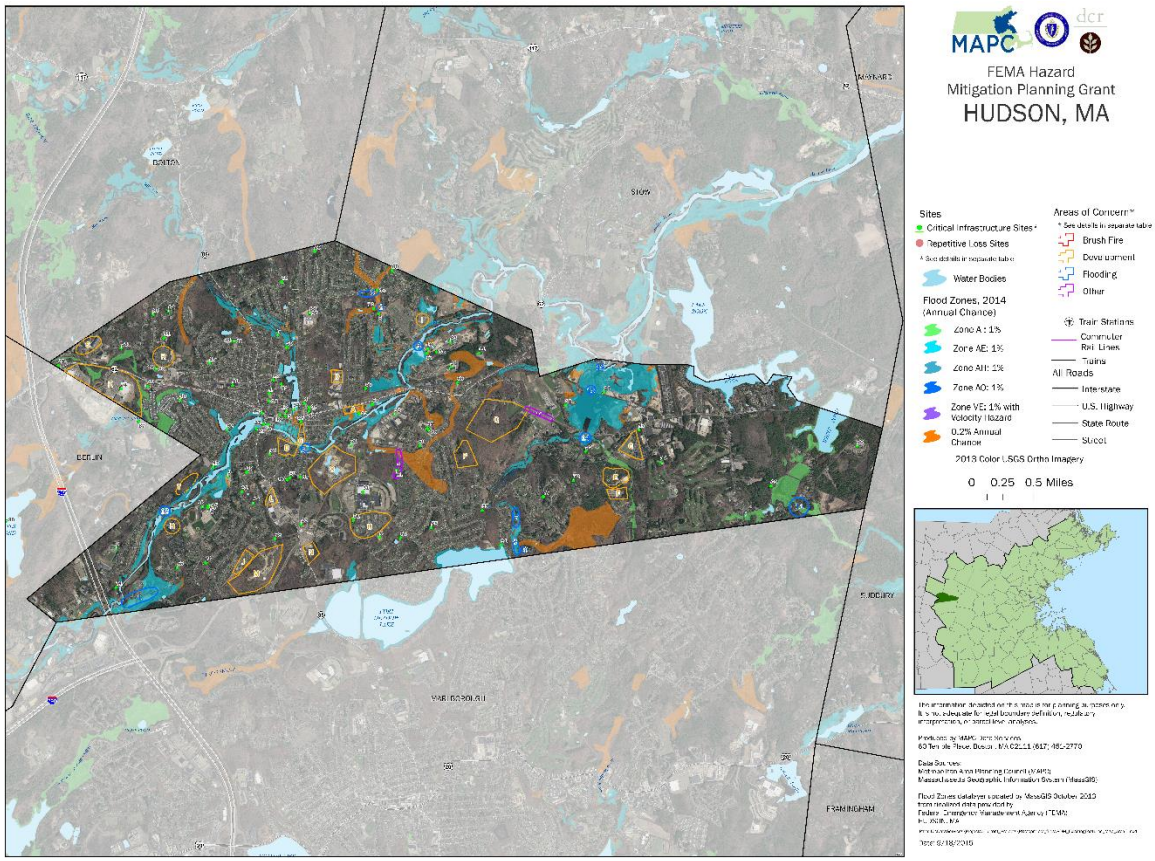
TOWN OF HUDSON
DRAFT HAZARD MITIGATION PLAN
2017 UPDATE



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

Plan Update
November 28, 2016

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ACKNOWLEDGEMENTS AND CREDITS

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

Planning Process

Planning for the Hazard Mitigation Plan update was led by the Hudson Local Hazard Mitigation Planning Team, composed of staff from a number of different Town Departments. This team met on August 7 and September 29, 2105 and April 20 and September 29, 2016 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 hosted two public meetings, the first with the Planning Board on December 15, 2015 and the second on November 18, 2016 with the Internal Traffic Committee. 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 Hudson Hazard Mitigation Plan assesses the potential impacts to the Town from flooding, high winds, winter storms, brush fire, geologic hazards, extreme temperatures, and drought. Flooding, driven by hurricanes, northeasters and other storms, clearly presents the greatest hazard to the Town. These are shown on the map series (Appendix B).

The Hudson Local Hazard Mitigation Planning Team identified 97 Critical Facilities. These are also shown on the map series and listed in Table 22, 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 ($13 million to $50) million as well as earthquakes of magnitudes 5 and 7 ($375 million to $2.6 billion). Flood damage estimates range from $2 million to $10 million.

Hazard Mitigation Goals

The Hudson Local Hazard Mitigation Planning Team identified the following hazard mitigation goals for the Town.

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

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

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

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

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

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

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

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

Hazard Mitigation Strategy

The Hudson Local Hazard Mitigation Planning Team identified a number of mitigation measures that would serve to reduce the Town's vulnerability to natural hazard events. These include measures to mitigate flooding, wind, winter hazards, earthquakes, extreme temperatures, drought, and climate change. These are described in Section VIII and summarized I Table 28.

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

Plan Review and Update Process

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

Table 1 Plan Review and Update Process

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 Emergency Management Team. 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 Hudson 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 2010 plan were reviewed and assessed as to whether they were completed, in-progress, or deferred. The Local Hazard Mitigation Planning Team determined whether to carry forward measures into this Plan Update or modify or delete them. The Plan Update's hazard mitigation strategy reflects both new measures and measures carried forward from the 2010 plan. The Local Hazard Mitigation Team prioritized all of these measures based on current conditions.
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, Hudson made some progress on implementing mitigation measures identified in the 2010 Hazard Mitigation Plan. A new combined Police Station and Public Works Facility is under construction, and new fire equipment upgrades for brushfires were completed. The town's Open Space Plan was just updated in 2016, and three new open space parcels have been acquired, totaling 43 acres.

Several mitigation measures that were not completed since the 2010 plan will be continued into this plan update, including: Setback Requirements for Fire Protection; Tree Maintenance Program Funding; Assessment of Potential Contamination and Solutions at Chestnut Street Wells #2 and #3; Culvert and Drainage Upgrades; Open Space Protection / Land Acquisition; and Update of FEMA Flood Maps. Several new measures have been added to address winter hazards, earthquakes, extreme temperatures, and drought.

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

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

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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).

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

What is a Hazard Mitigation Plan?

Natural hazard mitigation planning is the process of determining how to systematically reduce or eliminate the loss of life and property damage resulting from natural hazards such as floods, earthquakes, and hurricanes. Hazard mitigation means to permanently reduce or alleviate the losses of life, injuries, and property resulting from natural hazards through long-term strategies. These long-term strategies include planning, policy changes, programs, projects, and other activities.

Previous Federal/State Disasters

The Town of Hudson has experienced 17 natural hazards that triggered federal or state disaster declarations since 1991. These are listed in Table 2 below. The majority of these events involved flooding, while five were due to hurricanes or nor'easters, and four were due to severe winter weather.

