol, Dukes, Essex, Hampden, Middlesex, Plymouth, Nantucket, Norfolk, Suffolk (16 projects)
No-Name Storm (October 1991)	FEMA Public Assistance Project Grants	Counties of Barnstable, Bristol, Dukes, Essex, Middlesex, Plymouth, Nantucket, Norfolk
	FEMA Individual Household Program	Counties of Barnstable, Bristol, Dukes, Essex, Middlesex, Plymouth, Nantucket, Norfolk
	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



**TOWN OF HAMILTON- HAZARD MITIGATION PLAN- 2019 UPDATE**

<b>DISASTER NAME (DATE OF EVENT)</b>	<b>TYPE OF ASSISTANCE</b>	<b>DECLARED AREAS</b>
June Flood (June 1998)	FEMA Individual Household Program	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester
	Hazard Mitigation Grant Program	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester (19 projects)
(1998)	Community Development Block Grant-HUD	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester
March Flood (March 2001)	FEMA Individual Household Program	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester
	Hazard Mitigation Grant Program	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester (16 projects)
February Snowstorm (Feb 17-18, 2003)	FEMA Public Assistance Project Grants	All 14 Counties
January Blizzard (January 22-23, 2005)	FEMA Public Assistance Project Grants	All 14 Counties
Hurricane Katrina (August 29, 2005)	FEMA Public Assistance Project Grants	All 14 Counties
May Rainstorm/Flood (May 12-23, 2006)	Hazard Mitigation Grant Program	Statewide
April Nor'easter (April 15-27, 2007)	Hazard Mitigation Grant Program	Statewide
Flooding (March, 2010)	FEMA Public Assistance FEMA Individuals and Households Program SBA Loan	Bristol, Essex, Middlesex, Suffolk, Norfolk, Plymouth, Worcester
	Hazard Mitigation Grant Program	Statewide
Tropical Storm Irene (August 27-28, 2011)	FEMA Public Assistance	Statewide
Hurricane Sandy (October 27-30, 2012)	FEMA Public Assistance	Statewide
Severe snowstorm and Flooding (February 8-09, 2011)	FEMA Public Assistance; Hazard Mitigation Grant Program	Statewide
Blizzard of 2015	FEMA Public Assistance;	Statewide



DISASTER NAME (DATE OF EVENT)	TYPE OF ASSISTANCE	DECLARED AREAS
(January 26-28, 2015)	Hazard Mitigation Grant Program	
Severe storm and flooding (March 2018)		Barnstable, Bristol, Norfolk, Nantucket, Essex, Plymouth
Severe winter storm (March 2018)		Norfolk, Middlesex, Essex, Suffolk, Worcester

Source: MA Hazard Mitigation and Climate Adaptation Plan, 2018

### FEMA Funded Mitigation Projects

The Town of Hamilton has received funding from FEMA for one mitigation project under the Hazard Mitigation Grant Program (HMGP).

Project Description/Title	Scope of Work	Total Project Cost (100%)	Federal Funding	Local Funding	Project Status
Bridge Street Culvert Upgrade	Culvert replacement and bridge replacement.	\$988,000	\$741,000	\$247,000	Complete

### Community Profile

Hamilton is a rural-suburban town in the eastern central portion of Essex County in eastern Massachusetts, United States. Currently the town has no manufacturing industry and no industrially-zoned land.

Its location on the North Shore of Massachusetts provides easy access to the Atlantic seashore with its reservations, beaches and boating. The town includes many historic houses, pastoral landscapes, and old stone walls that accompany winding tree-lined roads. It also has a rich equestrian heritage, which remains strong due to the influence of the many horse farms and of Myopia Hunt Club, which holds frequent equestrian events, including polo most Sunday afternoons. (Myopia also hosts a Thanksgiving Day fox hunt each year that the public may attend. Thus, the visitor to Hamilton may well share the

secondary roads with horse and pony riders. Hamilton is closely tied to neighboring Wenham, sharing a school system, library, recreation department, commuter rail station and newspaper. In 2010, the community of Hamilton-Wenham was listed among the “Best Places to Live” by Boston Magazine. Hamilton includes South Hamilton, which is that part of Hamilton that the Postal Service has assigned the zip code 01982. “Hamilton” and “South Hamilton” are indistinguishable from each other except for the difference in zip codes. The town maintains a website at <https://www.hamiltonma.gov/about/>

**Table 4: Hamilton Characteristics**

Population = 7,764 people
<ul style="list-style-type: none"><li>• 5.9 % are under age 5</li><li>• 27.4 % are under age 18</li><li>• 13.6 % are over age 65</li><li>• 4.4% under age 65 have a disability</li></ul>
Number of Housing Units = 3,039
<ul style="list-style-type: none"><li>• 16.7% are renter-occupied housing units</li><li>• 30.1% of housing units were built before 1940</li></ul>

Sources:

Disability Characteristics 2005 – 2007 American Community Survey  
English-speaking + vehicles: 2016 ACS 5-year estimates  
1940 fact: 2017 ACS 1-year estimates  
Renting info: 2016 ACS 5-year estimates



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### III. PLANNING PROCESS AND 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 Regional and 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, the local chamber of commerce, 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 in the Local Multi-Hazard Mitigation Planning Guidance. Public participation is a central element of this process, which attempts to focus on local problem areas and identify needed mitigation measures based on where gaps occur in the existing mitigation efforts of the municipality. MAPC is also able to identify regional opportunities for collaboration and facilitate communication between communities. In plan updates, the process described below allows staff to bring the most recent hazard information into the plan, including new hazard occurrence data, changes to a municipality’s existing mitigation measures, and progress made on actions identified in previous plans.



**1. Map the Hazards** – MAPC relies on data from a number of different federal, state, and local sources in order to map the areas with the potential to experience natural hazards. This mapping represents a multi-hazard assessment of the municipality and is used as a set of base maps for the remainder of the planning process. A particularly important source of information is the knowledge drawn from local municipal staff on

where natural hazard impacts have occurred, which is collected. 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:

- Bylaws of the Town of Hamilton
- Town of Hamilton, Zoning Bylaws
- Town of Hamilton draft Open Space and Recreation Plan
- Massachusetts State Hazard Mitigation Plan, 2018
- (Ipswich Basin Water Management Act Planning Grant, FY17-BWR2017-08, Final Report, Kleinfelder, 2017)
- FEMA, Local Mitigation Plan Review Guide, October 2011
- FEMA, Flood Insurance Rate Maps for Essex County, MA, 2012
- Massachusetts State Hazard Mitigation and Climate Adaptation Plan, 2018
- 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 Climatic Data Center, <http://www.ncdc.noaa.gov/>
- Northeast States Emergency Consortium, <http://www.nesec.org/>
- USGS, National Water Information System, <http://nwis.waterdata.usgs.gov/usa/nwis>
- US Census, 2010 and American Community Survey 2017 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 Chapter VII.

**5. Plan Approval & Adoption** – Once a final draft of the plan is complete it is sent to MEMA for the state level review and, following that, to FEMA for approval. Typically, once FEMA has approved the plan the agency issues a conditional approval (Approval Pending Adoption), with the condition being adoption of the plan by the municipality. More information on plan adoption can be found in Chapter IX and documentation of plan adoption can be found in Appendix D.



**6. Implement & Update the Plan** – Implementation is the final and most important part of any planning process. Hazard Mitigation Plans must also be updated on a five year basis making preparation for the next plan update an important on-going activity. Chapter IX includes more detailed information on plan implementation.

### The Local Multiple Hazard Community Planning Team

MAPC worked with the local community representatives to organize a local Multiple Hazard Community Planning Team for Hamilton (Local Committee). MAPC briefed the local representatives as to the desired composition of that team as well as the need for representation from the business community, civic organizations and citizens at large.

The Local Hazard Mitigation Planning Team is central to the planning process as it is the primary body tasked with developing a mitigation strategy for the community. The local team was tasked with working with MAPC to set plan goals, provide information on the hazards that impact the Town, existing mitigation measures, and helping to develop new mitigation measures for this plan update. The Local Hazard Mitigation Planning Team membership can be found in Table 4 below.

The Hamilton Planning Board, as well as the Hamilton 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 Hamilton Planning Department and the Conservation Administrator, as well as the Town Administrator, who oversees all town functions. The Planning Board hosted two public meetings on the plan, on April 23, 2019 and July 23, 2019. In addition, MAPC, the State designated regional planning authority for Hamilton, works with all agencies that regulate development in the region, including the listed municipal entities and state agencies, such as the MassDOT.

On February 12, 2019 MAPC conducted a meeting of the Hamilton Local Committee. The meeting was organized by the Hamilton Planning Department. The purpose of the meeting was to review and develop hazard mitigation goals, review the status of mitigation measures identified in the 2011 hazard mitigation plan, identify new potential mitigation measures and to gather information on local hazard mitigation issues and sites or areas related to these. The meeting also covered measures to be carried forward from the previous plan and to prioritize new measures.

The following Table lists the attendees at each meeting of the team. The agendas for these meetings are included in Appendix A.

The agendas for these meetings are included in Appendix A.

<b>Table 4</b>	
<b>Membership of the Hamilton Hazard Mitigation Planning Team</b>	
<b>Name</b>	<b>Representing</b>
Jim Hankin	Conservation Agent
Anne Gero	Resident

<b>Table 4</b>	
<b>Membership of the Hamilton Hazard Mitigation Planning Team</b>	
Leslie Whelan	Health Department
Scott Janes	Police Department
Tim Olson	Department of Public Works
Joe Domelowicz	Town Manager
Patrick Reffett	Planning Department
Russ Stevens	Police Chief
Raymond Brunet	Fire Chief

## 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 Hamilton hazard mitigation planning process during a Planning Board meeting on April 23, 2019 held in the Town Hall. The draft plan update was presented at a Planning Board meeting held on July 9, 2019 in Hamilton Town Hall. Both meetings were publicized as regular meetings of Planning Board according to the Massachusetts Public Meeting Law. The attendance list for each meeting can be found in Table 5. See public meeting notices in Appendix C.



<b>Table 5 Hamilton Public Meetings</b>	
<b>Name</b>	<b>Representing</b>
<b>Meeting #1 April 23, 2019</b>	
Patrick Reffett	Director of Planning and Inspections
Brian Stein	Chairman, Planning Board
Rick Mitchell	Clerk, Planning Board
Richard Boroff	Planning Board
Peter Clark	Planning Board
William Wheaton	Planning Board
Janel Curry	Planning Board
Daniel Hamm, P.E.	Planning Board
7 members of the Planning Board and 5 members of the public.	
<b>Meeting #2 July 23, 2019</b>	
Patrick Reffett	Director of Planning and Inspections
Rick Mitchell	Clerk, Planning Board
Richard Boroff	Planning Board
Peter Clark	Planning Board
William Wheaton	Planning Board
Janel Curry	Planning Board
Daniel Hamm, P.E.	Planning Board
6 members of the Planning Board and 4 members of the public.	

### **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:

- Essex County Trails Association
- Ipswich River Watershed Association
- Greater Beverly Chamber of Commerce
- Town of Wenham
- Town of Topsfield
- Town of Manchester
- Town of Essex
- Town of Ipswich

See Appendix C for public meeting notices. The draft Hamilton Hazard Mitigation Plan 2019 Update was posted on the Town’s website following 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 hazard. 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

February 12, 2019	Meeting of the Hamilton Local Hazard Mitigation Planning Team
April 23, 2019	First Public Meeting with Hamilton Planning Board
July 23, 2019	Second Public Meeting with Hamilton Planning Board
TBD	Draft Plan Update submitted to MEMA following posting and review
TBD	Plan Review Tool received from MEMA with requested edits
TBD	Revised Draft Plan Submitted to MEMA

## IV. RISK ASSESSMENT

The risk assessment analyzes the potential natural hazards that could occur within the Town of Hamilton as well as the relationship between those hazards and current land uses, potential future development, and critical infrastructure. . Climate change is projected to have significant impacts on many natural hazards. The Town will be completing a climate vulnerability assessment using the Hamilton Municipal Vulnerability Preparedness Workshop to be held later in 2019. Information from 2019 Natural Hazard Mitigation Plan update will be used to support and inform the workshop as well as be incorporated into the Town’s efforts to update community planning documents such as the Open Space and Recreation Plan and the Master Plan.

### Update Process

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

### 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 Hamilton. 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 Hamilton using the definitions for hazard frequency and severity listed below. Based on this, the Town set an overall priority for each hazard. Hamilton is not a coastal community and therefore not subject to coastal hazards, storm surge or tsunamis.

**Table 6 - Hazard Risks Summary**

Hazard	Frequency		Severity	
	Massachusetts	Hamilton	Massachusetts	Hamilton
Inland Flooding	High	High	Serious	Serious
Dam failures	Very Low	NA	Extensive	NA
Hurricane/Tropical Storm	Medium	Medium	Serious	Serious
Tornadoes	Medium	Very Low	Serious	Serious
Thunderstorms/Severe Weather	High	High	Minor	Minor
Nor’easter	High	High	Minor	Minor
Winter-Blizzard/Snow	High	High	Minor	Minor
Winter-Ice Storms	Medium	Medium	Minor	Minor
Earthquakes	Very Low	Very Low	Serious	Serious
Landslides	Low	Very Low	Minor	Minor
Brush fires	Medium	High	Minor	Minor

**Table 6 - Hazard Risks Summary**

Extreme Temperatures	Medium	Medium	Minor	Minor
Drought	Low	Low	Minor	Minor
Coastal Flooding	High	N/A	Serious	N/A
Coastal Erosion	High	N/A	Serious	N/A
Tsunami	Very Low	N/A	Extensive	N/A
Major Urban Fires	Low	N/A	Serious	N/A
Ice Jams	Low	N/A	Minor	N/A
Invasive Species	High	High	Minor	Minor

Source, Massachusetts State Hazard Mitigation Plan, 2018, modified for Hamilton

Note: Of the hazards listed in the Massachusetts State Hazard Mitigation Plan, several categories are not applicable to Hamilton:

- Major urban fires, due to the lack of significant wildfire areas in close proximity to urban development that could pose a significant threat of urban fire.
- Ice Jams, due to the lack of a river subject to ice jams in Hamilton
- Dam Failures, due to Hamilton having no dams.
- Tsunami due to a lack of open ocean exposure.
- Coastal Flooding and Coastal Erosion due to Hamilton not being located on the coast.

**Definitions used in the Commonwealth of Massachusetts State Hazard Mitigation Plan**

**Frequency**

**Very low frequency:** events that occur less frequently than once in 100 years (less than 1% per year)

**Low frequency:** events that occur from once in 50 years to once in 100 years (1% to 2% per year);

**Medium frequency:** events that occur from once in 5 years to once in 50 years (2% to 20% per year);

**High frequency:** events that occur more frequently than once in 5 years (Greater than 20% per year).

**Severity**

**Minor:** Limited and scattered property damage; limited damage to public infrastructure and essential services not interrupted; limited injuries or fatalities.

**Serious:** Scattered major property damage; some minor infrastructure damage; essential services are briefly interrupted; some injuries and/or fatalities.

**Extensive:** Widespread major property damage; major public infrastructure damage (up to several days for repairs); essential services are interrupted from several hours to several days; many injuries and/or fatalities.

**Catastrophic:** Property and public infrastructure destroyed; essential services stopped; numerous injuries and fatalities.



**Flood Related Hazards**

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

Regionally Significant Floods

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

- The Blizzard of 1978
- January 1979
- April 1987
- October 1991 (“The Perfect Storm”) Considered to be a 100-year storm.
- October 1996
- June 1998
- March 2001
- April 2004
- May 2006
- April 2007
- March 2010
- December 2010

Local data for previous flooding occurrences are not collected by the Town of Hamilton. The best available local data is for Essex County through the National Climatic Data Center (see Table 7). Essex County, which includes the Town of Hamilton, experienced 41 flood events from January 1, 1996 –June 30, 2018. Two deaths and three injuries were reported and the total reported property damage in the county was \$20.688 million dollars. Damages from the March 2010 floods in Essex County totaled \$1.37 million, while total damages for all floods since 2005 totaled \$20.667 million. There were no deaths or injuries reported. The vulnerability analysis conducted by MAPC estimates a range of damages from flooding of \$1.63 million to \$2.21 million. (See Table 25).

**Table 7 Essex County Flood Events, 1996- May, 2019**

Source: NOAA, National Climatic Data Center

Location	Date	Type	Deaths	Injuries	Property Damage \$
WESTERN ESSEX (ZONE)	10/22/1996	Flood	0	0	0.00K
WESTERN ESSEX (ZONE)	10/22/1996	Flood	0	0	0.00K
WESTERN ESSEX (ZONE)	06/17/1998	Flood	0	0	0.00K
WESTERN ESSEX (ZONE)	06/18/1998	Flood	0	0	0.00K



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<b>Location</b>	<b>Date</b>	<b>Type</b>	<b>Deaths</b>	<b>Injuries</b>	<b>Property Damage \$</b>
<u>EASTERN ESSEX (ZONE)</u>	03/05/2001	Flood	0	0	0.00K
<u>WESTERN ESSEX (ZONE)</u>	04/03/2004	Flood	0	0	0.00K
<u>WESTERN ESSEX (ZONE)</u>	04/03/2004	Flood	0	0	0.00K
<u>EASTERN ESSEX (ZONE)</u>	10/15/2005	Flood	0	0	50.00K
<u>EASTERN ESSEX (ZONE)</u>	10/25/2005	Flood	0	0	45.00K
<u>COUNTYWIDE</u>	05/13/2006	Flood	2	0	7.000M
<u>COUNTYWIDE</u>	05/13/2006	Flood	0	0	0.00K
<u>LYNN</u>	07/11/2006	Flood	0	0	10.00K
<u>PEABODY</u>	07/28/2006	Flood	0	0	20.00K
<u>PEABODY</u>	03/02/2007	Flood	0	0	20.00K
<u>HAVERHILL</u>	04/16/2007	Flood	0	0	45.00K
<u>HAVERHILL</u>	02/13/2008	Flood	0	0	30.00K
<u>LITTLE NAHANT</u>	03/08/2008	Flood	0	0	0.00K
<u>SALEM</u>	08/08/2008	Flood	0	0	25.00K
<u>TAPLEYVILLE</u>	09/06/2008	Flood	0	0	5.00K
<u>SOUTH ESSEX</u>	03/14/2010	Flood	0	1	9.800M
<u>NEWBURY</u>	03/30/2010	Flood	0	2	3.270M
<u>NEWBURY</u>	04/01/2010	Flood	0	0	0.00K
<u>LYNN</u>	08/05/2010	Flood	0	0	7.00K
<u>SALEM MARITIME NHS</u>	08/25/2010	Flood	0	0	0.00K
<u>HAWTHORNE</u>	10/04/2011	Flood	0	0	0.00K
<u>SOUTH LAWRENCE</u>	10/04/2011	Flood	0	0	5.00K
<u>TOPSFIELD</u>	10/04/2011	Flood	0	0	300.00K
<u>PEABODY</u>	06/23/2012	Flood	0	0	0.00K
<u>SOUTH LYNNFIELD</u>	06/23/2012	Flood	0	0	0.00K
<u>LYNN</u>	08/10/2012	Flood	0	0	0.00K
<u>NORTH SAUGUS</u>	06/24/2011	Flood	0	0	5.00K
<u>MARSH CORNER</u>	07/01/2011	Flood	0	0	0.00K
<u>SALEM MARITIME NHS</u>	07/01/2011	Flood	0	0	0.00K
<u>RIVERVIEW</u>	07/01/2011	Flood	0	0	0.00K
<u>SALEM MARITIME NHS</u>	07/27/2014	Flood	0	0	0.00K
<u>LYNN COMMON</u>	10/23/2014	Flood	0	0	30.00K
<u>METHUEN</u>	10/23/2014	Flood	0	0	0.00K
<u>(BVY)BEVERLY MUNI AR</u>	10/23/2014	Flood	0	0	0.00K
<u>PEABODY</u>	12/09/2014	Flood	0	0	0.00K
<u>SOUTH MIDDLETON</u>	12/09/2014	Flood	0	0	0.00K



TOWN OF HAMILTON- HAZARD MITIGATION PLAN- 2019 UPDATE

Location	Date	Type	Deaths	Injuries	Property Damage \$
<u>ROOTY PLAIN</u>	12/09/2014	Flood	0	0	0.00K
<u>SALEM MARITIME NHS</u>	12/09/2014	Flood	0	0	0.00K
<u>TOZIER CORNER</u>	08/18/2015	Flood	0	0	0.00K
<u>EAST SAUGUS</u>	08/18/2015	Flood	0	0	0.00K
<u>CARLETONVILLE</u>	09/30/2015	Flood	0	0	0.00K
<u>DEVEREUX</u>	06/29/2016	Flood	0	0	0.00K
<u>WEST ANDOVER</u>	04/06/2017	Flood	0	0	0.00K
<u>LYNNFIELD</u>	06/27/2017	Flood	0	0	1.00K
<u>SOUTH MIDDLETON</u>	06/27/2017	Flood	0	0	1.00K
<u>HAWTHORNE</u>	07/08/2017	Flood	0	0	0.00K
<u>SOUTH GROVELAND</u>	07/18/2017	Flood	0	0	0.00K
<u>LAWRENCE</u>	09/06/2017	Flood	0	0	0.00K
<u>LAWRENCE</u>	09/06/2017	Flood	0	0	0.00K
<u>SOUTH LAWRENCE</u>	09/15/2017	Flood	0	0	10.00K
<u>CARLETONVILLE</u>	09/30/2017	Flood	0	0	4.00K
<u>TAPLEYVILLE</u>	10/25/2017	Flood	0	0	0.00K
<u>RIVERVIEW</u>	10/25/2017	Flood	0	0	0.00K
<u>HAMILTON</u>	01/13/2018	Flood	0	0	5.00K
<b>Totals:</b>			2	3	20.688M

Overview of Watershed and Town-Wide Flooding

The Town of Hamilton is subject to inland flooding where the rate of precipitation or amount of water overwhelms the capacity of natural and structured drainage systems to convey water causing it to overflow the system. Inland flooding can be caused by rain storms, thunderstorms and major storms, known as northeasters and hurricanes. Northeasters can occur at any time of the year but they are most common in winter.

Inland Flooding

Overview of the Ipswich and Miles River Watershed and Flooding

The Ipswich River watershed encompasses a 155 square-mile area, north of Boston, Massachusetts in Essex and Middlesex counties. The Ipswich River extends approximately 45 miles from its westernmost headwaters in the towns of Burlington and Wilmington, northeasterly to its mouth at Essex Bay and Plum Island Sound. The Ipswich River watershed includes all or portions of 22 towns. Of these, only three, Middleton, North Reading, and Topsfield, are entirely within the basin. Boxford, Hamilton, Ipswich, Lynnfield, North Andover, Wenham, and Wilmington are mostly in the basin. About half or less than half of Andover, Beverly, Burlington, Danvers, Peabody, and Reading are within the basin and less than one square mile of Billerica, Essex, Georgetown, Tewksbury, Woburn and Rowley are in the basin.

The basin can be divided into three subsections: the upper, middle and lower watersheds. The upper watershed drains 44.5 square miles to South Middleton and has a mean annual stream flow of 41 million gallons per day (Mgd). The middle watershed drains 125 square miles, with a mean annual stream flow of 122 Mgd). The lower watershed, below the Willowdale Dam, includes another 30 square miles of drainage area to the Ipswich Dam and its flow is not measured by a stream flow gage. Below the Ipswich Dam the river becomes tidally-influenced. Approximately 20 tributaries feed into the Ipswich River. In the upper watershed, the larger tributaries include Maple Meadow Brook, Lubbers Brook and Martins Brook. In the middle watershed, tributaries include Norris, Emerson, Boston, Fish and Howlett Brooks. In the lower watershed, the Miles River is the largest tributary. A number of tributaries, as well as the Ipswich River itself, have dams that were built to store water, power mills and/or for recreation. Three dams continue to impound sections of the river, one in Middleton and two in Ipswich. Smaller dams and remnants can be found in the main stem and tributaries. (From: *Ipswich River Watershed Management Plan, 2003*)

**Restoration of the Miles River remains a high priority for Hamilton. The river flows from Beverly through extensive wetlands before reaching the Ipswich River in Ipswich. It provides excellent riparian and wetland habitat, but faces problems including low flow velocity, nutrient inputs, and barriers to flow.** The four watershed communities of Hamilton, Beverly, Ipswich and Wenham formed the Miles River Collaborative in 2011 to work together to solve these problems, and are still seeking funding from the US Army Corps of Engineers for a habitat restoration project. The Collaborative is also addressing beaver issues, fertilizer runoff, and undersized culverts. Ipswich River Watershed Association volunteers surveyed Miles River crossings in November 2006 in collaboration with the Massachusetts Riverways Stream Continuity Program.

- Hamilton replaced the old Bridge Street culvert with a much larger 12 x12 culvert since the last plan update and also upgraded culverts in the Linden and Howard Street neighborhoods.
- Longham Reservoir, created by damming the Miles River, is a major water source for the cities of Salem and Beverly. Water supply wells within the Miles River watershed are also a secondary source for Danvers and Wenham. The Myopia Hunt Club also withdraws water from the river.
- The Town of Wenham replaced and enlarged three culverts (Grapevine Rd East, Walnut Rd, and Larch Row) damaged during the Mother's Day floods of 2006.
- The Miles River has 13 road crossings and 1 dam.
- Localized flooding has occurred throughout the watershed, particularly around undersized culverts.
- Beaver activity in the river channel also raises water levels and may exacerbate flooding.
- Invasive vegetation, including purple loosestrife, is a concern. Vegetation clogs the river channel, due in part to low flow velocities and siltation, which alter the natural hydrology.
- Mass DEP has listed the Miles River as impaired because of organic enrichment due to nonpoint source pollution, low dissolved oxygen, and flow manipulation. Benthic macro invertebrates, a good indicator of habitat quality, are far below healthy levels (Mass DEP 2004).

(From Ipswich River Watershed Association (IRWA): Miles River Restoration Opportunities, 2006).

**Locally Identified Areas of Flooding**

Information on 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. The second was discussions with local officials. Many of these sites are carried over from the 2011 plan.

The locally identified areas of flooding described below were identified by town staff as areas where flooding occurs. These areas do not necessarily coincide with the flood zones from the FIRM maps. They 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, “Hazard Areas”. The numbers do not reflect priority order. Estimated damages associated with flooding are shown in Table 25.

**Flood Insurance Rate Map Zone Definitions**

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

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

**Zones X500** (.2% annual chance) - Zone X500 is the flood insurance rate zone that correspond to the 500-year floodplains that are determined in the Flood Insurance Study (FIS) by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no BFEs (base flood elevations) or depths are shown within this zone.

- 1) Woodbury Street culvert/ beaver-induced flooding: culvert replaced during 2006 Mother’s Day storm and Beaver Deceiver installed September, 2008. Water backs up onto Gordon Conwell Theological Seminary land. This is a carryover site from 2011.
- 2) Beaver dam at New England Biolabs: backs up Miles River and adds to siltation and vegetation Note: Ipswich and Hamilton to jointly work to dredge Miles River: been on state work list for last 2 years; working with legislative reps to resolve. This is a carryover site from 2011.
- 3) Winthrop Street Bridge: Incorporate design changes to prevent flooding due to water running around the bridge in the old mill sluiceway. This is a carryover site from 2011.
- 4) Bradford Road/ Sharon Road: Trench used: Northeast Mosquito Control used to dredge but now only monitors and sprays. This is a carryover site from 2011.



5) Flooding at Bay Road and Patton Park, Horseshoe and Tally Ho Drives: the heavily silted Miles River is unable to contain excess stormwater and the drain at Patton Park is unable to discharge due to backup. Note: Miles River drops only approximately 11 feet over 8 miles. The town has installed an overflow pipe at Patton Pond to rectify this issue and it now monitoring the situation. This is a carryover site from 2011.

Other known flooding sites, preceded by map #, carried over from the 2011 plan include:

19- Parallel to Tally Ho Drive and Locust Street;

20- Bay Road across from High School;

21- Harrigan's Field Neighborhood;

22- Miles River Road;

23- Lake Shore Drive / Chebacco Lake.

New Flooding sites for 2019 include:

7- Chebacco Road- Hillside erosion issue.

9- Flooding at Essex Street- needs to be tied into Appaloosa Street drainage.

### **Inland Flooding Since the 2011 Plan-**

Though the town does not record flood events, flooding has occurred several times in Essex County since the 2011 plan including the following examples:

October 23, 2014- Low pressure moving up the east coast brought a soaking rain and strong winds to much of southern New England. The strongest winds were along the east coast of Massachusetts where many trees were still fully leaved. This resulted in significant tree damage along with power outages. In addition, both downed leaves from the storm and naturally fallen leaves from before the storm clogged storm drains which resulted in street flooding, particularly across northeastern Massachusetts. An estimated \$30,000 of damage occurred with no fatalities. (National Climate Data Center)

January 13, 2019- A slow-moving cold front crossed New England from the afternoon of January 12 to the morning of January 13. Strong southerly winds ahead of the front drew mild and humid air north over Southern New England. This helped generate heavy downpours before the front moved through. Rainfall amounts ranged from one to three inches, except in Southeast Massachusetts where amounts ranged up to four inches. Maximum wind gusts ranged from 45 to 65 mph. An estimated \$5,000 of damage occurred with no fatalities. (National Climate Data Center)



Repetitive Loss Structures

As defined by 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. For more information on repetitive losses see <http://www.fema.gov/business/nfip/replps.shtm>.

There are two repetitive loss structures in Hamilton, the same as listed in the 2011 plan. These include two single family homes. One of these is located in flood zone AE, while the other structure is not located in a flood zone.

Table 8 summarizes the number and type of repetitive loss structures located within Hamilton and the number of losses and total claims associated with them.

**Table 8- Summary of Repetitive Losses and Claims 1979- 2018**

<b>Flood Zone</b>	<b>Single Family Residential</b>	<b>2 -4 Family Residential</b>	<b>Other Residential</b>	<b>Non-Residential</b>	<b>Total Repetitive Loss Claims</b>
FEMA Zone AE	\$9,804				<b>\$9,804</b>
Outside FIRM mapped areas	\$8,397				<b>\$8,397</b>
<b>TOTAL RL CLAIMS</b>	<b>\$18,201</b>				<b>\$18,201</b>

Source: Department of Conservation and Recreation, FEMA Repetitive Loss data

Based on the record of previous occurrences flooding events in Hamilton are a High frequency event as defined by the 2011 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 occur as a result of structural failure, independent of a hazard event, or as the result of the impacts of a hazard event such as flooding associated with storms or an earthquake. In the event of a dam failure, the energy of the water stored behind even a small dam can cause loss of life and property damage if there are people or buildings downstream. The number of fatalities from a dam failure depends on the amount of warning provided to the population and the number of people in the area in the path of the dam’s floodwaters.

DCR defines dam hazard classifications as follows:



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

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

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

Dam failure is a highly infrequent occurrence but a severe incident could result in loss of lives and significant property damage. Since 1984, three dams have failed in or very near to Massachusetts, one of which resulted in a death.

## **Dams**

### Hamilton Dams

There are no publicly or privately owned dams listed by the Department of Conservation Dam Safety Office for Essex.

## **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 Hamilton. Information on wind related hazards can be found on Map 5 in Appendix B

### Hurricanes and Tropical Storms

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

Since 1900, 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. There have been no recorded storm tracks through Hamilton. However, Hamilton experiences the impacts of hurricanes and tropical storms regardless of whether the storm track passes directly through the Town, and numerous hurricanes have affected the communities of eastern Massachusetts (see Table 9) The hazard mapping indicates that the 100 year wind speed in Hamilton is 110 miles per hour (see Appendix B).



**Table 9- Hurricane Records for Massachusetts, 1938 – June, 2019**

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:

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

Source: NOAA

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 Hamilton. Potential hurricane damages to Hamilton have been estimated using HAZUS-MH. Total damages are estimated at \$18.1 million for a Category 2 hurricane and \$84.4 million for a Category 4 hurricane. Other potential impacts are detailed in Table 21.

Based on records of previous occurrences, hurricanes in Hamilton are a Medium frequency event as defined by the 2011 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.

Tornadoes

A tornado is a violent windstorm characterized by a twisting, funnel-shaped cloud. These events are spawned by thunderstorms and occasionally by hurricanes, and may occur singularly or in multiples. They develop when cool air overrides a layer of warm air, causing the warm air to rise rapidly. Most vortices remain suspended in the atmosphere.



Should they touch down, they become a force of destruction. Some ingredients for tornado formation include:

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

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

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 gusts (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, 2018

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, Revere in 2014 and most recently in Concord (Middlesex County) on August 23, 2016. The Concord EF-1 tornado damaged 39 homes but no injuries or deaths were reported. (Source: *Concord Patch*) The Springfield tornado caused significant damage and resulted in 4 deaths in June of 2011. The Revere tornado touched down in Chelsea just south of Route 16 and 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 uninhabitable.



Although there have been no recorded tornados within the limits of the Town of Hamilton, since 1956 there have been 11 tornadoes in surrounding Essex County recorded by the NCDC. No tornados were F3, one was F2, eight were F1 and two were F0. These 11 tornados resulted in no fatalities and four injuries and up to \$560,280 in damages, as summarized in Table 10.

**Table 10 - Tornado Records for Essex County**

Location	Date	Type	Fujita Scale	Deaths	Injuries	Property Damage \$	Length	Width
ESSEX CO.	6/13/1956	Tornado	F1	0	0	2500	1	10
ESSEX CO.	11/21/1956	Tornado	F2	0	0	25000	0.8	17
ESSEX CO.	12/18/1956	Tornado	F1	0	0	250	0.5	23
ESSEX CO.	7/13/1960	Tornado	F0	0	0	30	0.1	33
ESSEX CO.	7/21/1962	Tornado	F1	0	3	25000	2.7	33
ESSEX CO.	5/19/1964	Tornado	F0	0	0	2500	0.1	300
ESSEX CO.	5/19/1964	Tornado	F1	0	0	2500	2	300
ESSEX CO.	8/10/1965	Tornado	F1	0	0	0	3.6	33
ESSEX CO.	7/1/1968	Tornado	F1	0	1	250000	0.3	100
ESSEX CO.	7/21/1972	Tornado	F1	0	0	2500	0.3	20
ESSEX CO.	8/15/1991	Tornado	F1	0	0	250000	0.8	300
<b>Total</b>				<b>0</b>	<b>4</b>	<b>\$560,280</b>		

Source: National Climatic Data Center

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 Hamilton, tornado impacts are relatively localized compared to severe storms and hurricanes. Damages from any tornado in Hamilton would greatly depend on the track of the tornado. The downtown areas between Asbury Street and Bay Road (Route 1A), as well as South Hamilton are more densely developed and would likely be subject to more damage in the event of a tornado.

Based on the record of previous occurrences since 1950, Tornado events in Hamilton are a Medium frequency event as defined by the 2011 Massachusetts State Hazard Mitigation



Plan. This hazard may occur from once in 5 years to once in 50 years, or a 2% to 20% chance per year.

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 rains or snows, depending on temperatures.

Previous occurrences of Nor'easters include the following:

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

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

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

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

Based on the record of previous occurrences, nor'easters in Hamilton are high frequency events as defined by the 2011 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. Generally defined as a storm that includes thunder, which always accompanies lightning, a thunderstorm is a storm event featuring lightning, strong winds, and rain and/or hail. Thunderstorms sometime give rise to tornados. On average, these storms are only around 15 miles in diameter and last for about 30 minutes.

A severe thunderstorm can include winds of close to 60 mph and rain sufficient to produce flooding. The Town's entire area is potentially subject to severe thunderstorms.

The Town does not keep records of thunderstorms, but estimates that at least eight to ten occur each year. Team members remembered severe thunderstorms and microbursts of high wind intensity occurring between 2011 and 2019 that impacted Hamilton. In particular, the Essex Street, Bridge Street, Greenbrook Road and Dodd Road neighborhoods suffered from severe thunderstorms during the summer of 2018 experiencing eight instances of power outages all accompanied by downed trees and power lines.

The best available data on previous occurrences of thunderstorms in Hamilton is for Essex County through the National Climatic Data Center (NCDC). Between 1995 and September 18, 2018, the latest data available, NCDC records show 221 thunderstorm wind events in Essex County communities (Table 11). These storms resulted in a total of \$2.70 million in property damages. There were two injuries and no deaths reported.

**Table 11 Essex County Thunderstorm Wind Events, 1995-September, 2018**

<u>Location</u>	<u>Date</u>	<u>Type</u>	<u>Dth</u>	<u>Inj</u>	<u>PrD</u>
<u>Swampscott</u>	09/14/1995	Thunderstorm Wind	0	0	0.00K
<u>NEWBURYPORT</u>	08/03/1997	Thunderstorm Wind	0	0	0.00K
<u>NEWBURY</u>	05/29/1998	Thunderstorm Wind	0	0	0.00K
<u>HAVERHILL</u>	05/31/1998	Thunderstorm Wind	0	0	0.00K
<u>METHUEN</u>	05/31/1998	Thunderstorm Wind	0	0	0.00K
<u>METHUEN</u>	08/11/1998	Thunderstorm Wind	0	0	0.00K
<u>NEWBURYPORT</u>	09/07/1998	Thunderstorm Wind	0	0	0.00K
<u>MANCHESTER</u>	04/26/1999	Thunderstorm Wind	0	0	1.00K
<u>METHUEN</u>	06/23/1999	Thunderstorm Wind	0	0	0.00K
<u>BEVERLY</u>	07/06/1999	Thunderstorm Wind	0	0	0.00K
<u>ANDOVER</u>	07/24/1999	Thunderstorm Wind	0	0	0.00K
<u>AMESBURY</u>	07/24/1999	Thunderstorm Wind	0	0	0.00K



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<u>Location</u>	<u>Date</u>	<u>Type</u>	<u>Dth</u>	<u>Inj</u>	<u>PrD</u>
<u>HVERHILL</u>	07/25/1999	Thunderstorm Wind	0	0	0.00K
<u>GEORGETOWN</u>	06/27/2000	Thunderstorm Wind	0	0	0.00K
<u>SALEM</u>	07/18/2000	Thunderstorm Wind	0	0	0.00K
<u>LYNNFIELD</u>	05/12/2001	Thunderstorm Wind	0	0	0.00K
<u>LYNNFIELD</u>	06/30/2001	Thunderstorm Wind	0	0	0.00K
<u>PEABODY</u>	06/30/2001	Thunderstorm Wind	0	0	0.00K
<u>HVERHILL</u>	07/01/2001	Thunderstorm Wind	0	0	0.00K
<u>ROWLEY</u>	07/01/2001	Thunderstorm Wind	0	0	0.00K
<u>TOPSFIELD</u>	07/01/2001	Thunderstorm Wind	0	0	0.00K
<u>HAMILTON</u>	08/10/2001	Thunderstorm Wind	0	0	0.00K
<u>LAWRENCE</u>	08/10/2001	Thunderstorm Wind	0	0	0.00K
<u>AMESBURY</u>	05/31/2002	Thunderstorm Wind	0	0	4.00K
<u>SWAMPSCOTT</u>	06/02/2002	Thunderstorm Wind	0	0	5.00K
<u>PEABODY</u>	07/23/2002	Thunderstorm Wind	0	0	15.00K
<u>IPSWICH</u>	06/27/2003	Thunderstorm Wind	0	0	5.00K
<u>BEVERLY</u>	06/27/2003	Thunderstorm Wind	0	0	10.00K
<u>TOPSFIELD</u>	07/02/2004	Thunderstorm Wind	0	0	15.00K
<u>BEVERLY</u>	08/20/2004	Thunderstorm Wind	0	0	10.00K
<u>METHUEN</u>	06/26/2005	Thunderstorm Wind	0	0	10.00K
<u>IPSWICH</u>	06/29/2005	Thunderstorm Wind	0	0	10.00K
<u>HVERHILL</u>	07/27/2005	Thunderstorm Wind	0	0	10.00K
<u>ANDOVER</u>	07/27/2005	Thunderstorm Wind	0	0	5.00K
<u>TOPSFIELD</u>	08/05/2005	Thunderstorm Wind	0	0	10.00K
<u>WENHAM</u>	08/05/2005	Thunderstorm Wind	0	0	50.00K
<u>PEABODY</u>	05/21/2006	Thunderstorm Wind	0	0	30.00K
<u>PEABODY</u>	05/21/2006	Thunderstorm Wind	0	0	10.00K
<u>MERRIMAC</u>	07/11/2006	Thunderstorm Wind	0	0	10.00K
<u>GROVELAND</u>	07/11/2006	Thunderstorm Wind	0	0	5.00K
<u>PEABODY</u>	07/11/2006	Thunderstorm Wind	0	0	500.00K
<u>SAUGUS</u>	07/28/2006	Thunderstorm Wind	0	0	10.00K
<u>AMESBURY</u>	06/01/2007	Thunderstorm Wind	0	0	0.00K



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<u>HAYERHILL</u>	06/02/2007	Thunderstorm Wind	0	0	0.00K
<u>AMESBURY</u>	06/02/2007	Thunderstorm Wind	0	0	0.00K
<u>GEORGETOWN</u>	06/02/2007	Thunderstorm Wind	0	0	0.00K
<u>NEWBURY</u>	06/02/2007	Thunderstorm Wind	0	0	0.00K
<u>ROWLEY</u>	06/02/2007	Thunderstorm Wind	0	0	0.00K
<u>NEWBURY</u>	06/02/2007	Thunderstorm Wind	0	0	0.00K
<u>IPSWICH</u>	06/02/2007	Thunderstorm Wind	0	0	0.00K
<u>AMESBURY</u>	07/05/2007	Thunderstorm Wind	0	0	0.00K
<u>LAWRENCE</u>	07/05/2007	Thunderstorm Wind	0	0	0.00K
<u>METHUEN</u>	07/05/2007	Thunderstorm Wind	0	0	0.00K
<u>BOXFORD</u>	07/05/2007	Thunderstorm Wind	0	0	0.00K
<u>ANDOVER</u>	07/06/2007	Thunderstorm Wind	0	0	0.00K
<u>MIDDLETON</u>	07/06/2007	Thunderstorm Wind	0	0	0.00K
<u>PEABODY</u>	07/06/2007	Thunderstorm Wind	0	0	0.00K
<u>IPSWICH</u>	07/06/2007	Thunderstorm Wind	0	0	0.00K
<u>METHUEN</u>	07/06/2007	Thunderstorm Wind	0	0	0.00K
<u>SALEM</u>	07/06/2007	Thunderstorm Wind	0	0	0.00K
<u>SAUGUS</u>	07/06/2007	Thunderstorm Wind	0	0	0.00K
<u>BOXFORD</u>	07/06/2007	Thunderstorm Wind	0	0	0.00K
<u>EAST BOXFORD</u>	07/06/2007	Thunderstorm Wind	0	0	0.00K
<u>EAST BOXFORD</u>	07/06/2007	Thunderstorm Wind	0	0	0.00K
<u>BOXFORD</u>	07/28/2007	Thunderstorm Wind	0	0	0.00K
<u>HAMILTON</u>	07/28/2007	Thunderstorm Wind	0	0	0.00K
<u>MARBLEHEAD</u>	07/28/2007	Thunderstorm Wind	0	0	0.00K
<u>BEVERLY</u>	07/28/2007	Thunderstorm Wind	0	0	0.00K
<u>HAWTHORNE</u>	09/08/2007	Thunderstorm Wind	0	0	10.00K
<u>HAWTHORNE</u>	09/08/2007	Thunderstorm Wind	0	0	8.00K
<u>PRIDES CROSSING</u>	09/08/2007	Thunderstorm Wind	0	0	10.00K
<u>HAWTHORNE</u>	05/27/2008	Thunderstorm Wind	0	0	2.00K
<u>CLIFTONDALE</u>	05/27/2008	Thunderstorm Wind	0	0	1.00K
<u>SALEM CGAS</u>	06/10/2008	Thunderstorm Wind	0	0	15.00K



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<u>Location</u>	<u>Date</u>	<u>Type</u>	<u>Dth</u>	<u>Inj</u>	<u>PrD</u>
<u>METHUEN</u>	06/10/2008	Thunderstorm Wind	0	0	5.00K
<u>PEABODY</u>	06/10/2008	Thunderstorm Wind	0	0	10.00K
<u>SWAMPSCOTT</u>	06/10/2008	Thunderstorm Wind	0	0	4.00K
<u>AMESBURY</u>	06/22/2008	Thunderstorm Wind	0	0	5.00K
<u>HAVERHILL</u>	06/27/2008	Thunderstorm Wind	0	0	7.00K
<u>ROWLEY</u>	06/27/2008	Thunderstorm Wind	0	0	0.50K
<u>LYNN</u>	07/01/2008	Thunderstorm Wind	0	0	20.00K
<u>MARBLEHEAD</u>	07/01/2008	Thunderstorm Wind	0	0	3.00K
<u>PRIDES CROSSING</u>	07/01/2008	Thunderstorm Wind	0	0	4.00K
<u>PRIDES CROSSING</u>	07/02/2008	Thunderstorm Wind	0	1	10.00K
<u>WENHAM</u>	07/02/2008	Thunderstorm Wind	0	0	0.00K
<u>HAWTHORNE</u>	07/03/2008	Thunderstorm Wind	0	1	3.00K
<u>PRIDES CROSSING</u>	07/03/2008	Thunderstorm Wind	0	0	5.00K
<u>SWAMPSCOTT</u>	07/03/2008	Thunderstorm Wind	0	0	5.00K
<u>GLOUCESTER</u>	07/18/2008	Thunderstorm Wind	0	0	3.00K
<u>PRIDES CROSSING</u>	07/19/2008	Thunderstorm Wind	0	0	15.00K
<u>SALEM CGAS</u>	09/09/2008	Thunderstorm Wind	0	0	12.00K
<u>SAUGUS IRON WORKS NH</u>	09/09/2008	Thunderstorm Wind	0	0	3.00K
<u>MARBLEHEAD</u>	09/09/2008	Thunderstorm Wind	0	0	5.00K
<u>SOUTH LAWRENCE</u>	07/26/2009	Thunderstorm Wind	0	0	25.00K
<u>HAWTHORNE</u>	07/31/2009	Thunderstorm Wind	0	0	10.00K
<u>PRIDES CROSSING</u>	07/31/2009	Thunderstorm Wind	0	0	40.00K
<u>WEST PEABODY</u>	07/31/2009	Thunderstorm Wind	0	0	0.50K
<u>GROVELAND</u>	06/03/2010	Thunderstorm Wind	0	0	0.00K
<u>HAWTHORNE</u>	06/03/2010	Thunderstorm Wind	0	0	5.00K
<u>SAUGUS IRON WORKS NH</u>	06/03/2010	Thunderstorm Wind	0	0	1.00K
<u>WEST PEABODY</u>	06/03/2010	Thunderstorm Wind	0	0	15.00K
<u>SWAMPSCOTT</u>	06/03/2010	Thunderstorm Wind	0	0	50.00K
<u>SHAWSHEEN VLG</u>	06/05/2010	Thunderstorm Wind	0	0	50.00K
<u>GEORGETOWN</u>	06/05/2010	Thunderstorm Wind	0	0	10.00K
<u>SAUGUS IRON WORKS NH</u>	06/06/2010	Thunderstorm Wind	0	0	3.00K



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<u>HAMILTON</u>	06/06/2010	Thunderstorm Wind	0	0	1.00K
<u>LYNN</u>	06/06/2010	Thunderstorm Wind	0	0	75.00K
<u>SWAMPSCOTT</u>	06/06/2010	Thunderstorm Wind	0	0	0.50K
<u>SHAWSHEEN VLG</u>	06/24/2010	Thunderstorm Wind	0	0	50.00K
<u>PRIDES CROSSING</u>	06/24/2010	Thunderstorm Wind	0	0	0.00K
<u>LYNN</u>	06/24/2010	Thunderstorm Wind	0	0	15.00K
<u>HAWTHORNE</u>	06/24/2010	Thunderstorm Wind	0	0	0.25K
<u>MARBLEHEAD</u>	06/24/2010	Thunderstorm Wind	0	0	0.50K
<u>HAVERHILL</u>	07/12/2010	Thunderstorm Wind	0	0	25.00K
<u>GLOUCESTER</u>	07/12/2010	Thunderstorm Wind	0	0	5.00K
<u>HAVERHILL</u>	07/19/2010	Thunderstorm Wind	0	0	25.00K
<u>NORTH ANDOVER</u>	06/09/2011	Thunderstorm Wind	0	0	15.00K
<u>LYNN</u>	06/09/2011	Thunderstorm Wind	0	0	15.00K
<u>SAUGUS</u>	06/09/2011	Thunderstorm Wind	0	0	5.00K
<u>TOPSFIELD</u>	06/09/2011	Thunderstorm Wind	0	0	15.00K
<u>WENHAM</u>	06/09/2011	Thunderstorm Wind	0	0	10.00K
<u>NEWBURY</u>	06/09/2011	Thunderstorm Wind	0	0	25.00K
<u>HAWTHORNE</u>	06/09/2011	Thunderstorm Wind	0	0	20.00K
<u>MANCHESTER</u>	06/09/2011	Thunderstorm Wind	0	0	3.00K
<u>WEST PEABODY</u>	06/09/2011	Thunderstorm Wind	0	0	3.00K
<u>AMESBURY</u>	07/04/2011	Thunderstorm Wind	0	0	15.00K
<u>NEWBURYPORT</u>	07/04/2011	Thunderstorm Wind	0	0	10.00K
<u>BYFIELD</u>	07/04/2011	Thunderstorm Wind	0	0	3.00K
<u>GLOUCESTER</u>	07/04/2011	Thunderstorm Wind	0	0	3.00K
<u>NEWBURY</u>	07/18/2011	Thunderstorm Wind	0	0	20.00K
<u>LYNN</u>	08/19/2011	Thunderstorm Wind	0	0	5.00K
<u>SALEM CGAS</u>	08/19/2011	Thunderstorm Wind	0	0	50.00K
<u>MARBLEHEAD</u>	08/19/2011	Thunderstorm Wind	0	0	5.00K
<u>NORTH SALEM</u>	10/04/2011	Thunderstorm Wind	0	0	10.00K
<u>NORTH ANDOVER</u>	06/23/2012	Thunderstorm Wind	0	0	25.00K
<u>EAST BOXFORD</u>	06/23/2012	Thunderstorm Wind	0	0	50.00K



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<u>HAWTHORNE</u>	06/23/2012	Thunderstorm Wind	0	0	0.50K
<u>SOUTH GROVELAND</u>	06/25/2012	Thunderstorm Wind	0	0	5.00K
<u>METHUEN</u>	07/04/2012	Thunderstorm Wind	0	0	5.00K
<u>HAWTHORNE</u>	06/24/2011	Thunderstorm Wind	0	0	10.00K
<u>WEST PEABODY</u>	06/24/2011	Thunderstorm Wind	0	0	15.00K
<u>METHUEN</u>	07/01/2011	Thunderstorm Wind	0	0	3.00K
<u>LYNN</u>	07/01/2011	Thunderstorm Wind	0	0	15.00K
<u>SOUTH LAWRENCE</u>	07/03/2014	Thunderstorm Wind	0	0	50.00K
<u>SAUGUS IRON WORKS NH</u>	07/03/2014	Thunderstorm Wind	0	0	25.00K
<u>DEVEREUX</u>	07/03/2014	Thunderstorm Wind	0	0	25.00K
<u>ANDOVER</u>	07/15/2014	Thunderstorm Wind	0	0	15.00K
<u>EAST BOXFORD</u>	07/28/2014	Thunderstorm Wind	0	0	5.00K
<u>HAVERHILL</u>	07/28/2014	Thunderstorm Wind	0	0	10.00K
<u>AMESBURY</u>	09/02/2014	Thunderstorm Wind	0	0	5.00K
<u>METHUEN</u>	09/06/2014	Thunderstorm Wind	0	0	3.00K
<u>NORTH ANDOVER</u>	09/06/2014	Thunderstorm Wind	0	0	10.00K
<u>NORTH ANDOVER</u>	09/06/2014	Thunderstorm Wind	0	0	10.00K
<u>LAWRENCE</u>	09/06/2014	Thunderstorm Wind	0	0	30.00K
<u>METHUEN</u>	09/06/2014	Thunderstorm Wind	0	0	10.00K
<u>IPSWICH</u>	09/06/2014	Thunderstorm Wind	0	0	100.00K
<u>EAST BOXFORD</u>	09/06/2014	Thunderstorm Wind	0	0	10.00K
<u>GLOUCESTER</u>	09/06/2014	Thunderstorm Wind	0	0	30.00K
<u>HAMILTON</u>	09/06/2014	Thunderstorm Wind	0	0	5.00K
<u>PRIDES CROSSING</u>	09/06/2014	Thunderstorm Wind	0	0	25.00K
<u>NORTH ANDOVER</u>	09/06/2014	Thunderstorm Wind	0	0	10.00K
<u>WEST PEABODY</u>	09/06/2014	Thunderstorm Wind	0	0	5.00K
<u>METHUEN</u>	05/28/2015	Thunderstorm Wind	0	0	50.00K
<u>GEORGETOWN</u>	05/28/2015	Thunderstorm Wind	0	0	15.00K
<u>ROWLEY</u>	05/28/2015	Thunderstorm Wind	0	0	25.00K
<u>IPSWICH</u>	05/28/2015	Thunderstorm Wind	0	0	30.00K
<u>LYNN</u>	05/28/2015	Thunderstorm Wind	0	0	10.00K