Table 2 Previous Federal/State Disaster Declarations

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

DISASTER NAME (DATE OF EVENT)	TYPE OF ASSISTANCE	DECLARED AREAS
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

DISASTER NAME (DATE OF EVENT)	TYPE OF ASSISTANCE	DECLARED AREAS
Severe snowstorm and Flooding (February 8-09, 2013	FEMA Public Assistance; Hazard Mitigation Grant Program	Statewide
Blizzard of 2015 (January 26-28, 2015)	FEMA Public Assistance; Hazard Mitigation Grant Program	Statewide

Source: database provided by MEMA)

FEMA Funded Mitigation Projects

Town of Hudson has received funding from FEMA for one mitigation projects under the Hazard Mitigation Grant Program (HMGP). The project is summarized in Table 3 below.

Table 3 FEMA-Funded Mitigation Projects

Grant	Project Title	Scope of Work	Total Cost	Federal Funding	Local Funding
HMGP 18813-05	Brook St. Flood Mitigation and Drainage	18 catch basins and 8 manholes to increase drainage	$356,071	$267,053	$89,018

(Source: database provided by MEMA)

Community Profile

Hudson is located in Middlesex County in Eastern Massachusetts and is bordered by Berlin on the west, Bolton and Stow on the north, Sudbury on the east, and Marlborough on the south. Hudson is 18 miles northeast of Worcester and 28 miles west of Boston. Hudson is serviced by State Routes 62 and 85 and Interstate Route 495. Hudson has no freight or passenger rail service nor any regional bus service. The closest air facility to Hudson is the Minute Man Airport, a Reliever facility located in Stow, MA.

The town has a Town Meeting – Selectman form of government. The Selectmen are the Chief Elected Officials and primary policy makers for the Town of Hudson. They serve as appointing authority for the Executive Assistant who carries out the day-to-day governing functions of the town. The town operates under the open town meeting format.

The Town of Hudson was incorporated in 1866. At the time, the town was primarily agricultural. Hudson is a quiet community of hard-working citizens which offers the beauty of a semi-rural New England town as well as the convenience of a metropolitan suburb. Bisected by the Assabet River, Hudson also hosts numerous streams and two major lakes within its 11 square mile area. A combination of older affordable houses, condominiums and newer houses provide a variety of housing options for those wishing to settle in the area.

There are 9,884 workers employed in Hudson. Hudson is home to several working farms, as well as an economically well-developed community with a wide range of mature industry, including Intel Massachusetts. As Hudson is situated at the eastern-most terminus of Route 290, with two exits directly off Interstate 495, the town is accessible to the major cities in eastern Massachusetts and reflects the housing patterns of many of the communities along the Route 495 beltway.

The town is 11.87 square miles in area and in 2010 was home to about 19,063 persons, with around 7,000 housing units.

Public water supply and wastewater services are provided by the Hudson Department of Public Works. Water is withdrawn from local wells and a small reservoir in neighboring Belin, MA. Wastewater treated and discharged to the Assabet River.

Challenges facing Hudson when planning for natural disasters include:

- Nearly a quarter of the housing units are old (built before1940)
- Over a quarter of the housing units are renter-occupied
- 23% of households do not own a car, posing challenges for evacuations
- One in seven residents is over 65 years old
- Almost 8% have limited English skills
- The town is densely population near the town center

Table 4 - Hudson Characteristics

Population = 19,063

- 6.1% are under age 5
- 22.8% are under age 18
- 14.3% are over age 65
- 7.7% speak English less than "very well" (over age 5)
- .1% live in group quarters

Number of Housing Units = 7,998

- 27.6% are renter-occupied housing units
- 24.3% of housing units were built before 1940

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

The town's website is at http://www.Hudsonma.gov

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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 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 seven-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. By working on municipal hazard mitigation plans in groups of neighboring cities and towns, MAPC is able to identify regional opportunities for collaboration and facilitate communication between communities. In plan updates, the process described below allows staff to bring the most recent hazard information into the plan, including new hazard occurrence data, changes to a municipality's existing mitigation measures, and progress made on actions identified in previous plans.

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

- Assess the Risks & Potential Damages – Working with local staff, critical facilities, infrastructure, vulnerable populations, and other features are mapped and contrasted with the hazard data from the first step to identify those that might represent particular vulnerabilities to these hazards. Land use data and development trends are also incorporated into this analysis. In addition, MAPC develops estimates of the potential impacts of certain hazard events on the community. . MAPC drew on the following resources to complete the plan:

    - Town of Hudson, General Bylaws
    - Town of Hudson, Zoning Bylaw
    - Town of Hudson Comprehensive Plan, 2014
    - Town of Hudson Open Space Plan, 2016
    - Massachusetts State Hazard Mitigation Plan, 2013
    - FEMA, Local Mitigation Plan Review Guide; October 1, 2011
    - FEMA, Flood Insurance Rate Maps for Middlesex County, MA, 2014
    - Metropolitan Area Planning Council, GIS Lab, Regional Plans and Data.
    - New England Seismic Network, Boston College Weston Observatory,
    - 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

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

- Develop Mitigation Strategies – MAPC works with the local municipal staff to identify new mitigation measures, utilizing information gathered from the hazard identification, vulnerability assessments, and the community's existing mitigation efforts to determine where additional work is necessary to reduce the potential damages from hazard events. Additional information on the development of hazard mitigation strategies can be found in Chapter VII.

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

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

2010 Plan Implementation and Maintenance

The 2010 Town of Hudson Hazard Mitigation Plan contained a risk assessment of identified hazards for the Town and mitigation measures to address the risk and vulnerability from these hazards. Since approval of the plan by FEMA and local adoption, progress has been made on implementation of the measures. The Town has advanced several projects for implementation, including beginning construction on a new combined Police Department and Public Works facility, completion of a new Open Space plan and several open space purchases, and Fire Department equipment for brush fires.

The Local Multiple Hazard Community Planning Team

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

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

The Local Hazard Mitigation Planning Team met on: July 8 and September 29, 2015 and April 20 and September 29, 2016. The purpose of the first meeting was to introduce the Hazard Mitigation planning program, featuring a presentation by MEMA staff. The second meeting focused on gathering information updated critical facilities and local hazard mitigation issues and sites or areas related to these. The third meeting focused on verifying information gathered by MAPC staff and discussion of existing mitigation practices, the status of mitigation measures identified in the 2010 hazard mitigation plan. The fourth meeting focused on developing and prioritizing recommended mitigation measures for this Plan Update. The agendas for these meetings are included in Appendix A.

Table 5
Membership of the Hudson Hazard Mitigation Planning Team

Name	Representing
John Blood	Fire Chief
Pam Helinek	Conservation Agent/Planner
Jack Hunter	Planning and Economic Development Director
Eric Ryder	Dept. of Public Works Director
Sam Wong	Public and Community Health Services Director

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.

Hazard mitigation plans unfortunately often attract little public attentoin, 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 Hudson hazard mitigation planning process during a meeting of the Planning Board, on December 15, 2015 held in Town Hall. The draft plan update was presented at an Emergency Management Team meeting held on June 9, 2015 in Hudson Town Hall. Both meetings were publicized in accordance with the Massachusetts Public Meeting Law. The attendance list for each meeting can be found in Table 6. See public meeting notices in Appendix C.