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<u>LYNNFIELD</u>	05/28/2015	Thunderstorm Wind	0	0	1.00K
<u>NEWBURYPORT</u>	06/23/2015	Thunderstorm Wind	0	0	5.00K
<u>LYNN</u>	07/27/2015	Thunderstorm Wind	0	0	1.00K
<u>LYNNFIELD</u>	08/04/2015	Thunderstorm Wind	0	0	15.00K
<u>PEABODY</u>	08/04/2015	Thunderstorm Wind	0	0	15.00K
<u>LYNNFIELD</u>	08/04/2015	Thunderstorm Wind	0	0	10.00K
<u>(BVY)BEVERLY MUNI AR</u>	08/04/2015	Thunderstorm Wind	0	0	5.00K
<u>PEABODY</u>	08/04/2015	Thunderstorm Wind	0	0	20.00K
<u>PRIDES CROSSING</u>	02/25/2016	Thunderstorm Wind	0	0	5.00K
<u>MERRIMAC</u>	02/25/2016	Thunderstorm Wind	0	0	15.00K
<u>LYNN</u>	02/25/2016	Thunderstorm Wind	0	0	1.00K
<u>MARBLEHEAD</u>	06/29/2016	Thunderstorm Wind	0	0	25.00K
<u>LYNN</u>	07/01/2016	Thunderstorm Wind	0	0	5.00K
<u>SALEM CGAS</u>	07/01/2016	Thunderstorm Wind	0	0	10.00K
<u>GROSVENOR CORNER</u>	07/18/2016	Thunderstorm Wind	0	0	100.00K
<u>METHUEN</u>	07/18/2016	Thunderstorm Wind	0	0	5.00K
<u>METHUEN</u>	07/23/2016	Thunderstorm Wind	0	0	5.00K
<u>HVERHILL</u>	07/23/2016	Thunderstorm Wind	0	0	5.00K
<u>NEWBURY</u>	07/23/2016	Thunderstorm Wind	0	0	25.00K
<u>SALISBURY</u>	07/23/2016	Thunderstorm Wind	0	0	15.00K
<u>EAST BOXFORD</u>	07/23/2016	Thunderstorm Wind	0	0	20.00K
<u>WEST PEABODY</u>	07/23/2016	Thunderstorm Wind	0	0	25.00K
<u>TOPSFIELD</u>	07/23/2016	Thunderstorm Wind	0	0	35.00K
<u>LYNN</u>	07/23/2016	Thunderstorm Wind	0	0	25.00K
<u>AMESBURY</u>	09/11/2016	Thunderstorm Wind	0	0	5.00K
<u>SALISBURY</u>	09/11/2016	Thunderstorm Wind	0	0	5.00K
<u>MERRIMAC PORT</u>	05/18/2017	Thunderstorm Wind	0	0	1.00K
<u>MARSH CORNER</u>	05/18/2017	Thunderstorm Wind	0	0	1.00K
<u>MERRIMAC</u>	05/18/2017	Thunderstorm Wind	0	0	6.00K
<u>IPSWICH</u>	05/18/2017	Thunderstorm Wind	0	0	1.00K
<u>TAPLEYVILLE</u>	05/18/2017	Thunderstorm Wind	0	0	10.00K



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<u>HAVERHILL RVRSIDE AR</u>	05/18/2017	Thunderstorm Wind	0	0	5.00K
<u>SOUTH PEABODY</u>	05/18/2017	Thunderstorm Wind	0	0	2.00K
<u>SAUGUS</u>	05/18/2017	Thunderstorm Wind	0	0	3.00K
<u>MIDDLETON</u>	06/23/2017	Thunderstorm Wind	0	0	5.00K
<u>LOWELL JCT</u>	06/23/2017	Thunderstorm Wind	0	0	1.00K
<u>LYNNFIELD</u>	06/23/2017	Thunderstorm Wind	0	0	5.00K
<u>WEST BOXFORD</u>	06/23/2017	Thunderstorm Wind	0	0	1.50K
<u>SOUTH GROVELAND</u>	06/23/2017	Thunderstorm Wind	0	0	12.00K
<u>HAVERHILL RVRSIDE AR</u>	06/23/2017	Thunderstorm Wind	0	0	1.00K
<u>NEWBURYPORT</u>	06/23/2017	Thunderstorm Wind	0	0	1.00K
<u>BEVERLY</u>	06/27/2017	Thunderstorm Wind	0	0	1.00K
<u>HAMILTON</u>	06/27/2017	Thunderstorm Wind	0	0	1.00K
<u>PEABODY</u>	06/27/2017	Thunderstorm Wind	0	0	8.00K
<u>GROVELAND</u>	06/18/2018	Thunderstorm Wind	0	0	2.00K
<u>NEWBURYPORT</u>	06/18/2018	Thunderstorm Wind	0	0	2.00K
<u>HAVERHILL ARPT</u>	06/18/2018	Thunderstorm Wind	0	0	5.00K
<u>NEWBURY</u>	06/18/2018	Thunderstorm Wind	0	0	12.00K
<u>NEWBURY</u>	06/18/2018	Thunderstorm Wind	0	0	1.50K
<u>LINEBROOK</u>	06/18/2018	Thunderstorm Wind	0	0	3.00K
<u>AMESBURY</u>	06/18/2018	Thunderstorm Wind	0	0	16.00K
<u>IPSWICH</u>	06/18/2018	Thunderstorm Wind	0	0	5.00K
<u>LITTLE NAHANT</u>	9/18/2018	Thunderstorm Wind	0	0	1.00K
<u>SAUGUS</u>	9/18/2018	Thunderstorm Wind	0	0	15.00K
Totals:			0	2	2.702M

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

Severe thunderstorms are a Town-wide hazard for Hamilton. 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 Hamilton are high frequency events as defined by the 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.

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 reducing visibility to or below 1/4 mile. These conditions must be the predominant condition over a 3 hour period. Extremely cold temperatures are often associated with blizzard conditions, but are not a formal part of the definition. The hazard created by the combination of snow, wind and low visibility increases with temperatures below 20 degrees.

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

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

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

Source: National Climate Data Center, n.d.  
NESIS = Northeast Snowfall Impact Scale

Source: Massachusetts State Hazard Mitigation Plan, 2018



The most significant winter storm in recent history was the “Blizzard of 1978,” which resulted in over 3 feet of snowfall and multiple day closures of roadways, businesses, and schools. In Hamilton blizzards and severe winter storms have occurred in the following years:

**Table 12- Severe Winter Storm Records for Massachusetts**

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 2011	February 2011
Blizzard of 2015	January 2015
Blizzard of 2017	March, 2017

Source: National Oceanic and Atmospheric Administration

The historic average annual snowfall in Hamilton is 48 - 72 inches. (See Map 6 in Appendix B).

The Town of Hamilton does not keep local records of winter storms. Data for Essex County, which includes Hamilton, is the best available data to help understand previous occurrences and impacts of heavy snow events. According to the National Climate Data Center (NCDC) records, from 1996 to June, 2019, Essex County experienced 113 heavy snowfall events, resulting in no deaths, no injuries, and \$7.353 million dollars in property damage. See Table 13 for heavy snow events and impacts in Essex County.

**Table 13 - Heavy Snow events and Impacts in Essex County 1996 – June, 2019**

Location	Date	Type	Deaths	Injuries	Damage-\$
EASTERN ESSEX (ZONE)	1/2/1996	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	1/2/1996	Heavy Snow	0	0	0
EASTERN ESSEX (ZONE)	1/7/1996	Heavy Snow	0	0	1000000
WESTERN ESSEX (ZONE)	1/7/1996	Heavy Snow	0	0	1000000
EASTERN ESSEX (ZONE)	1/10/1996	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	1/12/1996	Heavy Snow	0	0	0
EASTERN ESSEX (ZONE)	2/2/1996	Heavy Snow	0	0	0



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Location	Date	Type	Deaths	Injuries	Damage-\$
EASTERN ESSEX (ZONE)	2/16/1996	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	3/2/1996	Heavy Snow	0	0	0
EASTERN ESSEX (ZONE)	3/2/1996	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	3/7/1996	Heavy Snow	0	0	0
EASTERN ESSEX (ZONE)	3/7/1996	Heavy Snow	0	0	0
EASTERN ESSEX (ZONE)	4/9/1996	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	4/9/1996	Heavy Snow	0	0	0
EASTERN ESSEX (ZONE)	12/6/1996	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	12/6/1996	Heavy Snow	0	0	0
EASTERN ESSEX (ZONE)	12/7/1996	Heavy Snow	0	0	1360000
WESTERN ESSEX (ZONE)	12/7/1996	Heavy Snow	0	0	1360000
EASTERN ESSEX (ZONE)	2/16/1997	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	3/31/1997	Heavy Snow	0	0	0
EASTERN ESSEX (ZONE)	3/31/1997	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	4/1/1997	Heavy Snow	0	0	2500000
EASTERN ESSEX (ZONE)	4/1/1997	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	11/14/1997	Heavy Snow	0	0	0
EASTERN ESSEX (ZONE)	11/14/1997	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	12/23/1997	Heavy Snow	0	0	0
EASTERN ESSEX (ZONE)	12/23/1997	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	1/15/1998	Heavy Snow	0	0	0
EASTERN ESSEX (ZONE)	1/15/1998	Heavy Snow	0	0	0
EASTERN ESSEX (ZONE)	1/14/1999	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	1/14/1999	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	3/6/1999	Heavy Snow	0	0	0
EASTERN ESSEX (ZONE)	3/6/1999	Heavy Snow	0	0	0
EASTERN ESSEX (ZONE)	3/15/1999	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	3/15/1999	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	1/13/2000	Heavy Snow	0	0	0
EASTERN ESSEX (ZONE)	1/13/2000	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	2/18/2000	Heavy Snow	0	0	0
EASTERN ESSEX (ZONE)	2/18/2000	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	12/30/2000	Heavy Snow	0	0	0
EASTERN ESSEX (ZONE)	1/20/2001	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	1/20/2001	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	2/5/2001	Heavy Snow	0	0	0
EASTERN ESSEX (ZONE)	2/5/2001	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	3/5/2001	Heavy Snow	0	0	0
EASTERN ESSEX (ZONE)	3/5/2001	Heavy Snow	0	0	0
EASTERN ESSEX (ZONE)	3/9/2001	Heavy Snow	0	0	0



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Location	Date	Type	Deaths	Injuries	Damage-\$
WESTERN ESSEX (ZONE)	3/9/2001	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	3/30/2001	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	12/8/2001	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	2/1/2003	Heavy Snow	0	0	0
EASTERN ESSEX (ZONE)	2/1/2003	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	3/16/2004	Heavy Snow	0	0	0
EASTERN ESSEX (ZONE)	3/16/2004	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	2/21/2005	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	1/23/2006	Heavy Snow	0	0	20000
EASTERN ESSEX (ZONE)	12/13/2007	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	12/13/2007	Heavy Snow	0	0	0
EASTERN ESSEX (ZONE)	12/16/2007	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	12/16/2007	Heavy Snow	0	0	0
EASTERN ESSEX (ZONE)	12/19/2007	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	12/19/2007	Heavy Snow	0	0	0
EASTERN ESSEX (ZONE)	1/14/2008	Heavy Snow	0	0	28000
WESTERN ESSEX (ZONE)	1/14/2008	Heavy Snow	0	0	20000
WESTERN ESSEX (ZONE)	2/22/2008	Heavy Snow	0	0	0
EASTERN ESSEX (ZONE)	2/22/2008	Heavy Snow	0	0	0
EASTERN ESSEX (ZONE)	12/19/2008	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	12/19/2008	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	12/21/2008	Heavy Snow	0	0	0
EASTERN ESSEX (ZONE)	12/31/2008	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	12/31/2008	Heavy Snow	0	0	0
EASTERN ESSEX (ZONE)	1/11/2009	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	1/11/2009	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	1/18/2009	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	3/1/2009	Heavy Snow	0	0	0
EASTERN ESSEX (ZONE)	3/1/2009	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	3/9/2009	Heavy Snow	0	0	0
EASTERN ESSEX (ZONE)	12/20/2009	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	12/20/2009	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	1/18/2010	Heavy Snow	0	0	0
EASTERN ESSEX (ZONE)	2/16/2010	Heavy Snow	0	0	15000
WESTERN ESSEX (ZONE)	2/16/2010	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	1/12/2011	Heavy Snow	0	0	0
EASTERN ESSEX (ZONE)	1/26/2011	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	1/26/2011	Heavy Snow	0	0	0
EASTERN ESSEX (ZONE)	2/8/2011	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	2/8/2011	Heavy Snow	0	0	0



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Location	Date	Type	Deaths	Injuries	Damage-\$
EASTERN ESSEX (ZONE)	3/7/2011	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	3/7/2011	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	3/18/2011	Heavy Snow	0	0	0
EASTERN ESSEX (ZONE)	3/18/2011	Heavy Snow	0	0	0
EASTERN ESSEX (ZONE)	12/14/2011	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	12/14/2011	Heavy Snow	0	0	0
EASTERN ESSEX (ZONE)	12/17/2011	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	12/17/2011	Heavy Snow	0	0	0
EASTERN ESSEX (ZONE)	1/2/2014	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	1/2/2014	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	1/18/2014	Heavy Snow	0	0	10000
EASTERN ESSEX (ZONE)	2/5/2014	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	2/5/2014	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	2/13/2014	Heavy Snow	0	0	0
EASTERN ESSEX (ZONE)	2/13/2014	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	2/18/2014	Heavy Snow	0	0	0
EASTERN ESSEX (ZONE)	1/24/2015	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	1/24/2015	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	1/26/2015	Heavy Snow	0	0	0
EASTERN ESSEX (ZONE)	2/2/2015	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	2/2/2015	Heavy Snow	0	0	0
EASTERN ESSEX (ZONE)	2/8/2015	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	2/8/2015	Heavy Snow	0	0	0
EASTERN ESSEX (ZONE)	2/14/2015	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	2/14/2015	Heavy Snow	0	0	0
WESTERN ESSEX (ZONE)	2/5/2016	Heavy Snow	0	0	40000
<b>Total</b>			<b>0</b>	<b>0</b>	<b>\$7.353 M</b>

The Town’s overall vulnerability to heavy snow and blizzards is primarily related to restrictions on travel on roadways, temporary road closures, school closures, and potential restrictions on emergency vehicle access. Other vulnerabilities include power outages due to fallen trees and utility lines, and damage to structures due to heavy snow loads.

Blizzards are considered to be high frequency events based on past occurrences, as defined by the Massachusetts State Hazard Mitigation Plan, 2011. This hazard occurs more than once in five years, with a greater than 20 percent 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:

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 Hamilton. The best available local data is for Essex County through the National Climatic Data Center (see Table 14). Essex County, which includes the Town of Hamilton, experienced one ice storm event from 1995 – April, 2018. No deaths or injuries were reported and the total reported property damage in the county was \$2.0 million dollars.

**Table 14- Essex County Ice Storm Events, 1995- June, 2019**

Date	Date	Type	Deaths	Injuries	Damage-\$
WESTERN ESSEX (ZONE)	12/11/2008	Ice Storm	0	0	\$2.00 M

Source: NOAA, National Climatic Data Center



Ice storms are considered to be medium frequency events based on past occurrences, as defined by the Massachusetts State Hazard Mitigation Plan, 2011. This hazard occurs once in 5 years to once in 50 years, with 2% to 20% chance of occurring each year.

The impacts of winter storms are often related to the weight of snow and ice, which can cause roof collapses and also causes tree limbs to fall which can in turn cause property damage and potential injuries.

Winter storms are a potential Town-wide hazard in Hamilton. The Town’s vulnerability is primarily related to restrictions to travel on roadways, temporary road closures, school closures, and potential restrictions on emergency vehicle access. The Town works to clear roads and carries out general snow removal operations, and bans on-street parking during snow removal to ensure that streets can be plowed and public safety vehicle access is maximized. Transit operations may also be impacted, as they were in the 2015 blizzard which caused the closure of the MBTA system for one day and limited services on several transit lines for several weeks. Another winter storm vulnerability is power outages due to fallen trees and utility lines.

Winter storms are considered to be high frequency events based on past occurrences, as defined by the Massachusetts State Hazard Mitigation Plan, 2018. This hazard occurs more than once in five years, with a greater than twenty percent chance of occurring each year.

**Geologic Hazards**

Geologic hazards include earthquakes and landslides. Although new construction under the most recent building codes generally will be built to seismic standards, there are still many structures which pre-date the most recent building code. Information on geologic hazards in Hamilton 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 (Richter scale) to express the seismic energy released by each earthquake. The typical effects of earthquakes in various ranges are summarized below.

<b>Richter Magnitudes</b>	<b>Earthquake Effects</b>
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.

Richter Magnitudes	Earthquake Effects
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 2010, 544 earthquakes were recorded in Massachusetts (NESEC). Most have originated from the La Malbaie fault in Quebec or from the Cape Ann fault located off the coast of Rockport. The region has experienced larger earthquakes, including a magnitude 5.0 earthquake in 1727 and a 6.0 earthquake that struck in 1755 off the coast of Cape Ann. More recently, a pair of damaging earthquakes occurred near Ossipee, NH in 1940, and a 4.0 earthquake centered in Hollis, Maine in October 2012 was felt in the Boston area. Historical records of some of the more significant earthquakes in the region are shown in Table 16.

**Table 16- Historical Earthquakes in Massachusetts or Surrounding Area**

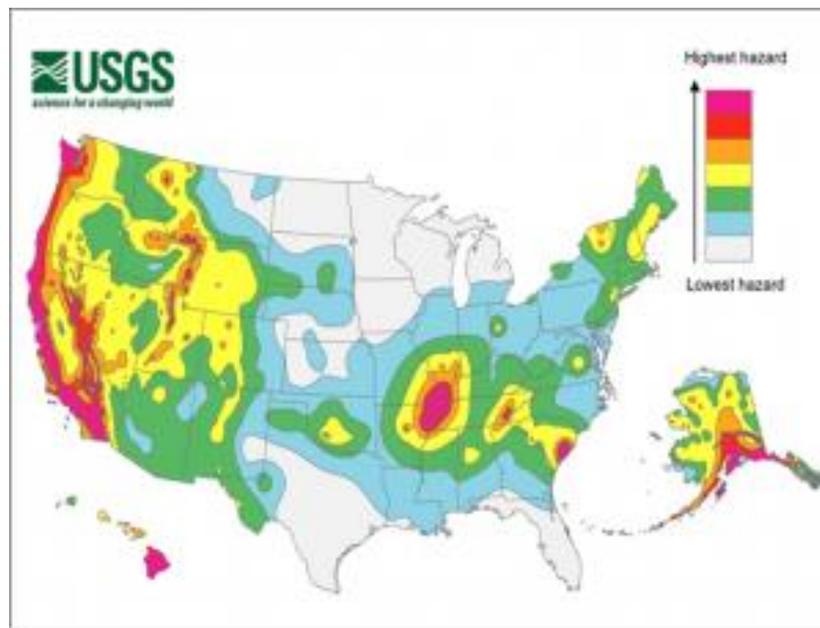
Location	Date	Magnitude
MA - Cape Ann	11/10/1727	5
MA - Cape Ann	12/29/1727	NA
MA - Cape Ann	2/10/1728	NA
MA - Cape Ann	3/30/1729	NA
MA - Cape Ann	12/9/1729	NA
MA - Cape Ann	2/20/1730	NA
MA - Cape Ann	3/9/1730	NA
MA - Boston	6/24/1741	NA
MA - Cape Ann	6/14/1744	4.7
MA - Salem	7/1/1744	NA
MA - Off Cape Ann	11/18/1755	6
MA - Off Cape Cod	11/23/1755	NA
MA - Boston	3/12/1761	4.6
MA - Off Cape Cod	2/2/1766	NA
MA - Offshore	1/2/1785	5.4
MA - Wareham/Taunton	12/25/1800	NA
MA - Woburn	10/5/1817	4.3
MA - Marblehead	8/25/1846	4.3
MA - Brewster	8/8/1847	4.2
MA - Boxford	5/12/1880	NA
MA - Newbury	11/7/1907	NA
MA - Wareham	4/25/1924	NA
MA - Cape Ann	1/7/1925	4
MA - Nantucket	10/25/1965	NA
MA - Boston	12/27/74	2.3
VA - Mineral	8/23/11	5.8
MA - Nantucket	4/12/12	4.5
ME - Hollis	10/17/12	4.0

Source: (NESEC).

One measure of earthquake risk is ground motion, which is measured as maximum peak horizontal acceleration, expressed as a percentage of gravity (1 g). The range of peak ground acceleration in Massachusetts is from 10g to 20g, with a 2% probability of exceedance in 50 years. Hamilton is in the middle part of the range for Massachusetts, at 14g to 16g, making it a relatively moderate area of earthquake risk within the state, although the state as a whole is considered to have a low risk of earthquakes compared to the rest of the country. There have been no recorded earthquake epicenters within Hamilton. The Hamilton team reported that they felt the 2012 tremors but have not felt any tremors since then in town.

Although New England has not experienced a damaging earthquake since 1755, seismologists state that a serious earthquake occurrence is possible. The USGS has characterized the Northeast US as a region of low to moderate earthquake hazard. 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. Most older buildings and infrastructure were constructed without specific earthquake resistant design features.

**Figure 1- USGS 2014 Seismic Hazard Map**



USGS 2014 Seismic Hazard Map

Source: (NESEC).

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.

Earthquakes are a potential Town-wide hazard in Hamilton. The Town has many older buildings that pre-date current building code which could be vulnerable in the event of a severe earthquake. Potential earthquake damages to Hamilton have been estimated using HAZUS-MH. Total building damages, including business interruption losses are estimated at \$143.13 million for a 5.0 magnitude earthquake and \$1,127.30 million for a 7.0 magnitude earthquake. Other potential impacts are detailed in Table 22.

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% per year.

Landslides

According to the USGS, “The term landslide includes a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows. Although gravity acting on an over steepened slope is the primary reason for a landslide, there are other contributing factors.” Among the contributing factors are: erosion by rivers or ocean waves over steepened slopes; rock and soil slopes weakened through saturation by snowmelt or heavy rains; earthquakes create stresses that make weak slopes fail; and excess weight from accumulation of rain or snow, and stockpiling of rock or ore, from waste piles, or from man-made structures.

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

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

Estimated Volume (m <sup>3</sup> )	Expected Landslide Velocity		
	Fast moving landslide (Rock fall)	Rapid moving landslide (Debris flow)	Slow moving landslide (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

The entire Town has been classified as having a low incidence risk for landslides, less than 1.5 % of the area is involved in land sliding. (Map 4, Appendix B) The Town does not have records of any damages caused by landslides in Hamilton. Because of this, no specific mitigation measures for landslides have been included in the plan update.

Potential damages would depend on how many properties were affected. Given the relatively high assessed value of property in Hamilton, damages affecting a single residence could exceed \$500,000, and damages affecting several homes or business properties could theoretically extend from \$1 million to several million. However, there are no data available on landslide damages in Hamilton, as there are no records of any damages caused by landslides in the town.

Should a landslide occur in the future, the type and degree of impacts would be highly localized, and the Town’s vulnerabilities could include damage to structures, damage to transportation and other infrastructure, and localized road closures. Injuries and casualties, while possible, would be unlikely given the low extent and impact of landslides in Hamilton.

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

**Fire Related Hazards**

A 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, these fires typically burn no more than the underbrush of a forested area. 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.

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.

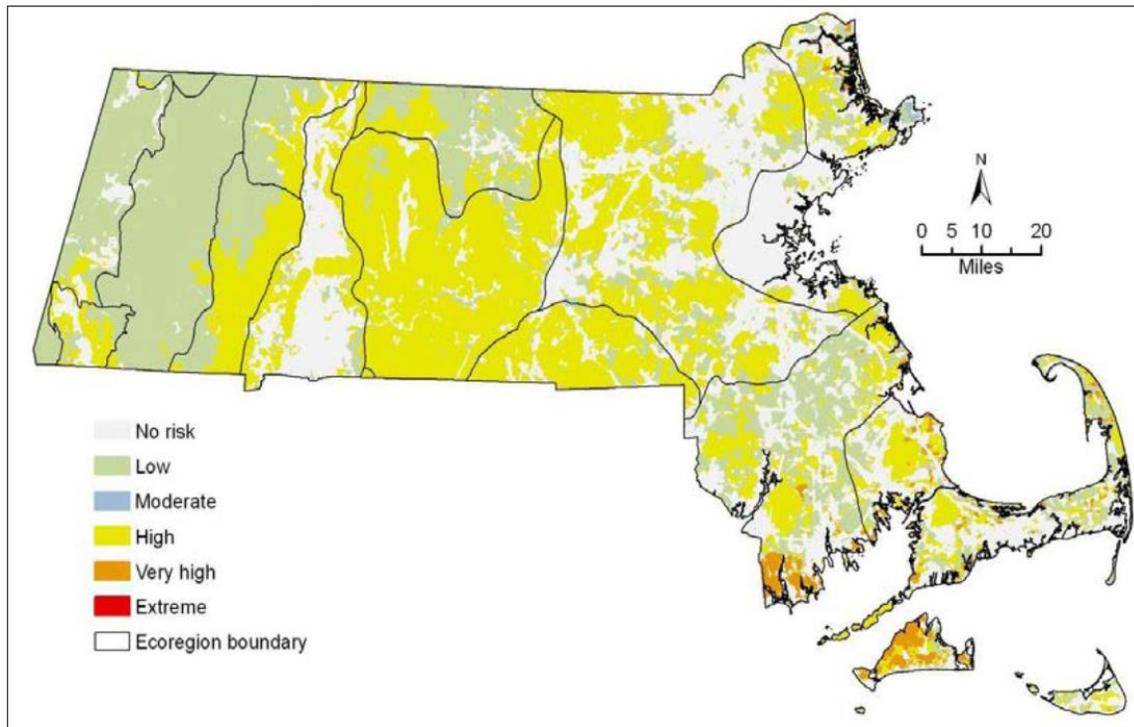
Hamilton averages about 15 brush fires per year. None of the fires has resulted in major property damage and no loss of life has ever been reported. Brush fires are responded to as a regular fire by the Fire Department and current brush and forest fire equipment includes a 2006 Ford F-550 squad pumper truck and a dual-wheeled, 4x4, International truck. The areas of town with the highest incidences of brush fires include Chebacco Woods, Bradley Palmer State Park, Turkey Island, Harvard Forest, Appleton Farms,

Sagamore Hill and Cilly’s Hill. Most fires are localized brush fires caused during open burning season or by campers and children.

The Northeast Wildfire Risk Assessment Geospatial Work Group completed a geospatial analysis of fire risk in the 20-state U.S. Forest Service Northeastern Area. The assessment is comprised of three components—fuels, wildland-urban interface, and topography (slope and aspect)—that are combined using a weighted overlay to identify wildfire-prone areas where hazard mitigation practices would be most effective. Figure 2 illustrates the areas identified for Massachusetts.

Source: 2018 Massachusetts State Hazard Mitigation Plan

**Figure 2- Massachusetts Wildfire Risk Areas**



Source: 2018 Massachusetts State Hazard Mitigation Plan

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

Potential damages from wildfires in Hamilton would depend on the extent and type of land affected. There could be the need for post-fire revegetation to restore burned properties, which could cost from a few thousand dollars to tens of thousands for an extensive area. However, there are no data on actual wildfire damages.

Based on past occurrences and the Massachusetts Hazard Mitigation Plan, brushfires are of High frequency, events that occur more frequently than once in 5 years (Greater than 20% 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 when there is a prolonged period of excessively hot or cold weather. Hamilton has four well-defined seasons. The seasons have several defining factors, with temperature one of the most significant. Extreme temperatures can be defined as those, which are far outside of the normal seasonal ranges for Massachusetts. The average temperatures for Massachusetts are: winter (Dec-Feb) Average = 31.8°F and summer (Jun-Aug) Average = 71°F. Extreme temperatures are a Town-wide hazard.

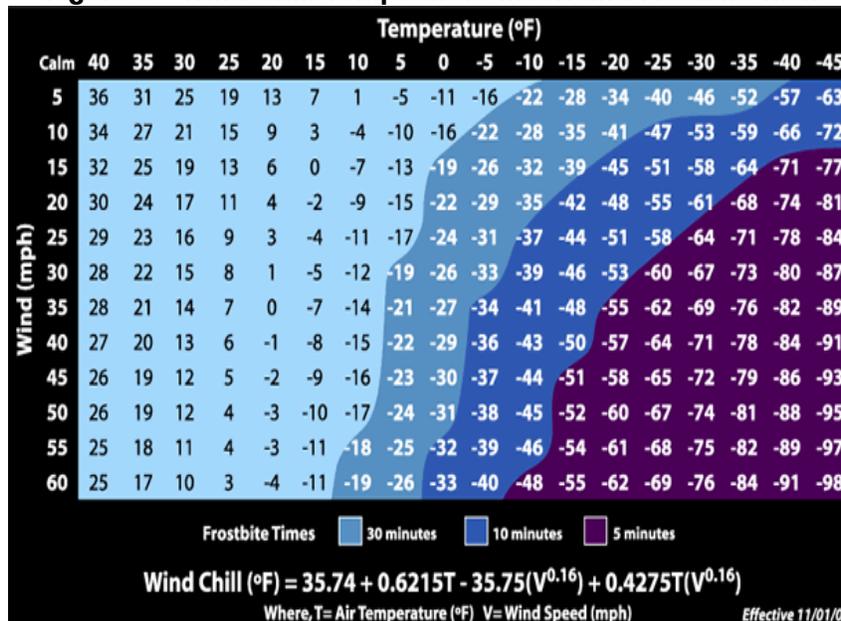
*Extreme Cold*

For extreme cold, temperature is typically measured using Wind Chill Temperature Index, which is provided by the National Weather Service (NWS). The latest version of the index was implemented in 2001 and it meant to show how cold conditions feel on unexposed skin. The index is provided in Figure 3 below.

Extreme cold is also relative to the normal climatic lows in a region. Temperatures that drop decidedly below normal and wind speeds that increase can cause harmful wind-chill factors. The wind chill is the apparent temperature felt on exposed skin due to the combination of air temperature and wind speed.

Extreme cold is a dangerous situation that can result in health emergencies for susceptible people, such as those without shelter or who are stranded or who live in homes that are poorly insulated or without heat. The elderly and people with disabilities are often most vulnerable. In Hamilton, 19.8 percent of the population are over 65 and 6.6% of the population has a disability. (2010 US Census)

**Figure 3 - Wind Chill Temperature Index and Frostbite Risk**





The Town of Hamilton does not collect data for previous occurrences of extreme cold. The best available local data are for Essex County, 1996- June, 2019, through the National Climatic Data Center (NCDC). There are four extreme cold events on record which caused no deaths and no injuries, and no property damage (see Table 16).

**Table 16 – Essex County Extreme Cold and Wind Chill Occurrences**

Location	Date	Type	Deaths	Injuries	Damage-\$
EASTERN ESSEX	2/15/2015	Extreme Cold/Wind Chill	0	0	0
WESTERN ESSEX	2/16/2015	Extreme Cold/Wind Chill	0	0	0
WESTERN ESSEX	2/13/2016	Extreme Cold/Wind Chill	0	0	0
EASTERN ESSEX	2/13/2016	Extreme Cold/Wind Chill	0	0	0

Source: NOAA, National Climatic Data Center

**Extreme Heat**

While a heat wave for Massachusetts is defined as three or more consecutive days above 90°F, another measure used for identifying extreme heat events is through a Heat Advisory from the NWS. These advisories are issued when the heat index (Figure 4) is forecast to exceed 100 degree Fahrenheit (F) for 2 or more hours; an excessive heat advisory is issued if forecast predicts the temperature to rise above 105 degree F.

**Figure 4- Heat Index Chart**

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

Extreme heat poses a potentially greater risk to the elderly, children, and people with certain medical conditions, such as heart disease. However, even young and healthy individuals can succumb to heat if they participate in strenuous physical activities during hot weather. 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 Hamilton does not collect data on excessive heat occurrences. The best available local data are for Essex County, through the National Climatic Data Center. From 1995 – June, 2019, there has been a total of three excessive heat events, with no reported deaths, no injuries, and no property damage resulting from excessive heat (see Table 17).

Extreme temperature events are projected to be medium frequency events based on past occurrences, as defined by the Massachusetts State Hazard Mitigation Plan, 2011. Both extreme cold and hot weather events occur between once in five years to once in 50 years, or a 2 percent to 20 percent chance of occurring each year.

**Table 17 – Essex County Extreme Heat Occurrences 1995 to August, 2018**

Date	Type	Deaths	Injuries	Damage
7/22/2011	Excessive Heat	0	0	0
7/1/2018				
7/3/2018				

Source: NOAA, National Climatic Data Center

**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 1960's, a cool drought occurred because dry air from the north caused lower temperatures in the spring and summer of 1962-65. The northerly winds drove frontal systems to sea along the Southeast Coast and prevented the Northeastern States from receiving moisture (U.S. Geological Survey). This is considered the drought of record in Massachusetts.

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

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



Hamilton is located in the Northeast Region. In Hamilton drought is a potential Town-wide hazard.

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. They begin with a normal situation where data are routinely collected and distributed, move to heightened vigilance with increased data collection during an advisory, 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 is 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 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 are below normal (lowest 25% of period of record).
6. The Stream flow Index is based on the number of consecutive months that stream flow levels are below normal (lowest 25% of period of record).
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.

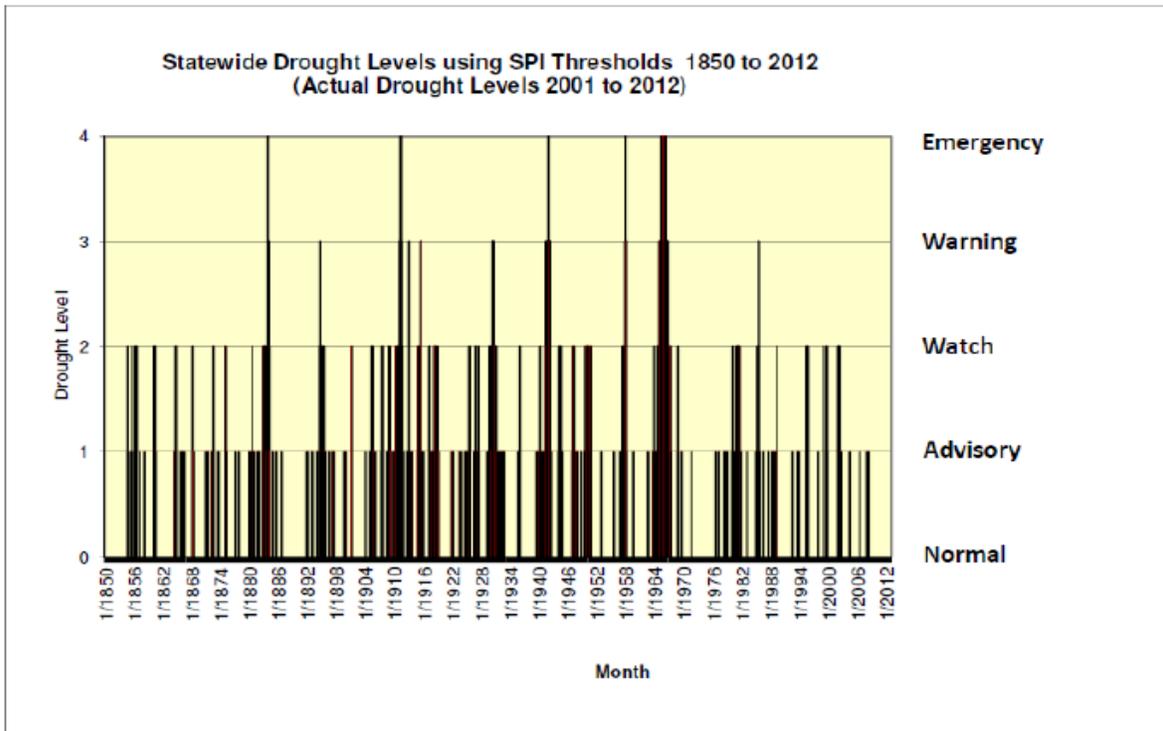
#### Previous Occurrences

Hamilton does not collect data relative to drought events. Because drought tends to be a regional natural hazard, this plan references state and county data as the best available data for drought. The statewide scale is a composite of six regions of the state. Regional

composite precipitation values are based on monthly values from six stations, and three stations in the smaller regions (Cape Cod/Islands and West).

Figure 5 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 percent of the time between 1850 and 2012. Table 17 summarizes the chronology of major droughts from 1929 to 2017.

**Figure 5 - Statewide Drought Levels using SPI Thresholds 1850 – 2012**



(Source: Mass. State Drought Management Plan 2013)

Drought Emergency

Drought emergencies have been reached infrequently, with 5 events occurring in the period between 1850 and 2012: in 1883, 1911, 1941, 1957, and 1965-1966. The 1965-1966 drought period 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 one percent chance of being in a drought Emergency.



Drought Warning

Drought Warning levels not associated with drought Emergencies have occurred five times, in 1894, 1915, 1930, and 1985, and 2016. On a monthly basis over the 162-year period of record, there is a two percent chance of being in a drought Warning level.

Drought Watch

Drought Watches not associated with higher levels of drought generally have occurred in three to four years per decade between 1850 and 1950. In the 1980s, there was a lengthy drought Watch level of precipitation between 1980 and 1981, followed by a drought Warning in 1985. A frequency of drought Watches at a rate of three years per decade resumed in the 1990s (1995, 1998, 1999). In the 2000s, Drought Watches occurred in 2001 and 2002.

On July 8, 2016, following four continuous months of unusually dry weather, Massachusetts Energy and Environmental Affairs (EEA) Secretary Matthew Beaton declared a Drought Watch for Central and Northeast Massachusetts, which includes the Town of Hamilton, and a Drought Advisory for Southeast Massachusetts and the Connecticut River Valley. In August 2016 the Northeast Region was upgraded to a Drought Warning. As of January 1, 2017, four of the six statewide regions in Massachusetts were listed in Drought Warning, the second highest drought stage, and the Northeast Region was listed in the third-ranked Drought Watch stage. By June 1, 2017 all areas of the state were listed as being in a normal condition.

The overall frequency of being in a drought Watch is 8 percent on a monthly basis over the 162-year period of record.

**Table 18 - Chronology of Major Droughts in Massachusetts**

Date	Area affected	Recurrence interval (years)	Remarks
1929-32	Statewide	10 to >50	Water-supply sources altered in 13 communities. Multistate.
	Statewide	15 to >50	More severe in eastern and extreme western Massachusetts. Multistate.
1957-59	Statewide	5 to 25	Record low water levels in observation wells, northeastern Massachusetts.
1961-69	Statewide	35 to >50	Water-supply shortages common. Record drought. Multistate.
1980-83	Statewide	10 to 30	Most severe in Ipswich and Taunton River basins; minimal effect in Nashua River basin. Multistate.
1985-88	Housatonic River basin	25	Duration and severity unknown. Streamflow showed mixed trends elsewhere.
2016	Statewide	N/A	Drought declaration began in July 2016 with a

Date	Area affected	Recurrence interval (years)	Remarks
			Drought Watch, which was upgraded to a Drought Warning in August 2016. The Central and Northeast regions were the most severely affected.

Data on drought occurrences for Essex County, is available through the National Climatic Data Center. From 1995 – August, 2018, there have been a total of 17 drought occurrence events, with no reported deaths, no injuries, and no property damage resulting from drought (see Table 19).

**Table 19 – Essex County Drought Occurrences 1996- June, 2019**

Location	Date	Type	Dth	Inj	PrD
<u>EASTERN ESSEX (ZONE)</u>	04/12/2012	Drought	0	0	0.00K
<u>WESTERN ESSEX (ZONE)</u>	04/12/2012	Drought	0	0	0.00K
<u>EASTERN ESSEX (ZONE)</u>	05/01/2012	Drought	0	0	0.00K
<u>EASTERN ESSEX (ZONE)</u>	07/05/2016	Drought	0	0	0.00K
<u>WESTERN ESSEX (ZONE)</u>	07/05/2016	Drought	0	0	0.00K
<u>EASTERN ESSEX (ZONE)</u>	08/01/2016	Drought	0	0	0.00K
<u>WESTERN ESSEX (ZONE)</u>	08/01/2016	Drought	0	0	0.00K
<u>EASTERN ESSEX (ZONE)</u>	09/01/2016	Drought	0	0	0.00K
<u>WESTERN ESSEX (ZONE)</u>	09/01/2016	Drought	0	0	0.00K
<u>EASTERN ESSEX (ZONE)</u>	10/01/2016	Drought	0	0	0.00K
<u>WESTERN ESSEX (ZONE)</u>	10/01/2016	Drought	0	0	0.00K
<u>EASTERN ESSEX (ZONE)</u>	11/01/2016	Drought	0	0	0.00K
<u>WESTERN ESSEX (ZONE)</u>	11/01/2016	Drought	0	0	0.00K
<u>EASTERN ESSEX (ZONE)</u>	12/01/2016	Drought	0	0	0.00K
<u>WESTERN ESSEX (ZONE)</u>	12/01/2016	Drought	0	0	0.00K
<u>WESTERN ESSEX (ZONE)</u>	01/01/2017	Drought	0	0	0.00K
<u>EASTERN ESSEX (ZONE)</u>	01/01/2017	Drought	0	0	0.00K
Totals:			0	0	0.00K

Source: NOAA, National Climatic Data Center

Under a severe long term drought the Hamilton could be vulnerable to restrictions on water supply, particularly given its reliance on the stressed Ipswich River watershed and local surface water supplies. 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 in Hamilton, there are no data or estimates of potential damages, but under a severe drought scenario it would be reasonable to expect a range of potential damages from several million to tens of millions of dollars. However, given the proximity and resilience of the MWRA water system due to its large amount of storage in the Quabbin and Wachusett Reservoirs, (equivalent to five years of water demand), severe impacts to the Town are unlikely in an emergency scenario. For example, even during the multi-year drought of record in the 1960s, there were no severe limitations of supply from the regional water system, which at the time was operated by the Metropolitan District Commission.

#### Probability of Future Occurrences

The state has experienced Emergency Droughts five times between 1850 and 2012. Even given that 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.

#### **Impacts of Climate Change**

Many of the natural hazards that Hamilton 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.

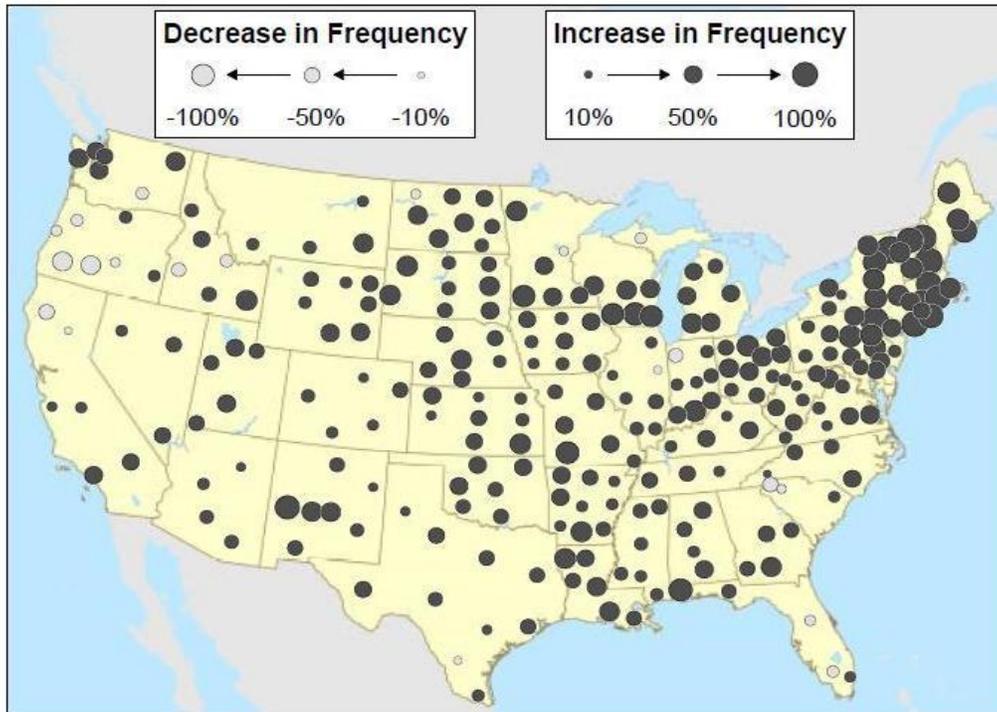
##### *Climate Change Impacts: Extreme Precipitation*

Hamilton's average annual precipitation is 48 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 6). 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.

At the other extreme, changes in precipitation patterns and the projected future rising temperatures due to climate change (discussed below) will likely increase the frequency of short-term (one- to three-month) droughts and decrease stream flow during the summer.

**Figure 6- 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

*Climate Change Impacts: Extreme Heat*

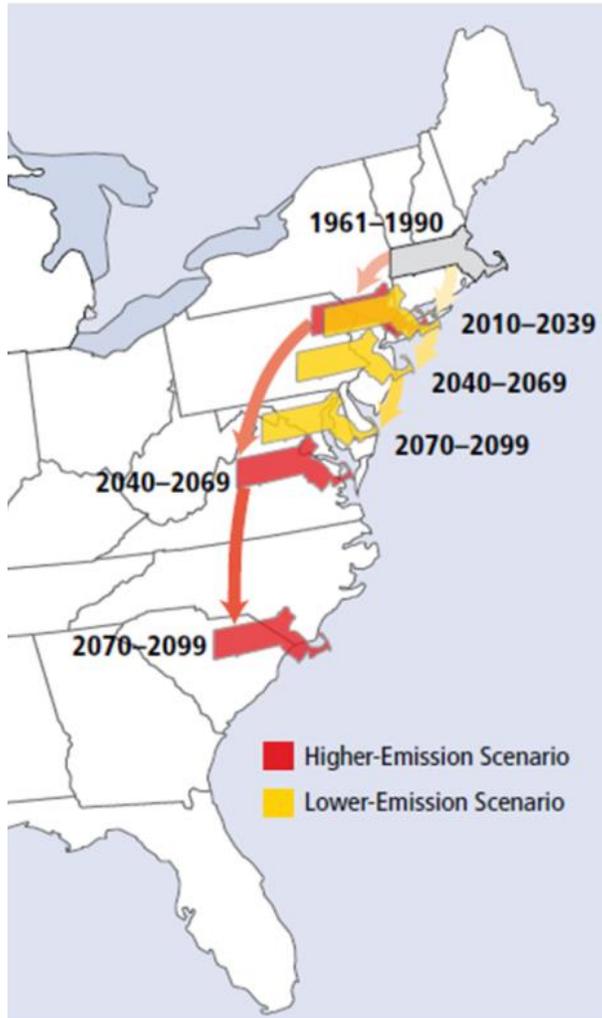
Recent temperature trends suggest greater potential impacts to come due to climate change. In the report “Confronting Climate Change in the U.S. Northeast,” (2007), the Union of Concerned Scientists presented temperature projections to 2099 based on two scenarios, one with lower carbon dioxide emissions,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

**Figure 7 – Mass. Extreme Heat Scenarios**

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 (Figure 7). Furthermore, the number of days with poor air quality could quadruple in Boston by the end of the 21<sup>st</sup> 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 7- 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. Table 20 shows the acreage and percentage of land in 10 categories. If the four residential categories are aggregated, residential uses make up 14 % of the area of the Town (1,367.1) acres). Commercial and industrial uses combined make up 0.4 % of the Town, or 41.9 acres.

**Table 20- 2005 Land Use**

High Density Residential	82.5
Medium Density Residential	516.8
Low Density Residential	504.6
Very Low Density Residential	263.2
Total Developed	1,319.6
Commercial	31.8
Industrial	10.1
Transportation	12.0
Agriculture	1,018.7
Undeveloped	164.6
Forest	4003.3
Undeveloped Wetlands	1,498.0
<b>TOTAL TOWN ACRES</b>	<b>9533.2</b>

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-summary-statistics>.

Description and Economic Elements

Hamilton’s economy is small and largely suburban, yet it has features that make the town a unique and strikingly beautiful place. The most visible element of Hamilton’s economic base, Downtown Hamilton, is a pleasant, low-key business district with a mix of small stores, professional offices and service businesses. Sized for a business area that caters mainly to local shoppers, Downtown Hamilton is the town’s only commercial zone. Public, non-profit institutional, agricultural and equestrian establishments are more prominent in Hamilton than in most Boston-area suburbs. By choice, the town has no industrial base.



Local government and the Hamilton-Wenham Regional School District are the town's largest employers, but two other non-taxpayer institutions also employ a significant number of people: Gordon-Conwell Seminary and Pingree School. Myopia Hunt Club and several equestrian and farm enterprises provide a small but historically stable pool of equestrian, recreational and service jobs. (Hamilton Master Plan 2004)

The median income for a household in the town for 2013 to 2017 was \$112,250 with a median family income of \$140,101, both above the Essex County average. Males had a average income of \$103,778 versus \$65,865 for females. The per capita income for the town was \$61,847. (2013-2017 US Census Factfinder)

#### Historic, Cultural, and Natural Resource Areas

The Town of Hamilton was settled by farmers who tilled the fields to the south of Ipswich. Early settlers in Hamilton asked that their local church be "set off" from Ipswich due to the distance that the community in the "Hamlet" had to travel to downtown Ipswich for church. The forty families within the town did not find enough room for them at the Wenham church located to the south and decided to build their own church in 1713. After the Revolutionary War, they petitioned to separate into their own community. Finally in 1793, Hamilton became a town. The farms were originally scattered along early roads.

By 1859, Asbury Grove, a 100 acre religious retreat, included 300 cottages, a chapel, tabernacle, hotel, spur railroad station and post office. Many of the gingerbread style cottages were burned in the fire of 1927 and were never replaced.

While Asbury Grove was the first summer community to locate in Hamilton, Myopia Hunt Club was certainly the most significant. After the near-sighted friends (hence the name) moved their club from Winchester to Hamilton in 1891, wealthy Victorians began purchasing declining agricultural land for their country estates and summer homes, thereby preserving the rural quality of the area.

The settlement of downtown Hamilton where the service workers lived, began around 1880. The square area between Union Street and Main Street to Linden Street and Asbury Street had been completely built up by 1910. While the estates maintained an agricultural and rural quality, with their pastures now in the front yard, the service-worker neighborhood developed into a series of blocks within blocks, with similar houses for like-minded citizens.

By 1894, the railroad, (allowing easier access to information and traveling), the Industrial Revolution (encouraging the abandonment of rocky New England soils where machines were of little help), and the separation of church and state (decreasing community spirit) had all changed the fabric of many New England towns, but Hamilton managed to maintain its agricultural base. The early maps indicate that an increased number of smaller farms were now lining the roads. Many of these clustered farm sites also housed shoe shops which employed farm workers during the winter as well as full-time workers.