Table 6 -- Hudson Public Meetings

Name	Representing
Meeting #1 December 15, 2015	
Tom Collins	Planning Board
David Daigneault	Planning Board
Bob D'Amelio	Planning Board
Rodney Frias	Planning Board
Jack Hunter	Planning Director
Kristina Johnson	Assistant Director
Teresa Vickery	Clerk
Meeting #2 November 18, 2016	
John Blood	Fire Chief
Michael Burks, Sr.	Police Chief
Kristina Johnson	Assistant Director
Eric Ryder	Public Works Director
Jeff Wood	Building Commissioner
Rachel Boulanger	Resident
Roland Boulanger	Resident

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:

Assabet Valley Chamber of Commerce
Hudson Historic District Commission
Hudson Senior Center
Intel Massachusetts
Hudson Business Association
Hudson National Guard Armory
United States Arm Garrison
Hudson Public Library

See Appendix C for public meeting notices.

Continuing Public Participation

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

Planning Timeline

August 7, 2015	Meeting of the Hudson Local Hazard Mitigation Planning Team
September 29, 2015	Meeting of the Hudson Local Hazard Mitigation Planning Team
December 15, 2015	First Public Meeting with Hudson Planning Board
April 20, 2016	Meeting of the Hudson Local Hazard Mitigation Planning Team
September 29, 2016	Meeting of the Hudson Local Hazard Mitigation Planning Team
November 18, 2016	Second Public Meeting with Hudson Internal Traffic Committee
Pending	Draft Plan Update submitted to MEMA

IV. RISK ASSESSMENT

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

Update Process

In order to update Hudson'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 7 below summarizes the hazard risks for Hudson. 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 Hudson using the definitions for hazard frequency and severity listed below. Based on this, the Town set an overall priority for each hazard.

Table 7 - Hazard Risks Summary

Hazard	Frequency		Severity	
	Massachusetts	Hudson	Massachusetts	Hudson
Flooding	High	High	Serious	Serious
Dam failures	Very Low	Very Low	Extensive	Serious
Coastal Hazards	High	N/A	Serious	N/A
Hurricane/Trop Storm	Medium	Medium	Serious	Serious
Tsunami	Very Low	N/A	Extensive	N/A
Tornadoes	Medium	Low	Serious	Serious
Thunderstorms	High	High	Minor	Minor
Nor'easter	High	High	Minor	Minor
Winter-Blizzard/Snow	High	High	Minor	Minor
Winter-Ice Storms	Medium	Medium	Minor	Minor
Earthquakes	Very Low	Very Low	Serious	Serious
Landslides	Low	Very Low	Minor	Minor
Brush fires	Medium	Medium	Minor	Minor
Extreme Temperatures	Medium	Medium	Minor	Minor
Drought	Low	Low	Minor	Minor

Source, Massachusetts State Hazard Mitigation Plan, 2013, modified for Hudson

Definitions used in the Commonwealth of Massachusetts State Hazard Mitigation Plan

Frequency

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

Severity

Minor: Limited and scattered property damage; limited damage to public infrastructure and essential services not interrupted; limited injuries or fatalities.
Serious: Scattered major property damage; some minor infrastructure damage; essential services are briefly interrupted; some injuries and/or fatalities.
Extensive: Widespread major property damage; major public infrastructure damage (up to several days for repairs); essential services are interrupted from several hours to several days; many injuries and/or fatalities.
Catastrophic: Property and public infrastructure destroyed; essential services stopped; numerous injuries and fatalities.

Flood Related Hazards

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

Local data for previous flooding occurrences are not collected by the Town of Hudson. The best available local data is for Middlesex County through the National Climatic Data

Center (see Table 8). Middlesex County, which includes the Town of Hudson, experienced 60 flood events from 1996 –2016. No deaths or injuries were reported and the total reported property damage in the county was $40.9 million dollars. Of that total, $35.2 million is attributed to the two major events of March 2010.

Table 8 Middlesex County Flood Events, 1996-2014

Date	Type	Deaths	Injuries	Property Damage
1/29/1996	Flood	0	0	0
4/17/1996	Flood	0	0	0
9/18/1996	Flood	0	0	0
10/21/1996	Flood	0	0	0
10/22/1996	Flood	0	0	0
3/10/1998	Flood	0	0	0
3/11/1998	Flood	0	0	0
5/12/1998	Flood	0	0	0
6/14/1998	Flood	0	0	0
6/15/1998	Flood	0	0	0
6/17/1998	Flood	0	0	0
4/22/2000	Flood	0	0	0
4/23/2000	Flood	0	0	0
3/22/2001	Flood	0	0	0
3/23/2001	Flood	0	0	0
3/31/2001	Flood	0	0	0
4/1/2001	Flood	0	0	0
4/2/2004	Flood	0	0	0
4/15/2004	Flood	0	0	0
3/29/2005	Flood	0	0	0
10/15/2005	Flood	0	0	100000
10/15/2005	Flood	0	0	100000
10/15/2005	Flood	0	0	125000
5/13/2006	Flood	0	0	5000000
7/11/2006	Flood	0	0	2000
10/28/2006	Flood	0	0	5000
4/16/2007	Flood	0	0	25000
2/13/2008	Flood	0	0	0
5/27/2008	Flood	0	0	3000
6/24/2008	Flood	0	0	10000
6/29/2008	Flood	0	0	5000
8/10/2008	Flood	0	0	15000
8/10/2008	Flood	0	0	40000
9/6/2008	Flood	0	0	15000
12/12/2008	Flood	0	0	20000
3/14/2010	Flood	0	0	26430000
3/29/2010	Flood	0	0	8810000
4/1/2010	Flood	0	0	0
8/28/2011	Flood	0	0	5000
10/14/2011	Flood	0	0	0
6/8/2012	Flood	0	0	0
6/23/2012	Flood	0	0	15000
7/18/2012	Flood	0	0	5000
10/29/2012	Flood	0	0	0
6/7/2013	Flood	0	0	0
7/1/2013	Flood	0	0	0
7/23/2013	Flood	0	0	0

9/1/2013	Flood	0	0	10000
3/30/2014	Flood	0	0	35000
7/27/2014	Flood	0	0	0
8/31/2014	Flood	0	0	0
10/22/2014	Flood	0	0	20000
10/23/2014	Flood	0	0	0
12/9/2014	Flood	0	0	5000
12/9/2014	Flood	0	0	30000
5/31/2015	Flood	0	0	0
8/4/2015	Flood	0	0	0
8/15/2015	Flood	0	0	50000
8/15/2015	Flood	0	0	75000
9/30/2015	Flood	0	0	0

Source: NOAA, National Climatic Data Center

Overview of Town-Wide Flooding

All of Hudson drains to the Assabet River, which is part of the larger Concord-Assabet-Concord watershed, also known as the SuAsCo watershed. Several miles downstream from Littleton, the Assabet River joins with the Sudbury River to form the Concord River. This flows from Concord, MA to Lowell, MA, where it joins the larger Merrimack River. In addition to the Assabet River, there are several lakes and reservoirs ponds in Hudson, including Lake Boon, Whites Pond, and Fort Meadow Reservoir. The town's man-made drainage system collects storm water throughout town and outfalls into either the Assabet River or its tributaries.

Flooding in the Town of Hudson is primarily a result of precipitation and storm water run-off overwhelming the capacity of natural and structured drainage systems to convey water, causing it to overflow the system. Flooding in Hudson is caused by precipitation associated with severe rainstorms, thunderstorms, Nor'easters, and hurricanes.

Potential Flood Hazard Areas

Information on potential flood hazard areas was taken from two sources. The first was the National Flood Insurance Rate Maps. The FIRM flood zones are shown on Map 3 in Appendix B and their definitions are listed below. Mapped flood plains are located along the Assabet River, Danforth, Fort Meadow and Hog Brooks and their associated wetlands.

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

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.

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

Brigham Street (1) – Flooding these are from 2010, matches data except the yellow
This location has experienced flooding, mostly due to its location within the Assabet River floodplain.

Cox Street (2) – Flooding due to beaver activity
This site has experienced flooding due to beaver activity, and it is also located within a floodplain area.

Avon Drive (3) – Flooding
Flooding at this location has resulted in some flooding in back yards.

Cox Street (4) – Flooding
Flooding has historically occurred at Cox Street where it crosses the Assabet River. This site is located within the floodplain of the Assabet River.

Broad Street (5) – Flooding
Flooding has occurred at Manning Street where it crosses the Assabet River. This site is located within the floodplain of the river.

Lower Road (7) – Flooding due to beaver activity
This site has experienced flooding due to beaver activity, and it is also located within the floodplain area of Fort Meadow Brook.

Causeway Street (8) – Flooding due to beaver activity
This site has experienced flooding due to beaver activity, and it is also located within the floodplain area of Fort Meadow Brook. The town has replaced the culvert underneath Causeway Street.

Causeway Street (9) – Flooding
This site has experienced some minor flooding, mostly due to its proximity to Fort Meadow Brook and surrounding low-lying wetland areas.

Chestnut Street Well #2 (10) – Flooding due to beaver activity
Beaver activity has caused flooding near the town's Chestnut Street Well #2. This site is also located within a wetland and floodplain area. Flooding of the wells has the potential to cause contamination.

White Pond Road (11) – Flooding due to beaver activity
This site has experienced localized flooding due to beaver activity.

Chapin Road (13) – Flooding
Flooding has occurred at Chapin Road where it crosses the Assabet River. This site is located within the floodplain of the river.

Main Street (14) – Flooding due to beaver activity
This site has experienced flooding where Main Street crosses Fort Meadow Brook due to beaver activity, and it is also located within the floodplain area of Fort Meadow Brook.

Chestnut Street Well #3 (15) – Flooding due to beaver activity
Beaver activity has caused flooding near the town's Chestnut Street Well #3. This site is also located within a wetland and floodplain area. Flooding of the wells has the potential to cause contamination.

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 no repetitive loss structures in Hudson.

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

Dams and Dam Failure

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

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

According to data provided by the Massachusetts Department of Conservation and Recreation and the town, there are three dams located in Hudson

- Washington Street Dam on the Assabet River, owned by Hudson Power and Light
- Main Street Dam on Danforth Brook at Bruces Pond, privately owned by a lumber company
- Tripps Pond Dam on the Assabet River at Tripps Pond on Rivers Street, owned by the Town of Hudson. This pond level is low and this dam is a low hazard.

Another dam in the town, not provided in the DCR database includes:

- Fort Meadow Brook Dam, located at the Fort Meadow Reservoir and Fort Meadow Brook at Lake Shore Drive.

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.

Based on the record of previous occurrences dam failure in Hudson is a Very Low frequency event as defined by the 2013 Massachusetts State Hazard Mitigation Plan. This hazard may occur less frequently than once in 100 years (less than 1% chance per year).

Wind Related Hazards

Wind-related hazards include hurricanes, tropical storms, and tornadoes as well as high winds during Nor'easters and thunderstorms. As with many communities, falling trees that result in downed power lines and power outages are an issue in Hudson. 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.

As shown in Map 5 in Appendix B, the following storms tracked through Hudson:

- Category 1 Hurricane in 1858
- Tropical Storms in 1897 and1996

In addition,, Hudson 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 Hudson is 110 miles per hour (see Appendix B).

Table 9 Hurricane Records for Massachusetts, 1938 - 2016

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 Hudson. Potential hurricane damages to Hudson have been estimated

using HAZUS-MH. Total damages are estimated at $51.1 million for a Category 2 hurricane and $208.9 Million for a Category 4 hurricane. Other potential impacts are detailed in Table 23.

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

Tornados

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

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

Tornado damage severity is measured by the Fujita Tornado Scale, in which wind speed is not measured directly but rather estimated from the amount of damage. As of February 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, 2013

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

The most recent tornado events in Massachusetts were in Springfield in 2011 and in Revere in 2014. The Springfield tornado caused significant damage and resulted in 4 deaths in June of 2011. The Revere tornado touched down at 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 Hudson, since 1956 there have been 10 tornadoes in surrounding Middlesex County recorded by the Tornado History Project. One of these was an F2 tornado, and three were FI. These 10 tornadoes resulted in a total of one fatality and six injuries and up to $3.6 million in damages, as summarized in Table 10.

Table 10 - Tornado Records for Middlesex County

Date	Fujita	Fatalities	Injuries	Width	Length	Damage
10/24/1955	1	0	0	10	0.1	$500-$5000
6/19/1957	1	0	0	17	1	$5K-$50K
6/19/1957	1	0	0	100	0.5	$50-$500
7/11/1958	2	0	0	17	1.5	$50K-$500K
8/25/1958	2	0	0	50	1	$500-$5000
7/3/1961	0	0	0	10	0.5	$5K-$50K
7/18/1963	1	0	0	50	1	$5K-$50K
8/28/1965	2	0	0	10	2	$50K-$500K
7/11/1970	1	0	0	50	0.1	$5K-$50K
10/3/1970	3	1	0	60	35.4	$50K-$500K
7/1/1971	1	0	1	10	25.2	$5K-$50K
11/7/1971	1	0	0	10	0.1	$50-$500
7/21/1972	2	0	4	37	7.6	$500K-$5M
9/29/1974	3	0	1	33	0.1	$50K-$500K
7/18/1983	0	0	0	20	0.4	$50-$500
9/27/1985	1	0	0	40	0.1	$50-$500
8/7/1986	1	0	0	73	4	$50K-$500K

Source: The Tornado History Project

Buildings constructed prior to current building codes may be more vulnerable to damages caused by tornadoes. Evacuation of impacted areas may be required on short notice. Sheltering and mass feeding efforts may be required along with debris clearance, search and rescue, and emergency fire and medical services. Key routes may be blocked by downed trees and other debris, and widespread power outages are also typically associated with tornadoes.

Although tornadoes are a potential town-wide hazard in Hudson, tornado impacts are relatively localized compared to severe storms and hurricanes. Damages from any tornado in Hudson would greatly depend on the track of the tornado. Generally the downtown area, along Main Street and Route 85 in the western part of the town, is 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 Hudson are a Medium frequency event as defined by the 2013 Massachusetts State Hazard Mitigation Plan. This hazard may occur from once in 5 years to once in 50 years, or a 2% to 20% chance per year.