As country places became too expensive to maintain, they too began to disappear, replaced by commuter neighborhoods during the 1950's. Much of what little agricultural land remained was converted to residential development. These housing tracts retained

the names of the once lovely areas in which they were built, such as Harrigan's Meadow. The farmhouses, which were at one time moved back from the street when the summer residents bought the farm-land for estates, are now surrounded by half-acre, one acre, and two- acre house lots. A shopping center with a large parking lot is located at the railroad tracks in downtown Hamilton. The shopping center was renovated and expanded in 2002. Buildings along Railroad Avenue have been renovated and rebuilt in a more architecturally consistent manner, considering not only human scale, but regional architecture and color. (Hamilton Open Space and Recreation Plan, 2015)

A first time visitor driving through Hamilton sees farmland, and large open fields, lining some of the major thoroughfares, such as along Route 1A. If the visitor hikes the forested areas, such as Bradley Palmer State Park, Appleton Farms Grass Rides, or Willowdale Mill Reservation, they see that the essential landscape character of Hamilton is one of upland forests with numerous hiking and bridle paths. However, if the visitor flies over the town, they see that much of town consists of wetlands, lakes, and streams and they would notice a number of drumlin hills with distinctive oval shapes, generally oriented northwest to southeast. The true character of the landscape in Hamilton is therefore one of diversity, ranging from large open fields, upland forests, lakes and streams, and wetlands. (Hamilton Open Space and Recreation Plan, 2015)

### Development Trends

The population of Hamilton more than doubled between 1940 and 1960. During this period the Town established a Planning Board and adopted its first zoning by- law and subdivision regulations in 1954. The greatest number of new dwellings per year added to the Town housing stock came in the years 1954 to 1957. Since 1957, growth has been quite orderly, averaging 24 new homes per year with as few as six new dwellings one year and as many as 39 another.

Almost all new construction in Hamilton is single family residences with accessory buildings. The fact that the Town relies totally on individual on-lot septic systems and that little change has occurred in the transportation system in the Town and surrounding area contribute to this development pattern. Hamilton is entirely dependent on groundwater for municipal water supply. This is a significant factor in the Town's conservation planning. One of the major priorities is to prevent contamination of the Town's aquifers, through a combination of regulation and open space preservation. A constant theme in Hamilton's development has been the maintaining the rural character of the Town. New developments are required to have street trees, and since 1990, utilities in new developments must be installed underground. The Town's adoption of pork chop zoning has helped to promote development which preserves scenic vistas. A Groundwater Protection Overlay District aquifers has expanded lot sizes for new lots to 80,000 square feet in sensitive land areas adjacent to water supply zones (Hamilton Open Space and Recreation Plan, 2015)

Development statistics for the plan update period were provided by the Hamilton Planning Department. These projects includes 4 completed developments in the Town of Hamilton since from 2011 to 2018, the most recent data available.



The database also includes several attributes of the new development, including a description of the development type, the number of new housing units or subdivision lots, and impervious area. The developments in Hamilton include a total of 45 new housing units.

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 two of the developments, Patton Ridge and 550 & 560 Bay Road are located within a flood zone.

Recent and Potential Future Development

MAPC consulted with Town planning staff to determine areas that have been recently developed or may be developed in the future, based on the Town’s comprehensive planning efforts and current trends and projects. These areas are described below. Two of these sites are in a flood hazard zone, with both located in an AE or A zone with a 1 % annual chance of flooding. All of the developments are in the areas defined as “Low Landslide Incidence.” None of the developments are in brush fire hazard areas. Other hazards are categorized at the same level throughout town. For snowfall, the average annual snowfall east of Route 128 in Hamilton is 48 - 72 inches. With respect to wind, there is no variation across different sites in the town; the hazard map depicts the entire town of Hamilton within a 100-year wind speed of 110 miles per hour. (See hazard maps in Appendix B).

**Table 20  
Relationship of Recent and Potential Development to Hazard Areas**

<b>Parcel</b>	<b>Landslide risk</b>	<b>Flood Zone</b>	<b>Brush Fire Area</b>
Canter Brook Farm	Low	No	No
Patton Ridge	Low incidence	18.5% in AE: 1% Annual Chance of Flooding, with BFE	No
550 and 560 Bay Road	Low incidence	18.4% in AE: 1% Annual Chance of Flooding, with BFE	No
Porter Lane	Low incidence	No	No
Maple Street Extension	Low incidence	No	No
Woodland Mead	Low incidence	No	No

**Table 21- Summary of Hamilton Developments 2011-2018**

Map Label	Street	Number Units	Details
I	Patton Ridge	12	Patton Ridge-Senior condos
R	Asbury St.	23	Canter Brook-Senior condos
T	Porter Lane	4	Single family homes
U	Maple Street Extension	3	Single family homes
U	Woodland Mead	1	Single family home
U	TBD	2	Single family homes

Hamilton Planning Department

### Critical Infrastructure in Hazard Areas

Critical infrastructure includes facilities that are important for disaster response and evacuation (such as emergency operations centers, fire stations, water pump stations, etc.) and facilities where additional assistance might be needed during an emergency (such as nursing homes, elderly housing, day care centers, etc.). There are 55 facilities identified in Hamilton. These are listed in Table 23 and are shown on the maps in Appendix B.

#### Explanation of Columns in Table 22

**Column 1: ID #:** The first column in Table 10 is an ID number which appears on the maps that are part of this plan. See Appendix B.

**Column 2: Name:** The second column is the name of the site. If no name appears in this column, this information was not provided to MAPC by the community.

**Column 3: Type:** The third column indicates what type of site it is.

**Column 4: Landslide Risk:** The fourth column indicates the degree of landslide risk for that site. This information came from NESEC. The landslide information shows areas with either a low susceptibility or a moderate susceptibility to landslides based on mapping of geological formations. This mapping is highly general in nature. For more information on how landslide susceptibility was mapped, refer to <http://pubs.usgs.gov/pp/p1183/pp1183.html>.

**Column 5: FEMA Flood Zone:** The fifth column addresses the risk of flooding. A “No” entry in this column means that the site is not within any of the mapped risk zones on the Flood Insurance Rate Maps (FIRM maps). If there is an entry in this column, it indicates the type of flood zone.

**Column 6: Brush Fires-** Areas determined by Local Hazard Mitigation Team to be at risk for brush fires.



TOWN OF HAMILTON- HAZARD MITIGATION PLAN- 2019 UPDATE

Table 23- Critical Facilities and Relationship to Hazard Areas							
PDM ID	NAME	TYPE	Landslides	Within FEMA Flood Zone	Within Locally Identified Area of Flooding	Within Brush Fire Area	Average Annual Snow Fall
119 - 001	Hamilton Police Department	Police Station	Low incidence	No	No	No	H 48.1 - 72.0
119 - 002	Hamilton Fire Department	Fire Station	Low incidence	No	No	No	H 48.1 - 72.0
119 - 003	Town Hall	Municipal	Low incidence	No	No	No	H 48.1 - 72.0
119 - 004	Patton G.p. Well	Public Water Supply	Low incidence	No	No	No	H 48.1 - 72.0
119 - 005	Idlewood #1 Wells	Public Water Supply	Low incidence	AE: 1% Annual Chance of Flooding; with BFE	No	No	H 48.1 - 72.0
119 - 006	Plateau G.p. Well	Public Water Supply	Low incidence	No	No	No	H 48.1 - 72.0
119 - 007	Caisson Wells	Public Water Supply	Low incidence	AE: 1% Annual Chance of Flooding; with BFE	No	No	H 48.1 - 72.0
119 - 008	Hamilton Water Treatment Plant	Public Water Supply	Low incidence	No	No	No	H 48.1 - 72.0
119 - 009	Idlewood #2 G.p. Well	Public Water Supply	Low incidence	No	No	No	H 48.1 - 72.0
119	Round Pond Gp Well	Public Water	Low	No	No	Chebacco	H 48.1 -



TOWN OF HAMILTON- HAZARD MITIGATION PLAN- 2019 UPDATE

Table 23- Critical Facilities and Relationship to Hazard Areas							
PDM ID	NAME	TYPE	Landslides	Within FEMA Flood Zone	Within Locally Identified Area of Flooding	Within Brush Fire Area	Average Annual Snow Fall
- 010	#1	Supply	incidence			Woods area	72.0
119 - 011	Bridge St. Tub & Gp Wells - Out of Service	Well	Low incidence	No	No	No	H 48.1 - 72.0
119 - 012	School G.p. Well	Public Water Supply	Low incidence	A: 1% Annual Chance of Flooding; no BFE	No	No	H 48.1 - 72.0
119 - 013	Round Pond Tub Well #2	Well	Low incidence	No	No	Chebacco Woods area	H 48.1 - 72.0
119 - 014	Gravelly Pond	Public Water Supply	Low incidence	No	No	Chebacco Woods area	H 48.1 - 72.0
119 - 015	Manchester Water Treatment Plant	Public Water Supply	Low incidence	No	No	Chebacco Woods area	H 48.1 - 72.0
119 - 016	Kids' Connection	Child Care	Low incidence	No	No	No	H 48.1 - 72.0
119 - 017	Children's Development Center	Child Care	Low incidence	No	No	No	H 48.1 - 72.0
119 - 018	Hamilton-Wenham Community House	Child Care	Low incidence	No	No	No	H 48.1 - 72.0
119 - 019	Gordon-Conwell Nursery School	Child Care	Low incidence	No	No	No	H 48.1 - 72.0



TOWN OF HAMILTON- HAZARD MITIGATION PLAN- 2019 UPDATE

Table 23- Critical Facilities and Relationship to Hazard Areas							
PDM ID	NAME	TYPE	Landslides	Within FEMA Flood Zone	Within Locally Identified Area of Flooding	Within Brush Fire Area	Average Annual Snow Fall
119 - 020	Christ Church Parish Day School	Child Care	Low incidence	No	No	No	H 48.1 - 72.0
119 - 021	Cutler Elementary School	School	Low incidence	No	No	No	H 48.1 - 72.0
119 - 022	Winthrop Elementary School	School	Low incidence	No	Parallel to Tally Ho Drive and Locust Street	No	H 48.1 - 72.0
119 - 023	Miles River Middle School	School	Low incidence	No	No	No	H 48.1 - 72.0
119 - 024	Hamilton-Wenham Regional High School	School	Low incidence	No	No	No	H 48.1 - 72.0
119 - 025	Pingree School	School	Low incidence	No	No	No	H 48.1 - 72.0
119 - 026	Gordon Conwell Theological School	School	Low incidence	No	No	No	H 48.1 - 72.0
119 - 027	Hamilton-Wenham Communications Ctr.	Emergency Operations Center	Low incidence	No	No	No	H 48.1 - 72.0
119 - 028	Hamilton Dept. of Public Works	Municipal	Low incidence	No	No	No	H 48.1 - 72.0
119 -	Hamilton Housing (Brooks House)	Elder Housing	Low incidence	No	No	No	H 48.1 - 72.0



TOWN OF HAMILTON- HAZARD MITIGATION PLAN- 2019 UPDATE

Table 23- Critical Facilities and Relationship to Hazard Areas							
PDM ID	NAME	TYPE	Landslides	Within FEMA Flood Zone	Within Locally Identified Area of Flooding	Within Brush Fire Area	Average Annual Snow Fall
029							
119 - 030	Hamilton Housing Authority (Elderly)	Elder Housing	Low incidence	No	No	No	H 48.1 - 72.0
119 - 031	Hamilton Housing (Lamson Hall)	Senior Center	Low incidence	No	No	No	H 48.1 - 72.0
119 - 032	Hamilton Housing Authority (Elderly)	Elder Housing	Low incidence	No	No	No	H 48.1 - 72.0
119 - 033	Hamilton Housing Authority (Elderly)	Elder Housing	Low incidence	No	No	No	H 48.1 - 72.0
119 - 034	Hamilton Housing Authority (Elderly)	Elder Housing	Low incidence	No	No	No	H 48.1 - 72.0
119 - 035	Hamilton-Wenham Library	Library	Low incidence	No	No	No	H 48.1 - 72.0
119 - 036	Winthrop St. Bridge (Ipswich River)	Bridge	Low incidence	AE: Regulatory Floodway	Winthrop Street Bridge	No	H 48.1 - 72.0
119 - 037	Highland St. Bridge (Ipswich River)	Bridge	Low incidence	AE: Regulatory Floodway	No	No	H 48.1 - 72.0
119 - 038	Hamilton Annex (Old Library)	Place of Assembly	Low incidence	No	No	No	H 48.1 - 72.0
119	Verizon Building	Telecommunica	Low	No	No	No	H 48.1 -



TOWN OF HAMILTON- HAZARD MITIGATION PLAN- 2019 UPDATE

Table 23- Critical Facilities and Relationship to Hazard Areas							
PDM ID	NAME	TYPE	Landslides	Within FEMA Flood Zone	Within Locally Identified Area of Flooding	Within Brush Fire Area	Average Annual Snow Fall
- 039		tions	incidence				72.0
119 - 040	Sagamore Hill Solar Observatory (USAF)	Federal Office	Low incidence	No	No	No	H 48.1 - 72.0
119 - 041	Bridge St. Bridge (Miles River)	Bridge	Low incidence	AE: Regulatory Floodway	No	No	H 48.1 - 72.0
119 - 042	Gardner St. Bridge (Miles River)	Bridge	Low incidence	AE: 1% Annual Chance of Flooding; with BFE	No	No	H 48.1 - 72.0
119 - 043	Woodbury St. Bridge	Bridge	Low incidence	No	Woodbury Street culvert	No	H 48.1 - 72.0
119 - 044	Moulton St. Bridge (Miles River)	Bridge	Low incidence	AE: Regulatory Floodway	No	No	H 48.1 - 72.0
119 - 045	Myopia Dam & Bridge	Dam/Bridge	Low incidence	AE: Regulatory Floodway	Myopia Dam	No	H 48.1 - 72.0
119 - 046	Gordon-Conwell Sewage Treatment Plant	Sewer Pump Station	Low incidence	No	No	No	H 48.1 - 72.0
119 - 047	Hamilton Housing Authority (Elderly)	Elder Housing	Low incidence	No	No	No	H 48.1 - 72.0
119 - 048	Deveau House	Assisted Living	Low incidence	No	No	No	H 48.1 - 72.0



TOWN OF HAMILTON- HAZARD MITIGATION PLAN- 2019 UPDATE

Table 23- Critical Facilities and Relationship to Hazard Areas							
PDM ID	NAME	TYPE	Landslides	Within FEMA Flood Zone	Within Locally Identified Area of Flooding	Within Brush Fire Area	Average Annual Snow Fall
119 - 049	Subsurface Water Storage Tank 850,000gall	Water Storage Tank	Low incidence	No	No	No	H 48.1 - 72.0
119 - 050	Communication tower - commercial	Communication Tower	Low incidence	No	No	No	H 48.1 - 72.0
119 - 051	Public safety comm. towers/radios	Communication Tower	Low incidence	No	No	No	H 48.1 - 72.0
119 - 053	Brickland Farms	Composting Facility	Low incidence	No	No	No	H 48.1 - 72.0
119 - 054	Lawson and Welch Oil Company	Hazardous Material Site	Low incidence	No	No	No	H 48.1 - 72.0
119 - 055	TENNECO Gas Pipeline	Gas Pipeline	Low incidence	No	No	No	H 48.1 - 72.0

## Vulnerability Assessment

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

### Introduction to HAZUS-MH

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

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

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

There are three modules included with the HAZUS-MH software: hurricane wind, flooding, and earthquakes. There are also three levels at which HAZUS-MH can be run. Level 1 uses national baseline data and is the quickest way to begin the risk assessment process. The analysis that follows was completed using Level 1 data. Level 1 relies upon default data on building types, utilities, transportation, etc. from national databases as well as census data. While the databases include a wealth of information on the Town of Hamilton, 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 24 - Estimated Damages from Hurricanes**

	100 Year	500 Year
<b>Building Characteristics</b>		
Estimated total number of buildings	2,774	
Estimated total building replacement value (2014 \$)	\$ 1,203	
Millions of dollars		
<b>Building Damages</b>		
# of buildings sustaining minor damage	58	387
# of buildings sustaining moderate damage	2	45
# of buildings sustaining severe damage	0	2
# of buildings destroyed	0	2
<b>Population Needs</b>		
# of households displaced	0	2
# of people seeking public shelter	0	2
<b>Debris</b>		
Building debris generated (tons)	4,850	12,546
Tree debris generated (tons)	4,625	11,236
# of truckloads to clear building debris	8	49
<b>Value of Damages (Thousands of dollars)</b>		
Total property damage (buildings and content)	\$8,332.94	\$29,746.56
Total losses due to business interruption	\$176.28	\$1,174.77

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-25  
Estimated Damages from Earthquakes**

	<b>Magnitude 5.0</b>	<b>Magnitude 7.0</b>
<b>Building Characteristics</b>		
Estimated total number of buildings	2,774	
Estimated total building replacement value (2014 \$) Millions of dollars	\$ 1,203	
<b>Building Damages</b>		
# of buildings sustaining slight damage	823	75
# of buildings sustaining moderate damage	423	554
# of buildings sustaining extensive damage	106	815
# of buildings completely damaged	26	1,325
<b>Population Needs</b>		
# of households displaced	68	1,395
# of people seeking public shelter	41	840
<b>Debris</b>		
Building debris generated ( million tons)	0.02	0.17
# of truckloads to clear debris (@ 25 tons/truck)	760	6,880
<b>Value of Damages (Millions of dollars)</b>		
Total property damage	\$143.13	\$1,127.30
Total losses due to business interruption	\$18.80	\$121.84

Estimated Damages from Flooding

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

<b>Table-26 Estimated Damages from Flooding</b>		
	<b>100 Year Flood</b>	<b>500 Year Flood</b>
<b>Building Characteristics</b>		
Estimated total number of buildings	2,774	
Estimated total building replacement value (2010 \$) Millions of dollars	\$ 1,203	
<b>Building Damages</b>		
# of buildings sustaining slight damage ( 1-10%)	3	2
# of buildings sustaining moderate damage (11-50%)	0	0
# of buildings sustaining substantial damage (>50%)	0	0
<b>Value of Damages (millions of dollars)</b>		
Total property damage	\$1.63	\$2.21
Total losses due to business interruption	0.81	\$1.17

## V. HAZARD MITIGATION GOALS

The Hamilton Local Hazard Mitigation Planning Team reviewed and discussed the goals from the 2011 Hazard Mitigation Plan for the Town of Hamilton. The Team modified their 2011 goals to reflect a more inclusive and streamlined approach for this plan update. All of the goals are considered critical for the Town and they are not listed in order of importance.

1. Prevent and reduce the loss of life, injury, public health impacts and property damages resulting from all identified natural hazards.
2. Build and enhance local mitigation capabilities to ensure individual safety, reduce damage to public and private property and ensure continuity of emergency services.
3. Increase cooperation and coordination among private entities, Town officials and Boards, State agencies and Federal agencies.
4. Increase awareness of the benefits of hazard mitigation through outreach and education.



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## VI. EXISTING MITIGATION MEASURES

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

The Town's existing mitigation measures are listed by hazard type here and are summarized in Table 25 below.

### Flooding – Existing Town-wide mitigation

Hamilton 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:

*National Flood Insurance Program (NFIP)* – Hamilton participates in the NFIP with 30 policies in force as of the February 28, 2019. 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/policy-claim-statistics-flood-insurance/policy-claim-13>

The following information is provided for the Town of Hamilton:

Flood insurance policies in force ( as of February 28, 2019)	30
Coverage amount of flood insurance policies	\$9,422,000
Premiums paid	\$13,748
Closed paid losses	8
\$ of Closed paid losses	\$58,468

*Massachusetts State Building Code* – The Massachusetts State Building Code contains many detailed regulations regarding wind loads, earthquake resistant design, flood-proofing, and snow loads. The Town has adopted the state building code.

*Street sweeping* – Every street gets swept once a year. Street sweeping is contracted out.

*Catch basin cleaning* – The town has approximately 750 catch basins that are cleaned every other year on average. This service is contracted out by the town. Culvert maintenance is an ongoing problem issue for Hamilton.

*Roadway treatments* – The town uses calcium chloride.

Subdivision Rules and Regulations – The subdivision rules and regulations contain a number of requirements that address flood hazard mitigation. Some of these provisions also relate to other hazards.

#### Section IV Preliminary Subdivision Plans

*Preliminary Plans must include:*

Proposed system of drainage, including existing natural waterways, in a general manner both within and adjacent to the subdivision.

#### Section IV Definitive Subdivision Plans

*Definitive Subdivision Plans must include:*

The proposed storm drainage of land, including existing natural waterways and the proposed disposition of water from the proposed subdivision to adequate natural drainage channels or artificial means of disposal.

The Definitive Plan shall be accompanied by copies of written statements, including all provisions made for proper drainage of the area, including: location and size of drain lines, catch basins, culverts, etc.

#### Section V Design Standards

##### *Soil and Drainage*

No land shall be subdivided for residential use if, after adequate investigation, the Board of Health determines that it cannot be used for building purposes without danger to health or safety. The Planning Board may, in particular instances, require satisfactory evidence that soil conditions and natural drainage are suitable for the proposed subdivision from the point of view of sanitation and public health.

##### *Easements*

Where a subdivision is traversed by a watercourse, drainage way, channel or stream, the Board may require that there be provided a storm water easement or drainage right-of-way of adequate width to conform substantially to the lines of such watercourses, drainage way, channel or stream, and to provide for the free flow of water in its natural course or for construction or other necessary purposes.

##### *Zoning Regulations*

#### Section I Purposes

The purposes of this Zoning By-law are to promote the health, safety, morals, convenience and general welfare of the inhabitants of Hamilton, to lessen the danger from fire and congestion, and from the hazards of flood water inundation, to protect and conserve the value of property, to preserve and increase the amenities of the Town, to conserve natural conditions, to promote the educational, cultural and economic welfare of the public through the preservation and protection of buildings, sites, and districts of historic interest,



and to improve and beautify the Town by encouraging the most appropriate uses of land within the Town in accordance with the General or Master Plan, and under the provisions of Chapter 40A of the Massachusetts General Laws as amended.

Section I Limitations on Land Subject to Flooding

Lands deemed subject to seasonal or periodic flooding shall not be used for residence or any other purpose requiring a subsurface disposal system which would endanger the public health and safety or cause possible damage to adjoining property.

Section I Limitations on Ways across Wetlands and Floodplains

Lands deemed subject to seasonal or periodic flooding; lands within the Conservancy District as established by Section V.C. of the By-laws; or wetlands as defined in The Massachusetts General Laws, Chapter 131, Section 40, shall not be crossed by roads or driveways.

Section V Open Space and Farmland Preservation Development

The town allows for the use of this cluster-style development on a minimum parcel size of 10-acres through a Special Permit granted by the Planning Board. This style of development includes: the permanent protection of open space that can improve groundwater recharge and limit increased stormwater runoff and associated flooding, preservation of agricultural and forestry land, historical and archeological resources, existing and proposed trails, wildlife habitat and corridors, and other natural resources including wetlands and water bodies.

Section V Conservancy District

The Conservancy District is intended for the preservation and maintenance of groundwater quality and quantity, for the protection of watershed resources upon which the inhabitants depend for water supply, and for the enhancement of water quality by encouraging infiltration and percolation through natural soils; to protect the public health and safety, persons and property against hazards of flood water inundation; for the protection of the community against the costs which may be incurred when unsuitable development occurs in swamps, marshes, along watercourses, or in areas subject to floods; to preserve and increase the amenities of the Town; and to conserve natural conditions, wild life, and open spaces for the education, recreation and general welfare of the public.

The town allows by-right such uses such as conservation of water, plants, wild life and ponds; passive recreation activities which do not require paving, filling, or construction of facilities that may degrade water quality; safe agricultural uses, forestry, horticulture and floriculture including grazing of animals and harvesting of crops; and religious and educational uses. Some uses are granted only by a Zoning Board of Appeals Special Permit include produce stands, qualified dams and wind energy conversion systems. Other uses such as alteration of terrain which may result in increased discharge of stormwater runoff into the District, paving, filling, chemical storage, or the building of new structures are prohibited.

Section V Groundwater Protection Overlay District

The purposes of the District include:

The promotion of the health, safety and general welfare of the Town by ensuring an adequate quality and quantity of drinking water for the residents, institutions, and



business of Hamilton; to preserve and protect existing and potential sources of drinking water; the conservation of the town's natural resource areas and prevention of contamination of the environment. A minimum lot size of 80,000 square feet is required within the Groundwater Overlay Protection District and non-toxic uses are allowed by the underlying zoning. Uses such as automobile junkyards and chemical storage are prohibited.

#### Section V Flood Plain District

The purposes of the Flood Plain District are to 1) ensure public safety through reducing the threats to life and personal injury; 2) eliminate new hazards to emergency response officials; 3) prevent the occurrence of public emergencies resulting from water quality, contamination, and pollution due to flooding; 4) avoid the loss of utility services which if damaged by flooding would disrupt or shut down the utility network and impact regions of the community beyond the site of flooding; 5) eliminate costs associated with the response and cleanup of flooding conditions; 6) reduce damage to public and private property resulting from flooding waters.

The Flood Plain District includes all special flood hazard areas designated on the Hamilton Flood Insurance Rate Map (FIRM) issued by the Federal Emergency Management Agency (FEMA) for the administration of the NFIP dated June 4, 1990 as Zone A, and AE, which indicate the 100-year regulatory floodplain. The exact boundaries of the District may be defined by the 100-year base flood elevations shown on the FIRM and further defined by the Flood insurance study booklet dated June 4, 1990. The FIRM and Flood Insurance Study Booklet are incorporated by reference and are on file with the Town Clerk, Selectmen, Planning Board and Conservation Commission

An overlay district which allows underlying uses, the District has use regulations limiting the construction of new structures, the enlargement of existing structures, and includes prohibitions against dumping, filling, piling, excavation, or the relocation of earth products and other site alterations not allowed by the bylaw.

#### Base Flood Elevation and Floodway Data

Floodway Data. In Zone A and AE, along watercourses that have not had a regulatory floodway designated, the best Federal, State, local, or other floodway data shall be used to prohibit encroachments in floodways which would result in any increase in flood levels within the community during the occurrence of the base flood discharge.