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 which are listed in the Massachusetts State Hazard Mitigation Plan 2013:

February 1978	Blizzard of 1978
October 1991	Severe Coastal Storm ("Perfect Storm")
December 1992	Great Nor'easter of 1992
January 2005	Blizzard/ oreaster
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 2013	Februray 2013
Blizzard of 2015	January 2015

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

Hudson 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 Hudson 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 Hudson are high frequency events as defined by the 2013 Massachusetts State Hazard Mitigation Plan. This hazard may occur more frequently than once in 5 years (greater than 20% per year).

Severe Thunderstorms

While less severe than the other types of storms discussed, thunderstorms can lead to localized damage and represent a hazard risk for communities. A thunderstorm typically features lightning, strong winds, 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 best available data on previous occurrences of thunderstorms in Hudson is for Middlesex County through the National Climatic Data Center (NCDC). Between n the years 1995 and 2014 NCDC records show 24 thunderstorm events in Middlesex County (Table 11). These storms resulted in a total of $155,000 in property damages. There were no injuries or deaths reported.

Table 11 Middlesex County Thunderstorm Events, 2006-2016

Date	Type	Magnitude	Deaths	Injuries	Damage
4/1/2006	Thunderstorm Wind	50	0	0	8000
5/21/2006	Thunderstorm Wind	61	0	0	75000
5/21/2006	Thunderstorm Wind	61	0	0	20000
6/23/2006	Thunderstorm Wind	50	0	0	30000
7/11/2006	Thunderstorm Wind	50	0	0	10000
7/21/2006	Thunderstorm Wind	50	0	0	35000
7/28/2006	Thunderstorm Wind	50	0	0	15000
8/2/2006	Thunderstorm Wind	50	0	0	15000
5/16/2007	Thunderstorm Wind	50	0	0	0
6/27/2007	Thunderstorm Wind	50	0	0	0
7/6/2007	Thunderstorm Wind	50	0	0	0
7/9/2007	Thunderstorm Wind	50	0	0	0
7/15/2007	Thunderstorm Wind	50	0	0	0
7/28/2007	Thunderstorm Wind	50	0	0	0
7/29/2007	Thunderstorm Wind	50	0	0	0
8/17/2007	Thunderstorm Wind	50	0	0	0
9/8/2007	Thunderstorm Wind	50	0	0	25000
5/27/2008	Thunderstorm Wind	50	0	0	8000
6/10/2008	Thunderstorm Wind	50	0	0	20000
6/23/2008	Thunderstorm Wind	50	0	0	5000
6/24/2008	Thunderstorm Wind	50	0	0	5000
6/27/2008	Thunderstorm Wind	50	0	0	5000
6/29/2008	Thunderstorm Wind	50	0	0	10000
7/1/2008	Thunderstorm Wind	50	0	0	20000

7/2/2008	Thunderstorm Wind	50	0	0	5000
7/3/2008	Thunderstorm Wind	50	0	0	15000
7/19/2008	Thunderstorm Wind	50	0	0	8000
7/20/2008	Thunderstorm Wind	50	0	0	5000
7/27/2008	Thunderstorm Wind	50	0	0	5000
8/3/2008	Thunderstorm Wind	50	0	0	5000
8/7/2008	Thunderstorm Wind	50	0	0	5000
9/9/2008	Thunderstorm Wind	50	0	0	8000
5/9/2009	Thunderstorm Wind	50	0	0	2000
5/24/2009	Thunderstorm Wind	50	0	0	15000
7/7/2009	Thunderstorm Wind	50	0	0	1000
7/8/2009	Thunderstorm Wind	50	0	0	20000
7/26/2009	Thunderstorm Wind	50	0	0	15000
7/31/2009	Thunderstorm Wind	50	0	0	30000
5/4/2010	Thunderstorm Wind	50	0	0	30000
6/1/2010	Thunderstorm Wind	50	0	0	5000
6/3/2010	Thunderstorm Wind	50	0	0	20000
6/5/2010	Thunderstorm Wind	50	0	0	40000
6/6/2010	Thunderstorm Wind	50	0	0	100000
6/24/2010	Thunderstorm Wind	50	0	0	30000
7/12/2010	Thunderstorm Wind	50	0	0	50000
7/19/2010	Thunderstorm Wind	50	0	0	25000
6/1/2011	Thunderstorm Wind	50	0	0	5000
6/9/2011	Thunderstorm Wind	50	0	0	15000
8/2/2011	Thunderstorm Wind	50	0	0	1000
8/19/2011	Thunderstorm Wind	50	0	0	15000
6/8/2012	Thunderstorm Wind	50	0	0	25000
6/23/2012	Thunderstorm Wind	45	0	0	5000
7/4/2012	Thunderstorm Wind	50	0	0	10000
7/18/2012	Thunderstorm Wind	70	0	0	350000
9/7/2012	Thunderstorm Wind	50	0	0	10000
9/8/2012	Thunderstorm Wind	40	0	0	3000
6/17/2013	Thunderstorm Wind	50	0	0	25000
6/18/2013	Thunderstorm Wind	45	0	0	10000
6/24/2013	Thunderstorm Wind	45	0	0	3000
7/23/2013	Thunderstorm Wind	50	0	0	20000
7/29/2013	Thunderstorm Wind	50	0	0	5000
7/3/2014	Thunderstorm Wind	50	0	0	75000
7/7/2014	Thunderstorm Wind	87	0	0	100000
7/15/2014	Thunderstorm Wind	50	0	0	25000
7/28/2014	Thunderstorm Wind	50	0	0	50000
9/6/2014	Thunderstorm Wind	50	0	0	15000
5/28/2015	Thunderstorm Wind	45	0	0	5000

8/4/2015	Thunderstorm Wind	50	0	0	40000
8/15/2015	Thunderstorm Wind	50	0	0	25000
2/25/2016	Thunderstorm Wind	50	0	0	30000
3/17/2016	Thunderstorm Wind	45	0	0	5000

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

Severe thunderstorms are a town-wide hazard for Hudson. 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 Hudson are high frequency events as defined by the 2013 Massachusetts State Hazard Mitigation Plan. This hazard may occur more frequently than once in 5 years (greater than 20% per year).

Winter Storms

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

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 ¼ mile. These conditions must be the predominant condition over a 3 hour period. Extremely cold temperatures are often associated with blizzard conditions, but are not a formal part of the definition. The hazard created by the combination of snow, wind and low visibility significantly increases, however, with temperatures below 20 degrees.

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

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: Massachusetts State Hazard Mitigation Plan, 2013

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 Hudson 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 2013	February 2013
Blizzard of 2015	January 2015

Source: National Oceanic and Atmospheric Administration

The Town of Hudson does not keep local records of winter storms. Data for Middlesex County, which includes Hudson, is the best available data to help understand previous occurrences and impacts of heavy snow events. According to National Climate Data Center (NCDC) records, from 1996 to 2016 Middlesex County experienced 85 heavy snowfall events, resulting in no deaths, no injuries, and $4.5 million dollars in property damage. See Table 13 for and heavy snow events and impacts in Middlesex County.

Table 13 - Heavy Snow events and Impacts in Middlesex County 1996 –2016

Date	Type	Deaths	Injuries	Property Damage
1/2/1996	Heavy Snow	0	0	0
1/7/1996	Heavy Snow	0	0	1400000
1/7/1996	Heavy Snow	0	0	1500000
1/10/1996	Heavy Snow	0	0	0
1/12/1996	Heavy Snow	0	0	0
2/2/1996	Heavy Snow	0	0	0
2/16/1996	Heavy Snow	0	0	0
3/2/1996	Heavy Snow	0	0	0
3/7/1996	Heavy Snow	0	0	0
4/7/1996	Heavy Snow	0	0	0

4/9/1996	Heavy Snow	0	0	0
12/6/1996	Heavy Snow	0	0	0
12/7/1996	Heavy Snow	0	0	1360000
3/31/1997	Heavy Snow	0	0	0
4/1/1997	Heavy Snow	0	0	0
11/14/1997	Heavy Snow	0	0	0
12/23/1997	Heavy Snow	0	0	0
1/15/1998	Heavy Snow	0	0	0
1/23/1998	Heavy Snow	0	0	0
1/14/1999	Heavy Snow	0	0	0
2/25/1999	Heavy Snow	0	0	0
3/6/1999	Heavy Snow	0	0	0
3/15/1999	Heavy Snow	0	0	0
1/13/2000	Heavy Snow	0	0	0
1/25/2000	Heavy Snow	0	0	0
2/18/2000	Heavy Snow	0	0	0
12/30/2000	Heavy Snow	0	0	0
1/20/2001	Heavy Snow	0	0	0
2/5/2001	Heavy Snow	0	0	0
3/5/2001	Heavy Snow	0	0	0
3/9/2001	Heavy Snow	0	0	0
3/30/2001	Heavy Snow	0	0	0
12/8/2001	Heavy Snow	0	0	0
3/20/2002	Heavy Snow	0	0	0
3/16/2004	Heavy Snow	0	0	0
2/24/2005	Heavy Snow	0	0	0
12/13/2007	Heavy Snow	0	0	0
12/16/2007	Heavy Snow	0	0	0
12/19/2007	Heavy Snow	0	0	0
1/14/2008	Heavy Snow	0	0	28000
1/14/2008	Heavy Snow	0	0	20000
1/14/2008	Heavy Snow	0	0	20000
2/22/2008	Heavy Snow	0	0	0
3/1/2008	Heavy Snow	0	0	0
12/19/2008	Heavy Snow	0	0	0
12/20/2008	Heavy Snow	0	0	8000
12/21/2008	Heavy Snow	0	0	0
12/31/2008	Heavy Snow	0	0	0
1/10/2009	Heavy Snow	0	0	0
1/11/2009	Heavy Snow	0	0	0
1/18/2009	Heavy Snow	0	0	0
3/1/2009	Heavy Snow	0	0	0
3/2/2009	Heavy Snow	0	0	0
12/9/2009	Heavy Snow	0	0	15000
12/9/2009	Heavy Snow	0	0	500
12/19/2009	Heavy Snow	0	0	0
12/20/2009	Heavy Snow	0	0	0
1/18/2010	Heavy Snow	0	0	0
2/16/2010	Heavy Snow	0	0	15000
2/23/2010	Heavy Snow	0	0	8000
1/12/2011	Heavy Snow	0	0	0
1/26/2011	Heavy Snow	0	0	0
10/29/2011	Heavy Snow	0	0	30000
12/29/2012	Heavy Snow	0	0	0

2/8/2013	Heavy Snow	0	0	0
2/8/2013	Heavy Snow	0	0	0
2/23/2013	Heavy Snow	0	0	0
3/7/2013	Heavy Snow	0	0	0
3/18/2013	Heavy Snow	0	0	0
12/14/2013	Heavy Snow	0	0	0
12/17/2013	Heavy Snow	0	0	0
1/2/2014	Heavy Snow	0	0	0
1/18/2014	Heavy Snow	0	0	0
2/5/2014	Heavy Snow	0	0	0
2/13/2014	Heavy Snow	0	0	0
2/18/2014	Heavy Snow	0	0	0
11/26/2014	Heavy Snow	0	0	10000
1/24/2015	Heavy Snow	0	0	0
1/26/2015	Heavy Snow	0	0	0
2/2/2015	Heavy Snow	0	0	0
2/8/2015	Heavy Snow	0	0	0
2/14/2015	Heavy Snow	0	0	0
2/5/2016	Heavy Snow	0	0	70000
2/5/2016	Heavy Snow	0	0	5000
3/21/2016	Heavy Snow	0	0	0

Source: NOAA, National Climatic Data Center

Blizzards are considered to be high frequency events based on past occurrences, as defined by the Massachusetts State Hazard Mitigation Plan, 2013. This hazard occurs more than once in five years, with a greater than 20 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 Hudson. The best available local data is for Middlesex County through the National Climatic Data Center (see Table 14). Middlesex County, which includes the Town of Hudson, experienced eight events from 1969 –2014.

Table 14 Middlesex County Hail Events, 2000-2016

Date	Event	Magnitude	Deaths	Injuries	Damage
7/18/2000	Hail	1	0	0	0
6/20/2001	Hail	1.75	0	0	0
7/12/2001	Hail	1.5	0	0	0
5/27/2002	Hail	0.75	0	0	0
6/2/2002	Hail	0.75	0	0	0
8/13/2003	Hail	0.75	0	0	0
7/2/2004	Hail	0.75	0	0	0
8/20/2004	Hail	0.88	0	0	0
5/21/2006	Hail	0.75	0	0	0
5/21/2006	Hail	0.75	0	0	0
7/11/2006	Hail	1	0	0	0
7/28/2006	Hail	0.75	0	0	0
6/5/2007	Hail	1.25	0	0	0
6/22/2007	Hail	0.75	0	0	0
7/9/2007	Hail	1	0	0	0
7/28/2007	Hail	0.88	0	0	0
6/23/2008	Hail	0.75	0	0	0
6/24/2008	Hail	0.75	0	0	0
7/1/2008	Hail	0.88	0	0	0
7/2/2008	Hail	0.75	0	0	0
8/3/2008	Hail	0.75	0	0	0
8/7/2008	Hail	1	0	0	0
8/10/2008	Hail	0.75	0	0	0
5/24/2009	Hail	1	0	0	0
6/27/2009	Hail	0.88	0	0	0
6/27/2009	Hail	0.75	0	0	0
7/7/2009	Hail	0.75	0	0	0
7/8/2009	Hail	1.75	0	0	0

5/4/2010	Hail	0.75	0	0	0
5/7/2011	Hail	0.75	0	0	0
6/1/2011	Hail	0.75	0	0	0
8/2/2011	Hail	0.75	0	0	0
8/19/2011	Hail	0.75	0	0	0
3/13/2012	Hail	1.25	0	0	0
3/14/2012	Hail	1	0	0	0
6/23/2012	Hail	0.75	0	0	0
7/18/2012	Hail	1	0	0	0
10/30/2012	Hail	1	0	0	0
6/17/2013	Hail	0.75	0	0	0
5/25/2014	Hail	0.75	0	0	0
7/3/2014	Hail	1	0	0	0
8/7/2014	Hail	0.75	0	0	0
9/6/2014	Hail	0.88	0	0	0
8/4/2015	Hail	1	0	0	0
8/15/2015	Hail	0.75	0	0	0

Source: NOAA, National Climatic Data Center Magnitude refers to diameter of hail stones in inches.