Base Flood Elevation Data Base flood elevation data is required for subdivision proposals or other developments greater than 50 lots or 5 acres, whichever is the lesser, within unnumbered A zones.

The Floodplain District is established as an overlay district to all other districts. All development in the district, including structural and non-structural activities, whether permitted by right or by special permit must be in compliance with Chapter 131, Section 40 of the Massachusetts General Law and with the following:

Section of the Massachusetts State Building Code which addresses floodplain areas (currently 780 CMR 2102.0, "Flood Resistant Construction");

Wetlands Protection Regulations, Department of Environmental Protection (DEP) (currently 310 CMR 10.00);

Inland Wetlands Restriction DEP (currently 302 CMR 6.00);

Minimum Requirements for the Subsurface Disposal of Sanitary Sewage DEP (currently 310 CMR 15, Title 5) and the Hamilton Board of Health Regulations Chapter 6;



Any variances from the provisions and requirements of the above referenced state regulations may only be granted in accordance with the required variance procedures of these state regulations,

Other Floodplain Regulations

All subdivision proposals must be reviewed to assure that: 1) such proposals minimize flood damage; 2) all public utilities and facilities are located and constructed to minimize or eliminate flood damage; and 3) adequate drainage is provided to reduce exposure to flood hazards. The existing contour intervals of site and elevations of existing structures must be included on the plan proposal.

The following uses of low flood damage potential and causing no obstructions to flood flows are encouraged provided they are permitted in the underlying district and they do not require structures, fill, or storage of materials or equipment:

- a. Agricultural uses such as farming, grazing, truck farming, horticulture, etc.
- b. Forestry and nursery uses.
- c. Outdoor recreational uses, including fishing, boating, play areas, etc.
- d. Conservation of water, plants, wildlife.
- e. Wildlife management areas, foot, bicycle, and/or horse paths.
- f. Temporary nonresidential structures used in connection with fishing, growing, harvesting, storage, or sale of crops raised on the premises.
- g. Buildings lawfully existing prior to the adoption of these provisions.

Section V- Open Space Farmland Development

OSFD is allowed by Special Permit on parcels of land of at least 10 acres which creates more than 5 houses: Open space design type designed to minimize land disturbance and pervious areas, preserve farm and wildlife habitat, and decrease flooding.

Section VI Development Regulations- Site Plan Review

The proposed site plan shall be consistent with the capacity of local infrastructure, such as water supply, utilities, drainage and streets, or shall provide for such improvements as necessary. All site plans are required to show existing and proposed storm drainage systems.

Section XXIX Stormwater Management

The bylaw's purpose includes the use of practices to mitigate soil erosion and sedimentation and control the volume of stormwater runoff from land disturbance activities; the infiltration of stormwater and the recharge of groundwater; and to encourage the use of Low Impact Development techniques. The stormwater management bylaw applies to all activities that result in the disturbance of one or more acres of land, either as a single lot or part of a larger plan that drains to the Municipal Separate Stormwater System, including subdivisions.

Conservation Bylaw and Regulations

The town does have its own wetlands bylaw and regulations and uses no-disturb and no-build regulations for areas within the 100 foot buffer zone of any regulated wetland resource.

The no disturbance zone is bounded by the edge of the wetlands resource area and a line 25 feet away from the wetlands resource area and the no build zone extends from

the no disturbance zone to a line 50 feet from the edge of the wetlands resource area for:

- a. Residential lots actually occupied on December 31, 2007;
- b. Residential lots for which a building permit for a residential structure has been issued not later than December 31, 2007;
- c. For buildable lots for which a Request for Determination involving the construction of a residential structure or a Notice of Intent involving the construction of a residential structure has been filed not later than December 31, 2007. This provision, 1.c. does not contemplate ANRAD filings.

In all other cases, the no disturbance zone is bounded by the edge of the wetlands resource area and a line 50 feet away from the wetlands resource area and the no build zone extends from the no disturbance zone to a line 75 feet from the edge of the wetlands resource area.

### **Existing Wind Hazard Mitigation Measures**

*Massachusetts State Building Code* – The town enforces the Massachusetts State Building Code whose provisions are generally adequate to protect against most wind damage. The code’s provisions are the most cost-effective mitigation measure against high winds and tornados given the extremely low probability of occurrence. If a tornado were to occur, the potential for severe damages would be extremely high.

*Tree-trimming program* – The Town conducts its own tree maintenance and also uses its own equipment to trim and remove trees as needed and grind stumps. The electrical utility company National Grid does a full tree inspection of its power line corridors every three years and takes down problem trees as needed.

### **Winter-Related Hazards**

The average annual snowfall for the town is 48 – 72 inches.

#### *Existing Winter Hazard Mitigation Measures*

*Snow disposal* –*Snow disposal* –The town conducts general snow removal operations with its own equipment. The MassHighway Department (MHD) handles snow removal for Bradley Palmer State Park roads.

### **Fire-Related Hazards**

The Hamilton Fire Department responded to an average of 15 brush fires annually from 2011- 2018. High risk areas include Chebacco Woods, Appleton Farms, Bradley Palmer State Park, Chebacco Road, and Asbury Grove. The Fire Department has updated its handheld radios and GPS equipment. The Town receives brush fire fighting assistance from Bradley Palmer State Park. There have been no deaths as a result of brush fires or major losses of property.

#### *Existing Fire Hazard Mitigation Measures*



*Permits Required for Outdoor Burning – The Fire Department requires a written permit for outdoor burning and a call to the Fire Department prior to beginning a burn.*

*Subdivision Review – The Fire Department is involved in reviewing all subdivision plans and some special permit applications for the Zoning Board of Appeals.*

### **Geologic Hazards**

Most municipal officials acknowledged that earthquakes were the hazard for which their community was least prepared. There have been no recorded earthquake epicenters within Hamilton. Although new construction under the most recent building codes generally will be built to seismic standards, much of the development in the town predates the most recent building code.

The entire town is classified as having a low risk for landslides. Town officials did not identify any problems with areas of geologic instability such as sinkholes or subsidence.

#### **Existing Geologic Hazard Mitigation Measures**

*Massachusetts State Building Code – The State Building Code contains a section on designing for earthquake loads (780 CMR 1612.0). Section 1612.1 states that the purpose of these provisions is “to minimize the hazard to life to occupants of all buildings and non-building structures, to increase the expected performance of higher occupancy structures as compared to ordinary structures, and to improve the capability of essential facilities to function during and after an earthquake”. This section goes on to state that due to the complexity of seismic design, the criteria presented are the minimum considered to be “prudent and economically justified” for the protection of life safety. The code also states that absolute safety and prevention of damage, even in an earthquake event with a reasonable probability of occurrence, cannot be achieved economically for most buildings.*

Section 1612.2.5 sets up seismic hazard exposure groups and assigns all buildings to one of these groups according to a Table 1612.2.5. Group II includes buildings which have a substantial public hazard due to occupancy or use and Group III are those buildings having essential facilities which are required for post-earthquake recovery, including fire, rescue and police stations, emergency rooms, power-generating facilities, and communications facilities.

*Public Education on Stormwater-The Town DPW maintains a web page on good housekeeping practices and stormwater management frequently asked questions at: <https://www.hamiltonma.gov/government/department-public-works/stormwater-npdes-compliance/>*

#### **Flooding – Existing Site Specific Mitigation**

*2011 Plan Flooding Areas of Concern mitigation measures and existing status.*

**Bridge Street Bridge culvert replacement:** Replace undersized 4x4 culvert with 12x12 culvert, top town mitigation project. - 2019 Status: Complete



**Culverts at Linden and Howard Streets near Great Swamp area:** Replace undersized culverts with 4x4 culverts. 2019 Status: Complete: installed new culverts in 2013.

**Gregory Island Road:** elevate low section of road. 2019 Status: Complete

**Hatfield Road neighborhood flooding:** Elevate low section of Hatfield Road. 2019 status: not complete but will not be carried forward as area has not flooded since 2011.

**Winthrop St. Bridge:** Incorporate design changes to prevent flooding due to water running around the bridge in the old mill sluiceway. 2019 status: Not complete- carryover for 2019.

**Mosquito Control Trenches at Bradford Road and Sharon Road:** Clean and maintain mosquito control trenches. 2019 Status- ongoing, carry forward.

**Miles River:** Complete and implement a Vegetation Management Plan for the Miles River Watershed. 2019 status: Not complete- carryover for 2019.

**Update town Flood Information Rate Maps (FIRM) maps information and update town bylaw:** 2019 Status: Complete

**Continue with the town's long-term beaver management plan: ongoing, carry forward for 2019.**

**Develop a web-based GIS wetlands mapping capacity:** 2019 Status: Complete

**Study feasibility of creating stormwater utility:** 2019 Status: Not complete, carry forward as part of fulfilling MS4 stormwater permit requirements.

**Develop greater emergency flood preparation and emergency response capacity:** 2019 Status: ongoing, carry forward.

**Horseshoe Road at Tally Ho Drive flooding:** Overflow pipe installed at Patton Pond in 2006 to mitigate; town continues to monitor flooding. 2019 Status: carry forward

**Complete locating of all storm drains and catch basins into town GIS data base:** ongoing as part of MS4 stormwater permit requirement.

**Wetlands database:** Develop a town-based, digital database of all local wetlands delineations. 2019 status: complete. The town use the MA GIS wetlands data layers in conjunction with its assessment parcel database.

**Alewife Brook backup at Bass Road:** Culvert upgrade- 2019 status-Complete

**Develop a stronger wetlands, BMP, erosion control, and stormwater education outreach program for town residents and builders:** 2019 status- partially complete- ongoing as part of MS4 stormwater permit requirement.

**Complete and adopt stormwater regulations:** 2019 status: complete.



Dams

**Establish ongoing communications with owners of privately owned dams to monitor conditions and maintenance programs:** 2019 status: partially complete. Ongoing as part of 2019 plan update.

Existing Multihazard Mitigation

*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, hurricanes, tornadoes, dam failures, earthquakes, and winter storms. Therefore, the CEMP is a mitigation measure that is relevant to all of the hazards discussed in this plan. The Town of Hamilton’s current CEMP was updated in 2017.

*Emergency Management Team (EMT)*

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

**Comprehensive Emergency Management Plan (CEMP)** – Every community in Massachusetts is required to have a Comprehensive Emergency Management Plan. These plans address mitigation, preparedness, response and recovery from a variety of natural and man-made emergencies. 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.

**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.

**Participation in the Local Emergency Management Planning Committee (LEPC)**  
Hamilton has its own Local Emergency Planning Committee.

**Table 27- Summary Existing Hazard Mitigation Measures**

Hazard	Area	Mitigation Measure	Update/comments
Flooding	Town-wide	Participation in the National Flood Insurance Program (NFIP)	Effective / 30 policies in force
		Massachusetts Building Code	Effective
		Floodplain District	Updated /Effective
		Stormwater Management Bylaw and Regulations	MS4 permit update is ongoing

**Table 27- Summary Existing Hazard Mitigation Measures**

Hazard	Area	Mitigation Measure	Update/comments
		Street sweeping	Effective
		Catch basin cleaning	Effective
		Wetlands Regulations	Effective
		Subdivision and Zoning	Update with climate resilience and adaptation measures as needed.
		Town cleans & inspects catch basins every year.	Effective
		Public Education on Stormwater	Effective, update under MS4 permit
		2015 Open Space and Recreation Plan-being updated in 2019.	Effective
		Existing Site Specific Flooding Mitigation	Effective
		Wind	Town-wide
State Building Code addresses wind standards	Effective for new construction		
Winter-Related	Town-wide	Regular snow removal operations and roadway treatments	Effective
		Catch basin cleaning to maintain drainage	Effective
		State Building Code addresses snow load standards	Effective for new construction
Fire	Town-wide	Outdoor burning permits	Effective
Fire	Town-wide	Subdivision review	Effective
Geologic	Town-wide	State Building Code addresses earthquake standards	Effective for new construction / Town has many older buildings
Multi hazard	Town-wide	Comprehensive Emergency Management Plan (CEMP)	Effective/Up to date
Multi hazard	Town-wide	Emergency Management Team (EMT)	Effective
Multi-hazard	Town-wide	2004 Master Plan- being updated 2020	Add Climate Adaptation and Mitigation to next plan update

**Local Capacity for Implementation**

Under the Massachusetts system of “Home Rule,” the Town of Hamilton is authorized to adopt and from time to time amend a number of local bylaws and regulations that



support the town's capabilities to mitigate natural hazards. These include Zoning Bylaws, Subdivision and Site Plan Review Regulations, Wetlands Bylaws, Health Regulations, Public Works regulations, and local enforcement of the State Building Code. Local Bylaws may be amended each year at the annual Town Meeting to improve the town's capabilities, and changes to most regulations simply require a public hearing and a vote of the authorized board or commission, such as the Planning Board or Conservation Commission.

The Town of Hamilton has recognized several existing mitigation measures that require implementation or improvements, and has the capacity within its local boards and departments to address these. The Hamilton Department of Public Works and Engineering Department will address the needs for catch basin cleaning, repairs and upgrades to drainage infrastructure. The Planning Board will address the updates to the Master Plan and implementation of the Zoning Ordinance, Floodplain District, and Subdivision Rules and Regulations. The Conservation Commission will oversee implementation of the Wetlands Bylaw and the Open Space Plan. The Department of Public Works together with the Planning Board and Conservation Commission will coordinate implementation and enforcement of the Stormwater Bylaw.



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## VII. MITIGATION MEASURES FROM THE 2011 PLAN

### Implementation Status of the Previous Plan

At a meeting of the Hamilton Hazard Mitigation Planning Committee, Town staff reviewed the mitigation measures identified in the 2011 Hamilton 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 2019 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 28 summarizes the status of mitigation measures, and mitigation projects completed are described in more detail below.

**Table 28- Mitigation Measures from the 2011 Plan**

Mitigation Measure	Priority	Lead Implementation	Current Status	Include in 2019 Plan/Priority
Bridge Street Bridge: culvert upgrade	High	DPW	2019 Status: Complete.	No
Culverts at Linden and Howard Streets near Great Swamp area: Upgrade culverts with 4x4 culverts	High	DPW	2019 Status: Complete: installed new culverts in 2013.	No
Gregory Island Road: Elevate low section of road.	High	DPW/ Conservation Commission	2019 Status: Complete.	No
Hatfield Road: elevate low section of Hatfield Road	High	DPW/Conservation Commission	2019 status: Not complete.	No- Has not flooded again since 2011.
Winthrop Street Bridge: Incorporate design changes to prevent flooding due to water running around the bridge in the old mill sluiceway	High	DPW	2019 status: Not complete.	Yes-High



TOWN OF HAMILTON- HAZARD MITIGATION PLAN- 2019 UPDATE

Mitigation Measure	Priority	Lead Implementation	Current Status	Include in 2019 Plan/Priority
Mosquito Control Trenches at Bradford Road and Sharon Road: Clean and maintain mosquito control trenches.	High	Northeast Mosquito Control/DPW	2019 status: Partially complete.	Yes- Medium
Miles River: Complete and implement a Vegetation Management Plan for the Miles River Watershed	High	Miles River Task Force	2019 status: Not complete.	Yes-High
Power outages: Purchase mobile, long-running generators and/or install fixed, multi-fuel generators in designated emergency shelters.	High	Fire	2019 Status- complete	No
Brush Fires: Incorporate brushfire mitigation in community planning updates.	High	Fire	2019 status: not complete.	Yes- Medium
Multi-hazard: Purchase a digital/hard copy map plotter to enable large map creation from town GIS files.	High	Town Administrator	2019 status: Not complete.	Yes-Medium
Multi-hazard: Purchase hand-held GPS units and mobile radio communications equipment	High	Fire	2019 status: Complete.	No
Multi-hazard: Create new MediVac site for emergency medical responses.	High	Fire	2019 status: Not complete.	Yes-High



TOWN OF HAMILTON- HAZARD MITIGATION PLAN- 2019 UPDATE

Mitigation Measure	Priority	Lead Implementation	Current Status	Include in 2019 Plan/Priority
Upgrade DPW and Town Hall generators as needed; provide alternative fuel sources and generator power source flexibility	High	Fire	2019 status: Complete.	No
Multi-hazard: power outage: Install fixed, multi-fuel generators at Winthrop and Cutler Schools.	Medium	School Department	2019 status: Partially Completed: install generators at Winthrop and Cutler Schools.	Yes-High
Winter storms: Use the FireWise program to help keep private fire roads and trails open during winter storms to ensure emergency access	High	Fire/DPW	2019 status: Not complete.	No- not needed as fire roads are not plowed.
Land Protection: Acquire priority open space parcels for many uses including, cooling, maintaining flood storage and water infiltration capacity.	Medium	Conservation Commission and Open Space Committee	2019 status: complete for now with recent Sagamore Hill project completed 2018.	No
Update FIRM mapping and bylaws.	High	DPW	2019 status: complete.	No



TOWN OF HAMILTON- HAZARD MITIGATION PLAN- 2019 UPDATE

Mitigation Measure	Priority	Lead Implementation	Current Status	Include in 2019 Plan/Priority
Flooding, Drainage Infrastructure and Dams: Dedicate more resources for more frequent maintenance of town-owned drainage facilities, such as more frequent removal of sediment.	Medium	DPW	2019 status: ongoing.	Yes- Medium
Flooding, Drainage Infrastructure and Dams: Continue with the town's long-term beaver management plan.	Medium	Fire	2019 status: ongoing.	Yes- Medium
Study feasibility of creating stormwater utility	Medium	DPW	2019 status: not complete.	Yes-Medium as part of MS4 stormwater permit.
Develop a web-based GIS wetlands mapping capacity.	Medium	Conservation Commission	2019 status: complete.	No
Develop greater emergency flood preparation and emergency response capacity	Medium	DPW/Police/Fire	2019 status: complete: ongoing	Yes- Medium
Increase contract labor for tree maintenance program.	Medium	DPW	2019 status: complete: partially complete	Yes-Medium
Add new water standpipe at Sagamore Hill.	Medium	DPW	2019 status: not complete.	Yes-Medium
Investigate options to make all public buildings earthquake resistant.	Medium	DPW	2019 status: not complete.	Yes-Medium

Hamilton has made progress on implementing mitigation measures identified in the 2011 Hazard Mitigation Plan, including:

- Culvert upgrade at Bridge Street bridge and Linden and Howard Streets;
- Extension of water mains on Winthrop Street;
- Elevating a low section of Gregory Island Road;
- Upgrades of its emergency generation, communications, GPS and fire-fighting capacity;
- Upgrades to its FEMA flood maps, CEMP, stormwater management regulations and wetlands database;
- The completion of the Sagamore Hill open space acquisition;
- Ongoing beaver control flood management.

Critically, the Town will be taking part in climate resilience planning actions through the MA Municipal Vulnerability Preparedness (MVP) Program in 2019, is in the process of completing an update to its Open Space and Recreation Plan and is taking steps towards updating its current Master Plan. The Town will draw on the 2019 Hazard Mitigation Plan update as part of its strategy to establish climate resilience priorities and natural hazard safety going forward.

Overall, thirteen mitigation measures from the 2011 plan will be carried forward in the plan update.

Moving forward into the next five year plan implementation period there will be many more opportunities to incorporate hazard mitigation into the Town's decision making processes, including mitigation strategies from this plan update and those included from the MVP Workshop Summary, as well as the Open Space and Master Plan updates.

The challenges the Town faces in implementing these measures are primarily due to limited funding and available staff time. This plan should help the Town prioritize the best use of its limited resources for enhanced mitigation of natural hazards.



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## VIII. HAZARD MITIGATION STRATEGY

### What is Hazard Mitigation?

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

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

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

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

Hazard Mitigation Measures can generally be sorted into the following groups:

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

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

## 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 issues that involve cooperation between two or more municipalities. There is a third level of mitigation which is regional; involving a state, regional or federal agency or an issue that involves three or more municipalities.

## Regional Partners

In the densely developed communities of the study area, mitigating natural hazards, particularly flooding, is more than a local issue. The drainage systems that serve these communities are a complex system of storm drains, roadway drainage structures, pump stations and other facilities owned and operated by a wide array of agencies including but not limited to the Town of Middleton, the Beverly and Salem Water Board, the Northeast Massachusetts Mosquito Control Board, the Department of Conservation and Recreation (DCR), the Massachusetts Department of Transportation (MA DOT) and the Massachusetts Bay Transportation Authority (MBTA). The planning, construction, operations 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 numerous competing priorities. In the sections that follow, the plan includes recommendations for activities to be undertaken by these other agencies. Implementation of these recommendations will require that all parties work together to develop solutions.

## Regional Issues

Restoration of the Miles River continues to be a priority for Hamilton. The river flows from Beverly through extensive wetlands before reaching the Ipswich River in Ipswich. It provides excellent riparian and wetland habitat, but faces problems including low flow velocity, nutrient inputs, and barriers to flow. The four watershed communities of Hamilton, Beverly, Ipswich and Wenham have formed the Miles River Collaborative to work together to solve these problems, and are currently seeking funding from the US Army Corps of Engineers for a habitat restoration project. The Collaborative is also addressing beaver issues, fertilizer runoff, and undersized culverts. Ipswich River Watershed Association volunteers surveyed Miles River crossings in November 2006 in collaboration with the Massachusetts Riverways Stream Continuity Program.

- Longham Reservoir, created by damming the Miles River, is a major water source for the cities of Salem and Beverly. Water supply wells within the Miles River watershed are also a secondary source for Danvers and Wenham. The Myopia Hunt Club also withdraws water from the river.
- The Town of Wenham has replaced and enlarged three culverts (Grapevine Rd East, Walnut Rd, and Larch Row) damaged during the Mother's Day floods of 2006.



- The Miles River has 13 road crossings and 1 dam.
- Localized flooding has occurred throughout the watershed, particularly around undersized culverts.
- Beaver activity in the river channel also raises water levels and may exacerbate flooding.
- Invasive vegetation, including purple loosestrife, is a concern. Vegetation clogs the river channel, due in part to low flow velocities and siltation, which alter the natural hydrology.
- Mass DEP has listed the Miles River as impaired because of organic enrichment due to nonpoint source pollution, low dissolved oxygen, and flow manipulation. Benthic macro invertebrates, a good indicator of habitat quality, are far below healthy levels (Mass DEP 2004). (From Ipswich River Watershed Association (IRWA): Miles River Restoration Opportunities, 2006).

#### Regional Water Supply

Hamilton draws its drinking water from the Ipswich River Basin, which supplies water to approximately 350,000 people (EOEA, 2003) and is projected to increase by about 5% within 20 years. The Ipswich Basin, with limited and shallow aquifers, is chronically stressed during dry summer periods and communities withdrawing from it are closely regulated by MA DEP.

In 2017, the engineering consultant Kleinfelder did a study in conjunction with public water suppliers from Danvers, Middleton, Hamilton, Lynnfield Center Water District, Topsfield and Wenham to “improve understanding of the current and future water supply constraints and challenges facing the Basin’s municipal water suppliers... and to identify potential regional solutions.”

Though the Ipswich Basin is projected to be able to provide adequate water supply to the communities that draw from it over the next 25 years, Hamilton, in conjunction with the Town of Manchester-by-the-Sea, has begun to explore other sources of water supply outside the Ipswich Basin. The Town is exploring a connection with Manchester in the North Coastal Basin, which is in the process of evaluating its safe yield.

*(Ipswich Basin Water Management Act Planning Grant, FY17-BWR2017-08, Final Report, Kleinfelder, 2017)*

**Process for Setting Priorities for Mitigation Measures**

The last step in developing Hamilton’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 29 below demonstrates the prioritization of the Town’s potential hazard mitigation measures. For each mitigation measure, the geographic extent of the potential benefiting area is identified as is an estimate of the overall benefit and cost of the measures. The benefits, costs, and overall priority were evaluated in terms of:

**Estimated Benefits**

High	Action will result in a significant reduction of hazard risk to people and/or property from a hazard event
Medium	Action will likely result in a moderate reduction of hazard risk to people and/or property from a hazard event
Low	Action will result in a low reduction of hazard risk to people and/or property from a hazard event

**Estimated Costs**

High	Estimated costs greater than \$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 29- Mitigation Measure Prioritization**

Mitigation Action	Geographic Coverage	Estimated Benefit	Estimated Cost	Priority
<b>Flood Hazard Mitigation</b>				
Winthrop Street Bridge: Incorporate design changes to prevent flooding due to water running around the bridge in the old mill sluiceway.	Winthrop Street neighborhood	High	High	High
Clean and maintain mosquito control trenches.	Bradford Road and Sharon Roads neighborhood	High	Low	High
Complete and implement a Vegetation Management Plan for the Miles River Watershed	Miles River watershed, town-wide	High	High	High
Dedicate more resources for more frequent maintenance of town-owned drainage facilities, such as more frequent removal of sediment.	Town-wide	High	Medium	Medium
Complete MS4 federal stormwater permit requirements including infrastructure location, erosion and stormwater BMPs, regulatory updates, stormwater utility, and public education.	Town-wide	High	High	Medium
Upgrade drainage and overflow pipe from Patton Pond.	Patton Park, Bay Road, Horseshoe and Tally Ho Drives	Medium	Medium	High

**Table 29- Mitigation Measure Prioritization**

<b>Mitigation Action</b>	<b>Geographic Coverage</b>	<b>Estimated Benefit</b>	<b>Estimated Cost</b>	<b>Priority</b>
Continue with the town's long-term beaver management plan.	Town-wide	Medium	Low	Medium
Develop greater emergency flood preparation and emergency response capacity.	Town-wide	Medium	Low	Medium
Establish ongoing communications with owners of privately owned dams to monitor conditions and maintenance programs.	Town-wide	High	Low	Medium
<b>Wind Mitigation Measures</b>				
Increase funding and Update the town-owned tree inventory and risk assessment data base.	Town-wide	High	Low	Medium
<b>Brushfire Mitigation</b>				
Incorporate brushfire mitigation in master plan reviews and updates.	Town-wide	High	Low	Low
Identify brushfire hazard areas to facilitate analysis and planning decisions through comparison with zoning, development and infrastructure. Develop and maintain a database to track community vulnerability to brushfires if needed.	Town-wide	High	Low	Medium
<b>Winter Storm Hazard Mitigation</b>				
Purchase snow removal equipment for highways and public facilities as needed.	Town-wide	High	High	Medium
<b>Earthquake Mitigation</b>				
Public building seismic assessments.	Public Buildings	Low	Medium	Low

**Table 29- Mitigation Measure Prioritization**

Mitigation Action	Geographic Coverage	Estimated Benefit	Estimated Cost	Priority
<b>Dam Mitigation</b>				
Establish ongoing communications with owners of privately owned dams to monitor conditions and establish maintenance programs.	Town-wide	High	Low	Low
<b>Extreme Temperature Mitigation</b>				
Site Design to increase tree plantings near buildings, increase the percentage of trees used in parking areas, and along public ways.	Town-Wide	Medium	Medium	Medium
Promote Green Building and Cool Roof designs.	Town-Wide	Medium	Low	Medium
Assess placement of cooling centers at schools, senior center and emergency shelters.	Town-wide	Medium	Low	High
<b>Multihazard Mitigation</b>				
Develop emergency outreach strategy, particularly for vulnerable, non-English speaking, and hard-to-reach populations.	Town-wide	High	Medium	Medium
<b>Drought Mitigation</b>				
Promote drought tolerant landscaping, Green Infrastructure and site design measures.	Town-Wide	Medium	Low	Medium
<b>Climate Resilience/Adaptation</b>				
Incorporate climate resilience/adaptation components into capital, open space and master planning.	Town-Wide	High	Medium	High

## **Potential Mitigation Measures**

The potential mitigation measures are provided in this section and summarized in Table 29.