Ice storms are considered to be medium frequency events based on past occurrences, as defined by the Massachusetts State Hazard Mitigation Plan, 2013. 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 Hudson. The average annual snowfall for Hudson is 48 - 72 inches (see Map 6 in Appendix B). 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. Some Hudson residents rely on the regional commuter rail system, which was also severely impacted. Another winter storm vulnerability is power outages due to fallen trees and utility lines.

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 Hudson 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.

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

Source: Nevada Seismological Library (NSL), 2005

According to the State Hazard Mitigation Plan, New England experiences an average of five earthquakes per year. From 1668 to 2007, 355 earthquakes were recorded in Massachusetts (NESEC). Most have originated from the La Malbaie fault in Quebec or from the Cape Anne fault located off the coast of Rockport. The region has experienced larger earthquakes, including a magnitude 5.0 earthquake in 1727 and a 6.0 earthquake that struck in 1755 off the coast of Cape Anne. More recently, a pair of damaging earthquakes occurred near Ossipee, NH in 1940, 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 15.

Table 15 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: Boston HIRA

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. Hudson 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 Hudson.

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

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

Earthquakes are a potential town-wide hazard in Hudson. 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 Hudson have been estimated using HAZUS-MH. Total building damages are estimated at $322 million for a 5.0 magnitude earthquake and $2.4 billion for a 7.0 magnitude earthquake. Other potential impacts are detailed in Table 24.

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	**Expected Landslide Velocity**		
(m^3)	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 Town has been classified as having a low risk for landslides (see Map 4, Appendix B). The town does not have records of any damages caused by landslides in Hudson.

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 Hudson.

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

Fire Related Hazards

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

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

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

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

These fires can present a hazard where there is the potential for them to spread into developed or inhabited areas, particularly residential areas where sufficient fuel materials might exist to allow the fire the spread into homes. Protecting structures from fire poses special problems, and can stretch firefighting resources to the limit.

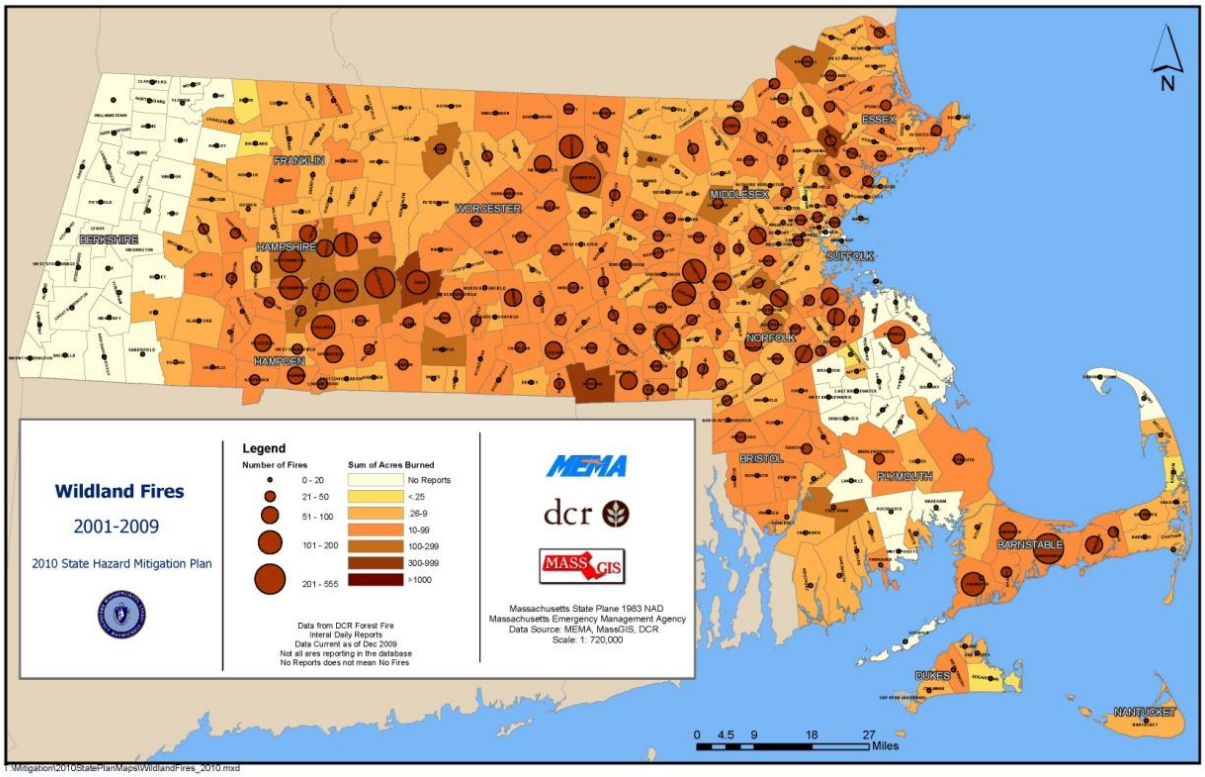
If heavy rains follow a fire, other natural disasters can occur, including landslides, mudflows, and floods. If the wild fire destroys the ground cover, then erosion becomes one of several potential problems.

Wildfires in Massachusetts are measured by the number of fires and the sum of acres burned. The most recent data available for wildfires in Massachusetts, shown in Figure 1 below, indicates that the wildfire extent in Hudson is low to moderate, consisting of 10-99 acres burned, with 21-50 recordable fires from 2001to 2009.

Hudson's Fire Chief has identified four relatively small areas of town that may be at an elevated risk of wildfire: Sudbury State Forest; the Bruen Road area, 41 Parmenter Road, and Forest Avenue. These are shown on Map 8 in Appendix B. In recent years there have

been few wildfires, and no significant fires that caused damage to residences or businesses.

Figure 1 Massachusetts Wildfires 2001-2009



Source: Massachusetts State Hazard Mitigation Plan

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

Based on past occurrences and the Massachusetts Hazard Mitigation Plan 2013, brushfires are of Medium frequency, events that occur from once in 5 years to once in 50 years (2% to 20% probability per year).

Extreme Temperatures

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

Hudson 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 2 below.

Extreme cold is relative to the normal climatic lows in a region. Temperatures that drop decidedly below normal and wind speeds that increase can cause harmful wind-chill factors. The 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 Town of Hudson does not collect data for previous occurrences of extreme cold. The best available local data are for Middlesex County, through the National Climatic Data Center (NCDC). There are three extreme cold events on record which caused no deaths, injuries, or property damage. (see Table 16).