### ***Flooding and Drainage Infrastructure***

The town would like to address upgrading drainage infrastructure at several sites including the Winthrop Street Bridge and at Patton Pond. Hamilton would like to maintain mosquito and drainage trenches, continue its beaver management plan, create a dialogue with private dam owners regarding dam upkeep and maintenance, complete a vegetation management plan for the Miles River watershed and develop climate resilience actions using the Massachusetts Municipal Vulnerability Preparedness (MVP) program. It is updating its Open Space and Recreation Plan and its Master Plan for flooding and climate resilience as well. The Town will be updating its stormwater and low impact development regulations and outreach as it complies with the MS4 Stormwater Permit over the next several years.

### ***Wind Hazards***

The Town is committed to the maintenance of trees and other vegetation for the purpose of ensuring safe and reliable distribution of electricity. The Town Tree Warden will work with the DPW and National Grid to develop a database of public trees and track their maintenance.

### ***Brushfire Hazards***

Incorporate brushfire mitigation into master plan reviews and updates. Identify brushfire hazard areas to facilitate analysis and planning decisions through comparison with zoning, development and infrastructure. Develop and maintain a database to track community vulnerability to brushfires if needed.

### ***Winter Hazards***

Purchase snow removal equipment for highways and public facilities as needed.

### ***Earthquakes***

Some town buildings are of steel construction and were built after 1975 under state building codes that mandated earthquake resistance. The town will conduct an enquiry on any masonry school structure built prior to that.

### ***Extreme Temperatures***

Site Design guidelines to increase tree plantings near buildings, increase the percentage of trees used in parking areas, and along public ways.

Promote guidelines for Green Building and Cool Roof designs.

Assess placement of cooling centers at schools, senior center and emergency shelters.

### ***Drought***

Promote guidelines for drought tolerant landscaping, Green Infrastructure and site design measures.

### ***Climate Change***

Incorporate climate resilience/adaptation components into the Town bylaws and regulations and the Town's next Master Plan update.

### **Introduction to Potential Mitigation Measures Table (Table 30)**

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 29, 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/stream bank protection, flood damage reduction, flood plain management services and planning services.

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

#### **Abbreviations Used in Table 30**

FEMA Mitigation Grants includes:

FMA = Flood Mitigation Assistance Program.

HMGP = Hazard Mitigation Grant Program.

PDM = Pre-Disaster Mitigation Program

ACOE = Army Corps of Engineers.

DHS/EOPS = Department of Homeland Security/Emergency Operations

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

USDA = United States Department of Agriculture

MA DOT = Massachusetts Department of Transportation

DCR = MA Department of Conservation and Recreation

CIP= Capital Improvement Program

HMPT=Hazard Mitigation Planning Team



<b>Table 30 – Potential Mitigation Measures</b>					
<b>Mitigation Measure</b>	<b>Priority</b>	<b>Lead Implementation</b>	<b>Time Frame</b>	<b>Estimated Cost</b>	<b>Potential Funding Sources</b>
<b>FLOODING/DAMS</b>					
Winthrop Street Bridge: Incorporate design changes to prevent flooding due to water running around the bridge in the old mill sluiceway.	High	DPW	Long Term 2019-2024	High \$350,000	Hamilton Capital Improvement Plan/Town Bond (CIP)/FEMA
Clean and maintain mosquito control trenches.	High	DPW	Long Term 20-2024	Low \$5,000 per year	Hamilton/North-east Mosquito Control
Complete and implement a Vegetation Management Plan for the Miles River Watershed	High	DPW	Long Term 2019-2024	High \$250,000 for study, \$7 to \$10 m. to implement	Town Bond, FEMA, ACOE
Dedicate more resources for more frequent maintenance of town-owned drainage facilities, such as more frequent removal of sediment.	Medium	DPW	Ongoing	Medium \$30,000 per year	Hamilton
Complete MS4 federal stormwater permit requirements including infrastructure location, erosion and stormwater BMPs, regulatory updates, stormwater utility, and public education.	High	DPW/Planning	Long Term 2019-2024	High \$80,000 per year	Hamilton
Upgrade drainage and overflow pipe from Patton Pond.	Low	DPW	Long Term 2019-2024	Medium \$15,000	Hamilton
Continue with the town's long-term beaver management plan.	Medium	DPW	Ongoing	Low \$10,000 per year	Hamilton

<b>Table 30 – Potential Mitigation Measures</b>					
<b>Mitigation Measure</b>	<b>Priority</b>	<b>Lead Implementation</b>	<b>Time Frame</b>	<b>Estimated Cost</b>	<b>Potential Funding Sources</b>
Develop greater emergency flood preparation and emergency response capacity.	Medium	DPW	Ongoing	Low \$5,000 per year	Hamilton
Upgrade Essex Street drainage by tying into Appaloosa Street drainage system.	Medium	DPW	Short Term 2020- 2022	Medium \$50,000	Hamilton
Establish ongoing communications with owners of privately owned dams to monitor conditions and maintenance programs.	Low	DPW/Conservation	Ongoing	Low Staff time	Hamilton
<b>WIND RELATED HAZARDS</b>					
Increase funding and update the town-owned tree inventory and risk assessment data base.	Medium	Hamilton Electric	Long Term 2019- 2024	Medium \$25,000 Staff time	Hamilton
<b>BRUSHFIRES</b>					
Incorporate brushfire mitigation in community planning updates.	Low	Planning/Fire	Long Term 2019- 2024	Low Estimated costs less than \$5,000 per year staff time	Staff time / Town general operating budget
<b>WINTER STORMS</b>					
Purchase snow removal equipment for highways and public facilities as needed.	High	DPW	Medium Term 2019- 2021	High \$100,00	DPW Budget/CIP
<b>EARTHQUAKES</b>					

<b>Table 30 – Potential Mitigation Measures</b>					
<b>Mitigation Measure</b>	<b>Priority</b>	<b>Lead Implementation</b>	<b>Time Frame</b>	<b>Estimated Cost</b>	<b>Potential Funding Sources</b>
Earthquake building assessment—Complete the assessment of all town-owned masonry buildings.	Low	Building/HMPT	Medium Term 2019-2023	Low Estimated costs less than \$10,000 and/or staff time	Staff time / Town general operating budget
<b>EXTREME TEMPERATURES</b>					
Site Design to increase tree plantings near buildings, increase the percentage of trees used in parking areas, and along public ways.	Low	Planning / Conservation	Long Term 2019-2024	Low Estimated costs less than \$10,000 and/or staff time	Staff time / Town general operating budget
Promote Green Building and Cool Roof designs.	Low	Building/Planning	Long Term 2019-2024	Low Estimated costs less than \$10,000 and/or staff time	Staff time / Town general operating budget
Assess placement of cooling centers at schools, senior center and emergency shelters.	Low	Fire/HMPT	Short Term 2019-2020	Low Estimated costs less than \$10,000 and/or staff time	Staff time / Town general operating budget
<b>DROUGHT</b>					
Promote drought tolerant landscaping, Green Infrastructure, and site design measures.	Medium	Planning / Conservation	Long Term 2019-2024	Low Estimated costs less than \$10,000 and/or staff time	Staff time / Town general operating budget
<b>CLIMATE RESILIENCE / ADAPTATION</b>					

<b>Table 30 – Potential Mitigation Measures</b>					
<b>Mitigation Measure</b>	<b>Priority</b>	<b>Lead Implementation</b>	<b>Time Frame</b>	<b>Estimated Cost</b>	<b>Potential Funding Sources</b>
Incorporate climate resilience/adaptation components into community planning updates including master plan, open space and master planning.	High	HMPT/Planning/ Conservation/ Public Works/ Public Health	Long Term 2019- 2024	Medium Estimated costs between \$10,000 to \$100,000	Town general operating funds / Staff time

## **IX. PLAN ADOPTION AND MAINTENANCE**

### **Plan Adoption**

The Hamilton Hazard Mitigation Plan 2019 Update was adopted by the Board of Selectmen on [ADD DATE]. See Appendix D for documentation. The plan was approved by FEMA on [ADD DATE] for a five-year period that will expire on [ADD DATE]. – To be completed following MEMA and FEMA review.

### **Plan Maintenance**

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

MAPC worked with the Hamilton Hazard Mitigation Planning Team to prepare this plan. After approval of the plan by FEMA, this group will meet on a regular basis, at least annually, 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 Director of Public Works, will have primary responsibility for tracking progress and updating the plan.

Begin to prepare for the next Plan Update -- 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. The 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 – 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. 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 Hamilton 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 Hamilton Hazard Mitigation Plan 2017 Update by FEMA, the Local Hazard Mitigation Team coordinator 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. The plan will be reviewed and discussed with the following departments during the first six (6) months following plan adoption. During updates of any town department’s plans or policies, the relevant portions of this mitigation strategy will be incorporated.

- Fire Department
- Emergency Management
- Police Department

- Public Works Department
- Engineering
- Planning Board/Planning and Community Development
- Conservation Commission
- Parks and Recreation
- Public Health
- Building

Other groups that will be coordinated with include large institutions, Chambers of Commerce, land conservation organizations and watershed groups. The plans will also be posted on a community's website with the caveat that 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 Hamilton Master Plan, Open Space Plan, Comprehensive Emergency Management Plan, and Capital Investment Program. The Hazard Mitigation Plan will serve to provide baseline information for the Town's Municipal Vulnerability Preparedness workshop later in 2019 to help establish climate resilience actions for the Town.



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## X. LIST OF REFERENCES

*Hamilton Comprehensive Emergency Management Plan, 2017*

*Open Space and Recreation Plan for the Town of Hamilton,*  
Hamilton Conservation Commission, 2015

Hamilton Town By-Laws

[https://www.hamiltonma.gov/wp-content/uploads/2019/01/2019\\_Bylaw-Update\\_STM-10-13-2018-.pdf](https://www.hamiltonma.gov/wp-content/uploads/2019/01/2019_Bylaw-Update_STM-10-13-2018-.pdf)

Hamilton Zoning By-Law

<https://www.hamiltonma.gov/government/planning-board/zoning-by-laws-6/>

Hamilton Subdivision Regulations

<https://www.hamiltonma.gov/government/planning-board/subdivision-regulations/>

*(Ipswich Basin Water Management Act Planning Grant, FY17-BWR2017-08, Final Report,*  
Kleinfelder, 2017)

Environment 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 Essex County, MA*, 2012

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

MA Emergency Management Agency, *State Hazard Mitigation Plan*, 2018

<https://www.mass.gov/service-details/massachusetts-integrated-state-hazard-mitigation-and-climate-adaptation-plan>

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 Climatic Data Center, <https://www.ncdc.noaa.gov/stormevents/>

U. S. Census, 2010, and American Community Survey, 2015

USGS, National Water Information Center, <https://waterdata.usgs.gov/nwis>



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## **APPENDIX A**

### **HAZARD MITIGATION PLANNING TEAM MEETING AGENDAS**

**Meeting Agenda  
Local Natural Hazard Mitigation Plan  
Town of Hamilton  
Fire Station**

**February 12, 2019, 10:00 AM – 11:30 AM**

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**Local Team Meeting (Information Gathering)**

- a) Hazard Mitigation Planning Map Series and Digitized Ortho Photo Map
- b) Review 2011 mitigation actions
- c) Identify Critical Facilities
- d) Identify local hazards:
  - i) Flood and Coastal Hazard Areas
  - ii) Fire Hazard Areas (brushfires/wildfires)
  - iii) Dams
  - iv) Ice jams
  - v) Thunderstorms
  - vi) Drought
  - vii) Extreme Temps
  - viii) Tornadoes
  - ix) High winds
  - x) Snow and Blizzards
  - xi) Ice storms
  - xii) Earthquakes
  - xiii) Landslides
  - xiv) Future Potential Development Areas
- e) Review Plan Goals and Objectives- see over
- f) Discuss Public Involvement and Outreach
  - i) Identify local stakeholders
  - ii) Schedule first public meeting
- g) Identify draft priority projects and funding for update

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**Project Overview** MAPC is working with Hamilton to update its plan to mitigate potential damages of natural hazards such as floods, winter storms, hurricanes, earthquakes and wild fires, before such hazards occur. The federal *Disaster Mitigation Act of 2000* requires that all municipalities adopt a *Pre-Disaster Mitigation Plan* for natural hazards in order to remain eligible for FEMA Disaster Mitigation Grants.

This FEMA planning program is separate from ongoing homeland security initiatives, and is focused solely on addressing natural hazards, although some of the data collected for this plan may be useful for other aspects of emergency planning as well.

**Recommended goals to align with State 2011 Plan and FEMA Guidelines:**

1. Prevent and reduce the loss of life, injury, public health impacts and property damages resulting from all identified natural hazards.
2. Build and enhance local mitigation capabilities to ensure individual safety, reduce damage to public and private property and ensure continuity of emergency services.
3. Increase cooperation and coordination among private entities, Town officials and Boards, State agencies and Federal agencies.
4. Increase awareness of the benefits of hazard mitigation through outreach and education.



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HAMILTON, MA

2019 APR 18 AM 8:16

**Hamilton Planning Board – Agenda (2<sup>nd</sup> REVISION)**

Tuesday 7:00 PM – April 23, 2019

Memorial Room – Town Hall - 577 Bay Road, Hamilton, MA 01982

1. **CONTINUED PUBLIC HEARING - Medical Marijuana Facility Site Plan Review** - the Hamilton Planning Board began two related public hearings concurrently for a Site Plan Review application and a Stormwater Management Special Permit application from the Green Meadow Farm, LLC, Hamilton, MA. The proposals are for a Medical Marijuana Cultivation and Processing Facility to be located at the Green Meadows Farm. The location is at 654 Asbury Street and also known as Assessors Map 19, Lot 4 and is zoned RA. The Applicant proposes to construct and operate a medical marijuana cultivation and production facility in a proposed 65,800 square foot building with appropriate site improvements to accommodate the use. The Site Plan Review will be in accordance with Section 10.6 of the Hamilton Zoning By-Law and will also include additional Host Community Agreement (HCA) conditions as previously approved by the Hamilton Board of Selectmen on August 20, 2018 for the facility. The hearing and review also includes a Special Permit application to the Hamilton Planning Board in accordance with the Town of Hamilton General By-Law Ch. XXIX, Stormwater Management. **(PREVIOUSLY CONTINUED)**.
2. **ABBREVIATED STORMWATER MANAGEMENT PERMIT** On April 23, 2019 at 7:00pm in the Hamilton Town Hall Memorial Room – 577 Bay Road, the Hamilton Planning Board will review and potentially vote upon a Stormwater Management Special Permit application from Franz and Anne Colloredo-Mansfeld (owners) in accordance with Town of Hamilton Stormwater Management Permit Rules and Regulations of August 2010 (General By-Law Ch. XXIX). The proposal is for 47 Winthrop Street also known as Assessors Map 6, Lot 3. The property is within the RA Zoning District.
3. **MASTER PLANNING –RESIDENTIAL FORUM PREPARATION** - The Board will discuss project status and public forum preparation for the upcoming April 29, 2019 event which will be held at the Hamilton-Wenham Library at 7:00pm in the main meeting room.
4. **MAPC NATURAL HAZARD MITIGATION PLAN PRESENTATION** – The Board is to hear a presentation from Sam Cleaves, MAPC Program Manager.
5. **REVIEW / SIGN DECISION** – Board to review and sign a Definitive Subdivision Decision for an Application submitted by Nazir Shamsuddin. Hearing was closed April 2, 2019.
6. **Board Business** - Upcoming filings; Meeting Minutes; Etc.

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Upcoming Board Meetings: Apr 29, 2019 (Master Plan Forum); May 7, 2019; May 21, 2019;



### **Hamilton Planning Board – Agenda**

Tuesday 7:00 PM – July 23, 2019

Memorial Room – Town Hall - 577 Bay Road, Hamilton, MA 01982

1. **BOARD PRESENTATION AND DISCUSSION** – Board to hear a presentation from a Metropolitan Area Planning Council (MAPC) representative regarding preparation of a Hazard Mitigation Plan being prepared by MAPC on behalf of the Town.
2. **CONTINUED PUBLIC HEARING - Medical Marijuana Facility Site Plan Review** - the Hamilton Planning Board began two related public hearings concurrently for a Site Plan Review application and a Stormwater Management Special Permit application from the Green Meadows Farm, LLC, Hamilton, MA. The proposals are for a Medical Marijuana Cultivation and Processing Facility to be located at the Green Meadows Farm. The location is at 654 Asbury Street and also known as Assessors Map 19, Lot 4 and is zoned RA. The Applicant proposes to construct and operate a medical marijuana cultivation and production facility in a proposed 65,800 square foot building with appropriate site improvements to accommodate the use. The Site Plan Review will be in accordance with Section 10.6 of the Hamilton Zoning By-Law and will also include additional Host Community Agreement (HCA) conditions as previously approved by the Hamilton Board of Selectmen on August 20, 2018 for the facility. The hearing and review also includes a Special Permit application to the Hamilton Planning Board in accordance with the Town of Hamilton General By-Law Ch. XXIX, Stormwater Management. **(PREVIOUSLY CONTINUED)**.
3. **APPROVAL NOT REQUIRED (ANR)** – Robert Patton on behalf of the Patton Family Limited Partnership proposes to modify property lot lines on the parcel otherwise known as Hamilton Assessors Map 19 Lot 4. The property is the RA zoning district.
4. **MASTER PLANNING –RESIDENTIAL FORUM RECAP** - The Board will discuss master planning project status and public forum outcomes and next steps.
5. **BOARD BUSINESS** - Meeting Minutes; Committee reports; Future agenda items; Etc.

**Upcoming Board Meetings:** August 6, 2019; August 20, 2019; September 10, 2019; September 24, 2019.

**NOTE:** Items may be heard out of the listed order. The agenda items listed are those items which were reasonably anticipated by the Chair to be discussed at the meeting. Not all items listed on the agenda may be discussed and other items not listed may also be brought up for discussion to the extent permitted by law.



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## APPENDIX B HAZARD MAPPING

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

The map series consists of eight maps as described below. The maps in this appendix are necessarily reduced scale versions for general reference. Full sized higher resolution PDF's of the maps can be downloaded from: <https://mapc-org.sharefile.com/d-s67316042bae47d48>

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

**Map 1: Population Density** – This map uses the US Census block data for 2010 and shows population density as the number of people per acre in seven categories with 60 or more people per acre representing the highest density areas.

**Map 2: 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 Essex 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 Hamilton 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.

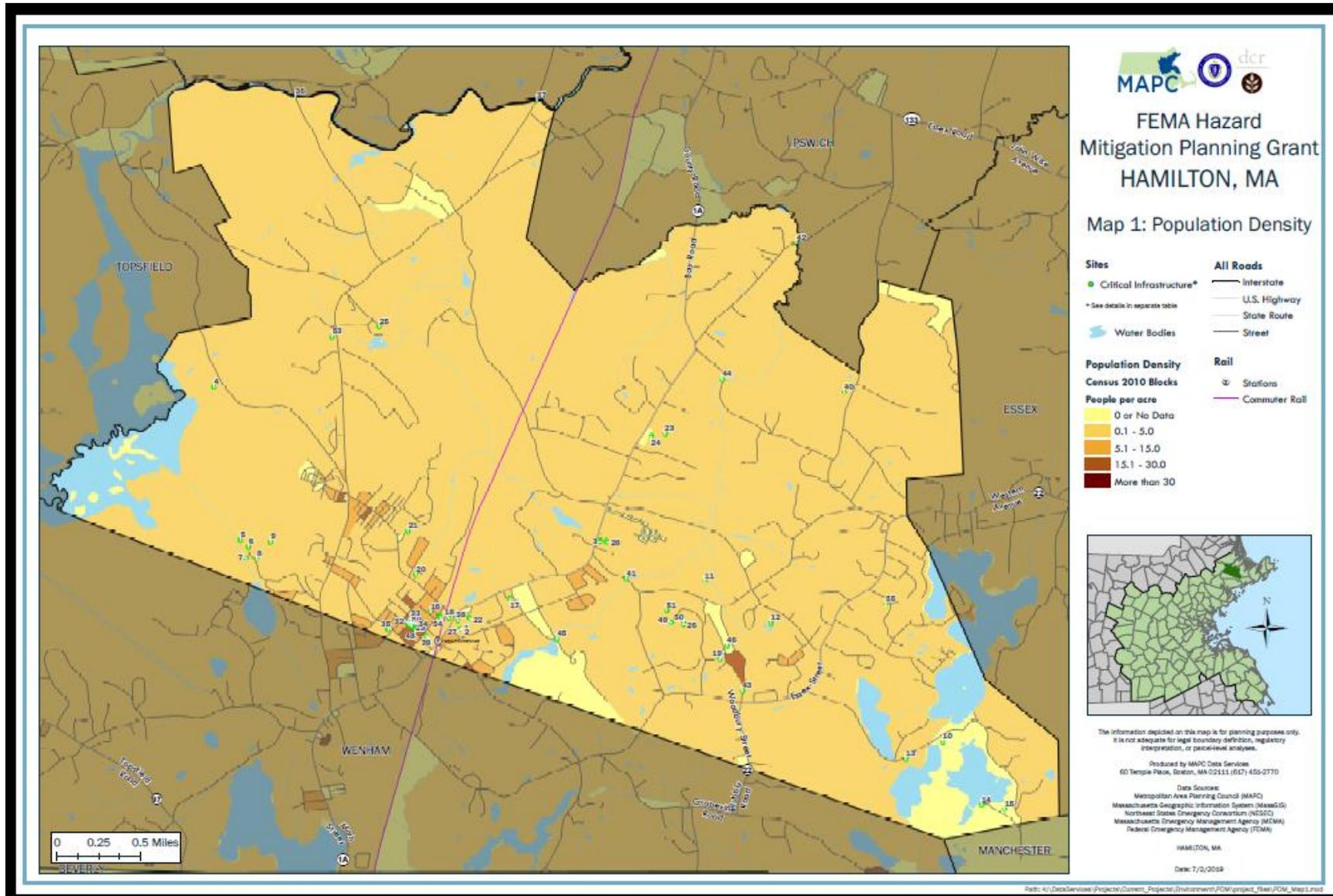
The landslide information shows areas with either a low susceptibility or a moderate susceptibility to landslides based on mapping of geological formations. This mapping is highly general in nature. For more information on how landslide susceptibility was mapped, refer to <http://pubs.usgs.gov/pp/p1183/pp1183.html>.

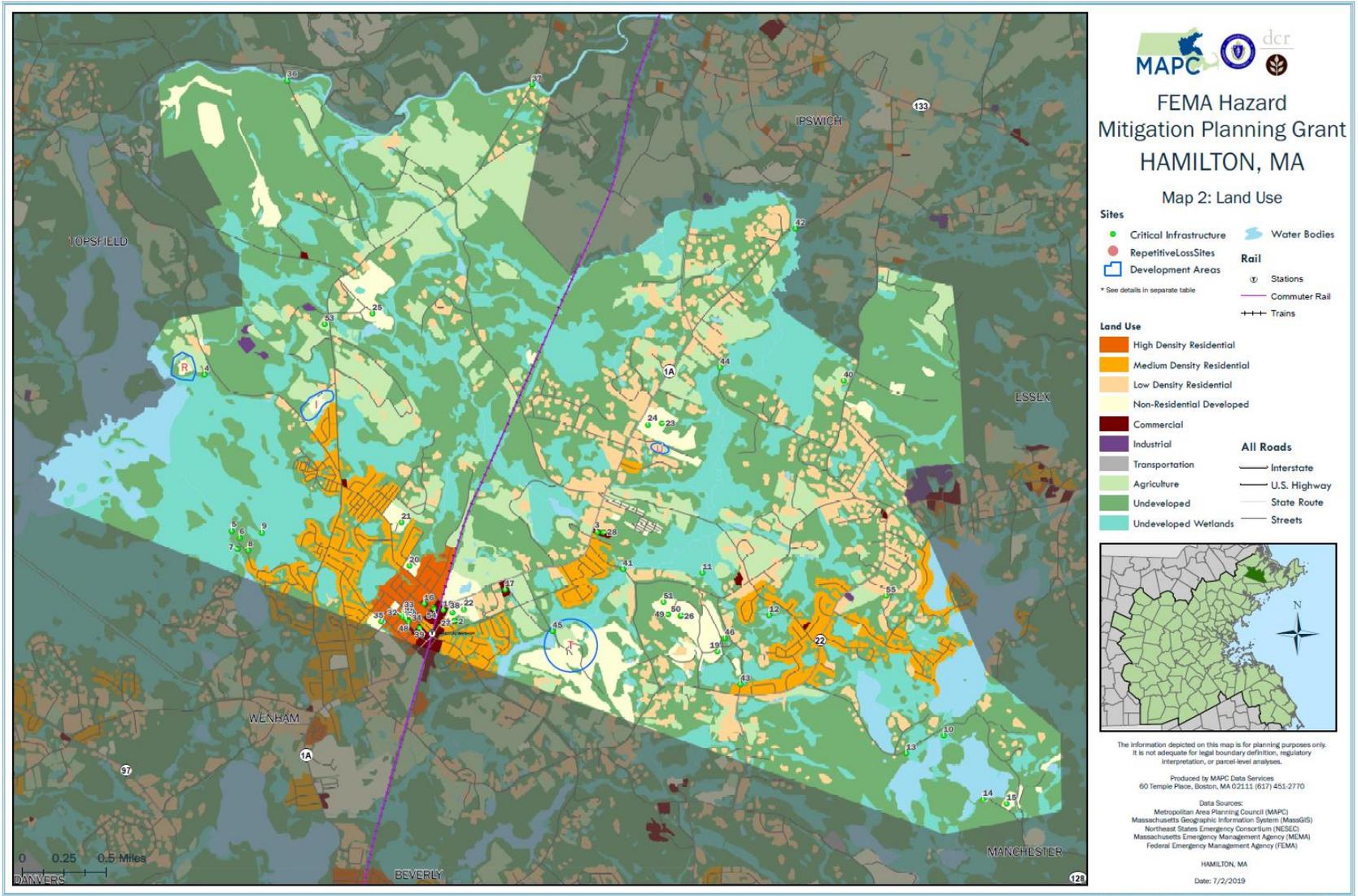
**Map 5: Hurricanes and Tornadoes** – This map shows a number of different items. The map includes the storm tracks for both hurricanes and tropical storms, if any occurred in this community. This information must be viewed in context. A storm track only shows where the eye of the storm passed through.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

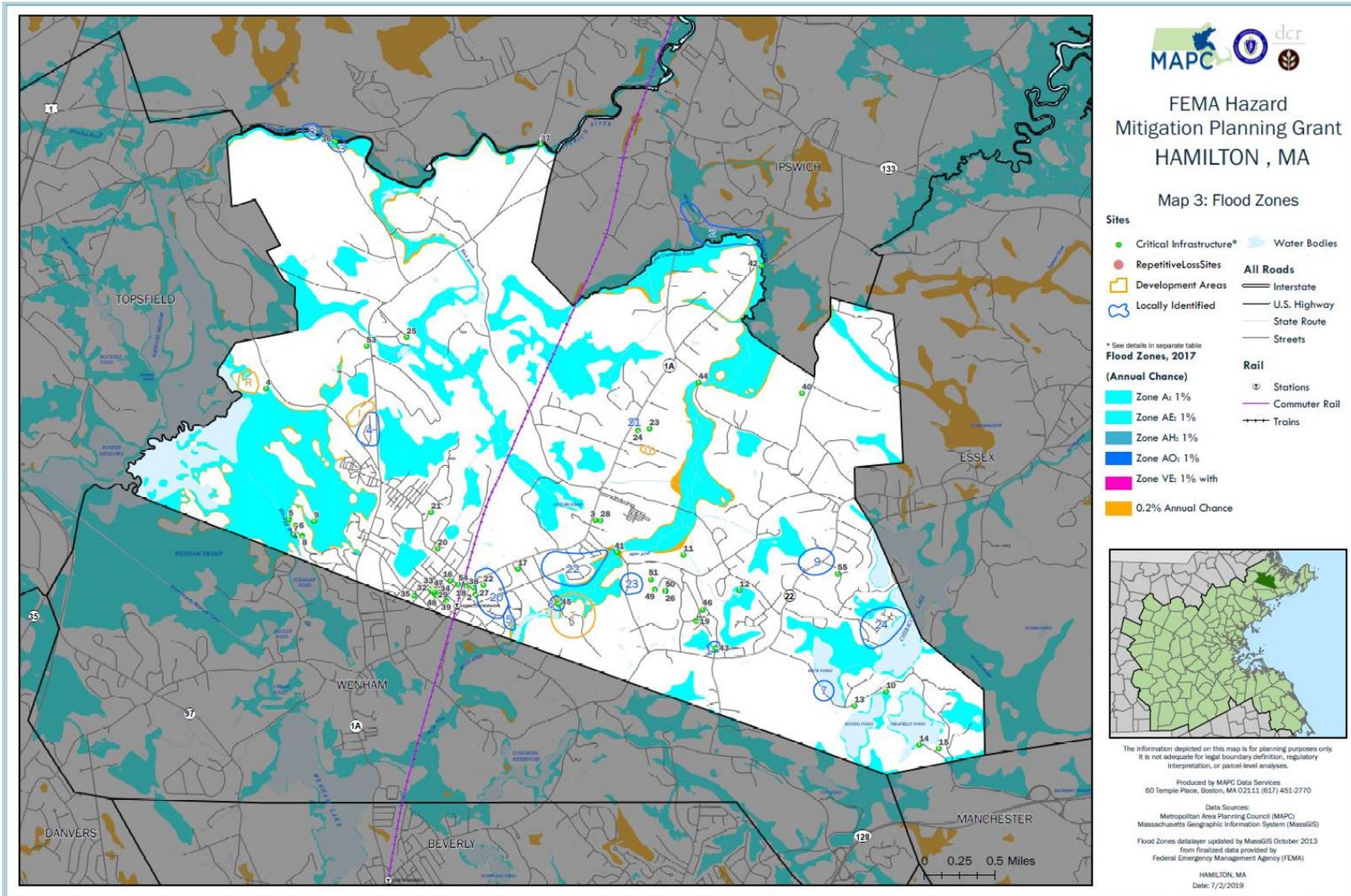
**Map 6: Average Snowfall** - - This map shows the average snowfall. It also shows storm tracks for nor'easters, if any storms tracked through the community.

**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.

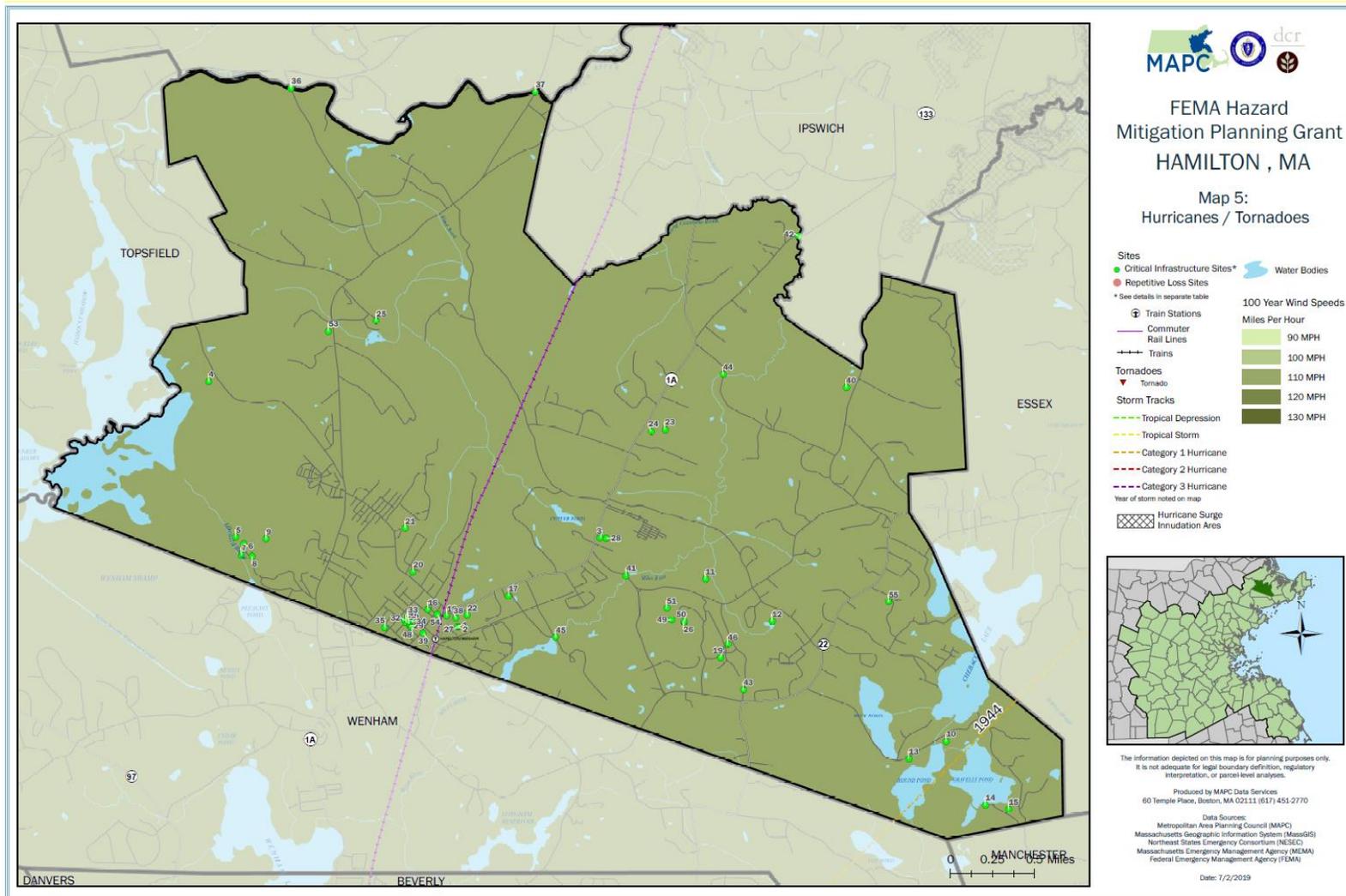
**Map 8: Hazard Areas** – For each community, locally identified hazard areas are overlaid on an aerial photograph dated April, 2010. The critical infrastructure sites are also shown. The source of the aerial photograph is Mass GIS.

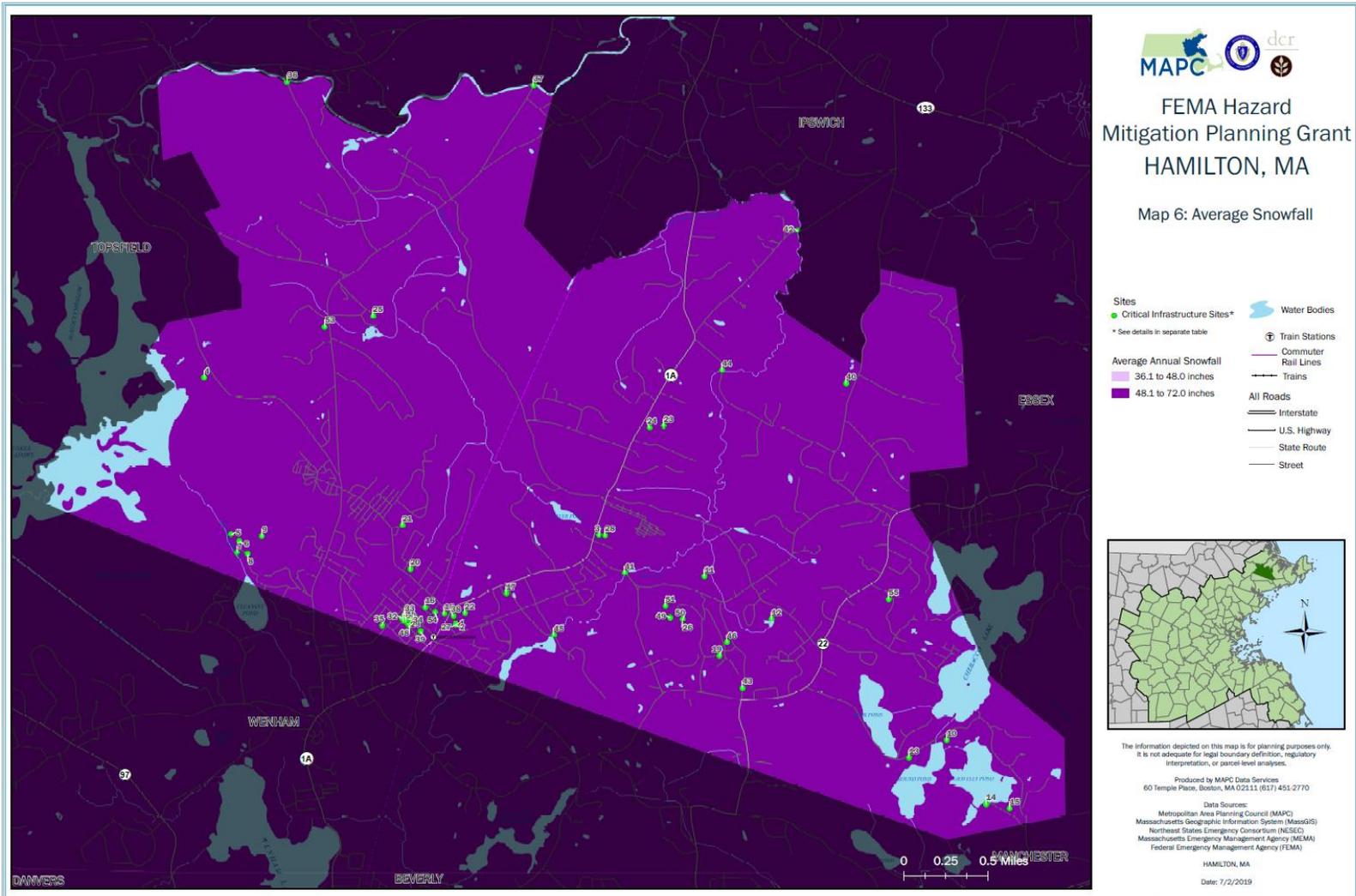


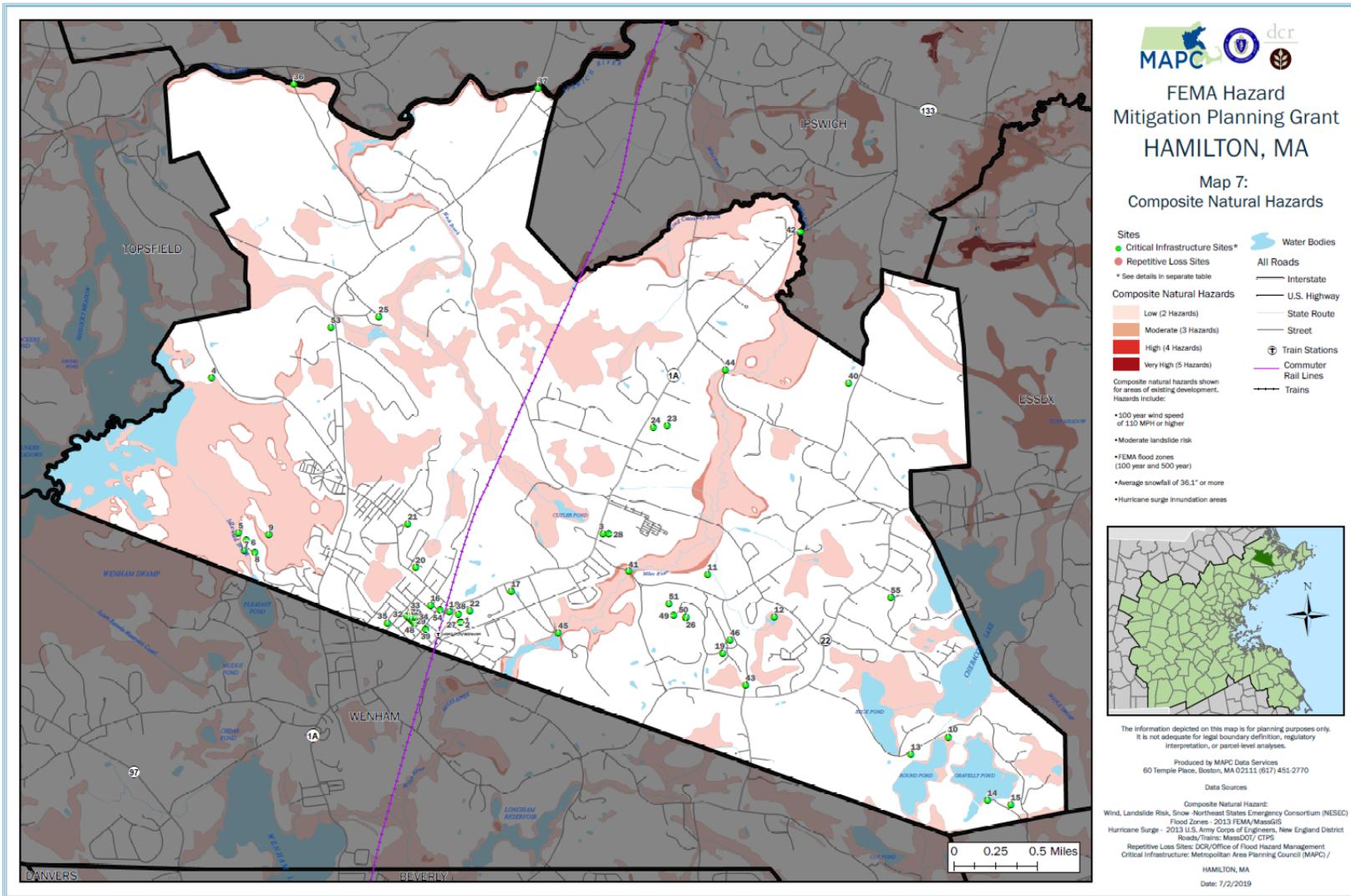


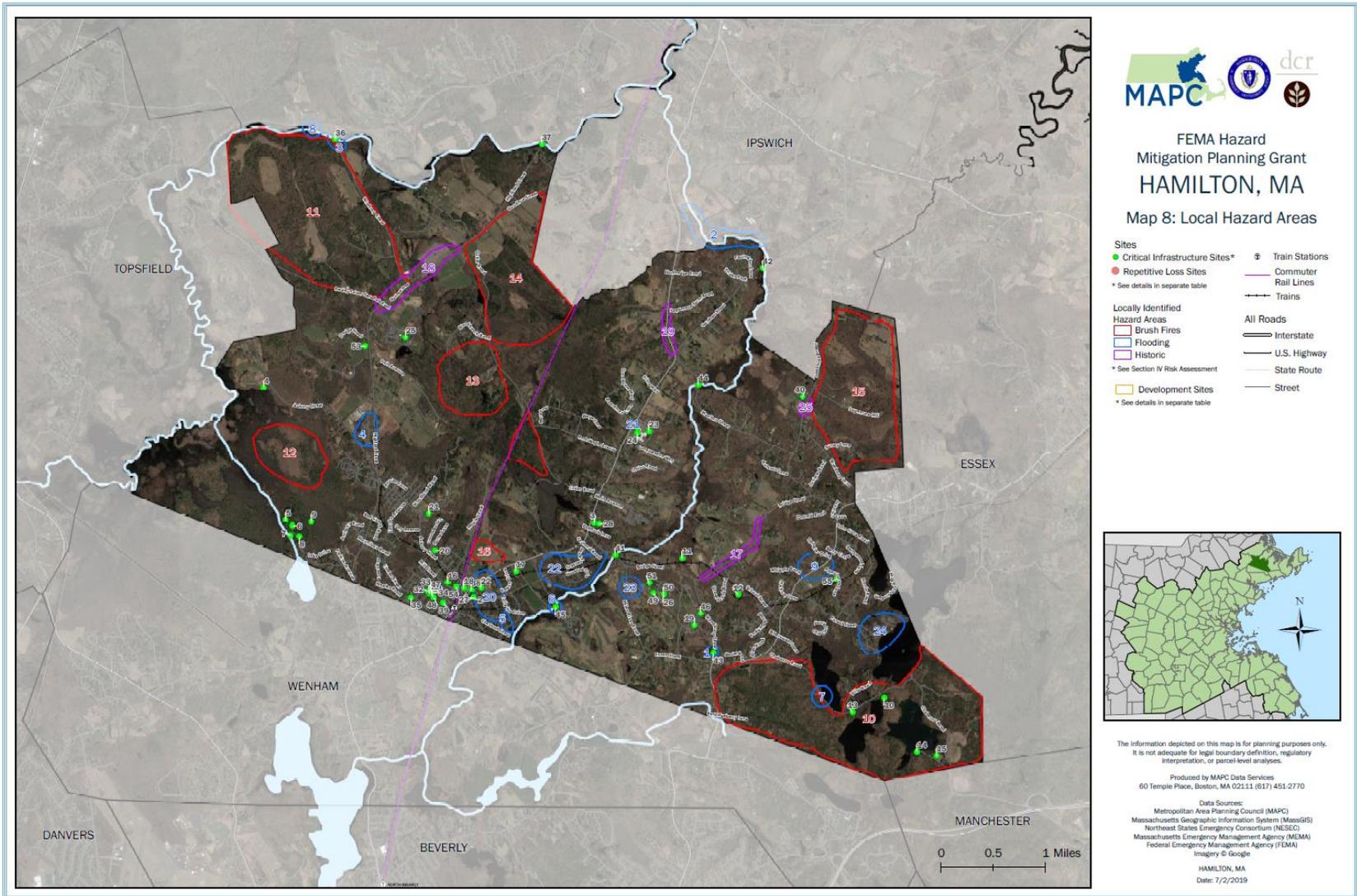














## APPENDIX C DOCUMENTATION OF PUBLIC PARTICIPATION

Amanda Linehan, Communications Manager, Metropolitan Area Planning Council  
617-933-0705, [alinehan@mapc.org](mailto:alinehan@mapc.org)

### CALENDAR LISTING / MEDIA ADVISORY

#### HAMILTON'S NATURAL HAZARDS PLAN UPDATE IS FOCUS OF APRIL 23 PUBLIC MEETING

*Meeting to present an overview of the update of Hamilton's Natural Hazards Mitigation Plan and solicit public comments*

**Who:** Hamilton 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 Hamilton Emergency Management Team (EMT) will hold a public meeting to present an overview of the pending update of the Town of Hamilton's Natural Hazards Mitigation Plan. 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 Hamilton adopted its first Hazard Mitigation Plan in 2011, which was approved by the Federal Emergency Management Agency (FEMA). The plan identifies natural hazards affecting Hamilton 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 an updated plan.

**When:** APRIL 23, 2019, 7:00 PM

**Where:** Hamilton Town Hall, 577 Bay Road

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](http://www.mapc.org).

Amanda Linehan, Communications Manager, Metropolitan Area Planning Council  
617-933-0705, [alinehan@mapc.org](mailto:alinehan@mapc.org)



## CALENDAR LISTING / MEDIA ADVISORY

### HAMILTON'S DRAFT HAZARD MITIGATION PLAN TO BE PRESENTED AT JULY 23 PUBLIC MEETING

*Meeting to present the update of Hamilton's Hazard Mitigation Plan and solicit public comments*

- Who:** Hamilton 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 Hamilton Conservation Commission and Emergency Management Team (EMT) will hold a public meeting to present an overview of the draft Hamilton Hazard Mitigation Plan Update. 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 Hamilton adopted its first Hazard Mitigation Plan in 2011, which was approved by the Federal Emergency Management Agency (FEMA). The plan identifies natural hazards affecting Hamilton 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 an updated plan.
- When:** July 23, 2019, 7:00 PM
- Where:** Hamilton Town Hall, 577 Bay Road, Hamilton, MA

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](http://www.mapc.org).



*Smart Growth & Regional Collaboration*

**What is the Hazard Mitigation Plan Update?**

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.

**Why is this plan important?**

The Federal Disaster Mitigation Act of 2000 requires that a city or town have an approved hazard mitigation plan in order to qualify for federal funding from the following grant programs:

- Pre-Disaster Mitigation Competitive (PDM-C)
- Hazard Mitigation Grant Program (HMGP)
- Flood Mitigation Assistance (FMA)

Additionally, the plan provides a municipality the opportunity to review potential vulnerabilities to natural hazards and develop measures that can reduce or mitigate these vulnerabilities and be included in the local planning process.

**What goes into a hazard mitigation plan?**

A hazard mitigation plan assesses the municipality's risks and vulnerabilities to natural hazard events such as flooding, hurricanes, winter storms, and earthquakes. MAPC uses statewide data and information directly from the community to make this assessment.

The plan includes a set of goals related to the overall goal of hazard mitigation planning, an assessment of existing mitigation measures, and a set of new mitigation measures that will serve to advance the plan goals. The plan update will also look at implementation progress that has been made on mitigation measures from the previous plan.

**What is the Local Hazard Mitigation Committee?**

The Local Hazard Mitigation Committee includes and coordinates with representatives from a number of different Town departments including Public Works, Engineering, Health, Community Development, Emergency Management and Fire. This committee provides the local on-the-ground knowledge necessary to write this plan including information on local hazard areas and current mitigation measures. This committee also identifies and prioritizes mitigation measures to be included in the plan.

**How can the public become involved in the Hazard Mitigation planning process?**

Public participation is very important to the hazard mitigation planning process. FEMA requires a minimum of two public meetings. When the first draft of the plan is developed, the Town will provide an online link where the plan can be viewed and comments may be provided by the public.

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Jay Ash, President • Michelle Ciccolo, Vice President • Marilyn Contreras, Secretary • Grace S. Shepard, Treasurer • Marc Driscoll, Executive Director

## APPENDIX D DOCUMENTATION OF PLAN ADOPTION

To be completed following MEMA and FEMA review



### CERTIFICATE OF ADOPTION BOARD OF SELECTMEN TOWN OF HAMILTON, MASSACHUSETTS

A RESOLUTION ADOPTING THE  
*TOWN OF HAMILTON HAZARD MITIGATION PLAN 2019 UPDATE*

WHEREAS, the Town of Hamilton established a Committee to prepare the *Town of Hamilton Hazard Mitigation Plan 2019 Update*; and

WHEREAS, the *Town of Hamilton Hazard Mitigation Plan 2019 Update* contains several potential future projects to mitigate potential impacts from natural hazards in the Town of Hamilton, and

WHEREAS, duly-noticed public meetings were held by the EMERGENCY MANAGEMENT TEAM AND PLANNING BOARD on April 23, 2019 and July 23, 2019

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

NOW, THEREFORE BE IT RESOLVED that the Town of Hamilton BOARD OF SELECTMEN adopts the *Town of Hamilton Hazard Mitigation Plan 2019 Update*, in accordance with M.G.L. 40 §4 or the charter and bylaws of the Town of Hamilton.

ADOPTED AND SIGNED this Date. \_\_\_\_\_

Name(s)

Title(s)

Signature(s)

ATTEST