Figure 2 - Wind Chill Temperature Index and Frostbit Risk

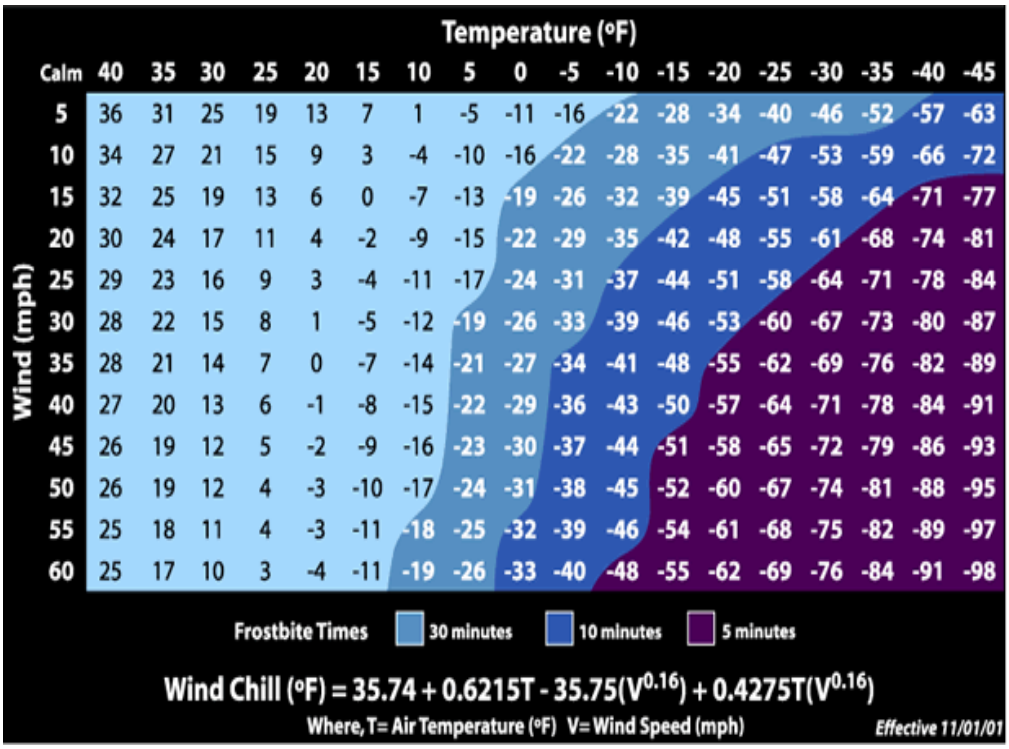


Table 16 – Middlesex County Extreme Cold and Wind Chill Occurrences

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

Source: NOAA, National 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 3) is forecast to exceed 100 degrees Fahrenheit (F) for 2 or more hours; an excessive heat advisory is issued if forecast predicts the temperature to rise above105 degree F.

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.

Figure 3 Heat Index Chart

Relative Humidity (%) \ Temperature (°F)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Category	Heat Index	Health Hazards
Extreme Danger	130 °F – Higher	Heat Stroke or Sunstroke is likely with continued exposure.
Danger	105 °F – 129 °F	Sunstroke, muscle cramps, and/or heat exhaustion possible with prolonged exposure and/or physical activity.
Extreme Caution	90 °F – 105 °F	Sunstroke, muscle cramps, and/or heat exhaustions possible with prolonged exposure and/or physical activity.
Caution	80 °F – 90 °F	Fatigue possible with prolonged exposure and/or physical activity.

The Town of Hudson does not collect data on excessive heat occurrences. The best available local data are for Middlesex County, through the National Climatic Data Center. From 1999 - 2011, there have been a total of 16 excessive heat events, with two 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, 2013. 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 – Middlesex County Extreme Heat Occurrences

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

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. Hudson is located in the Northeast Region. In Hudson 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

Hudson does not collect data relative to drought events. Because drought tends to be a regional natural hazard, this plan references state data as the best available data for drought. The statewide scale is a composite of 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 4 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 18 summarizes the chronology of major droughts since the 1920's.

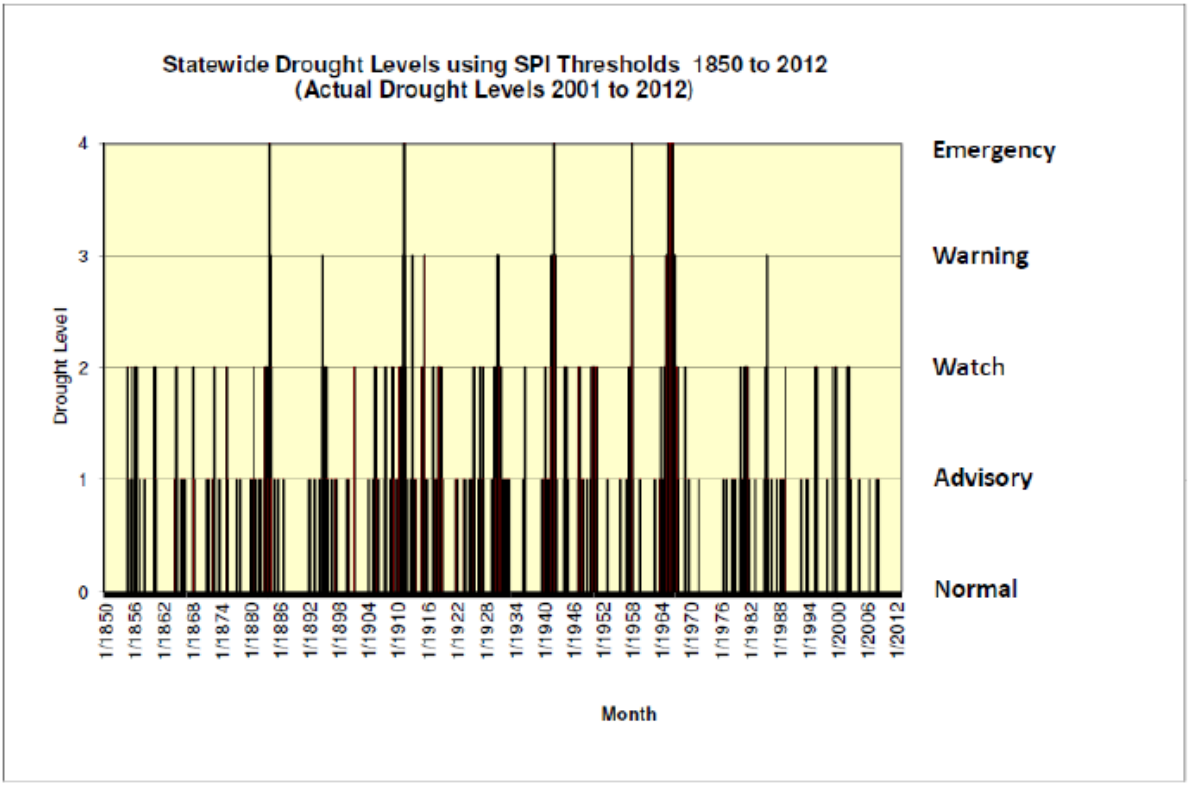
Drought Emergency

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 four times, in 1894, 1915, 1930, and 1985. On a monthly basis over the 162-year period of record, there is a two percent chance of being in a drought Warning level.

Figure 4 - Statewide Drought Levels using SPI Thresholds 1850 – 2012



(Source: Mass. State Drought Management Plan 2013)

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 (see Table 18). A frequency of drought Watches at a rate of three years per decade resumed in the 1990s (1995, 1998, 1999). In the 2000s, Drought Watches occurred in 2001 and 2002 and 2016. The overall frequency of being in a drought Watch is 8 percent on a monthly basis over the 162-year period of record.

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 June 2016 and covers 98 percent of the state, with more severe drought in the Central, Northeast, and Southeast regions.

Under a severe long term drought the Town of Brookline could be vulnerable to restrictions on water supply. Potential damages of a severe drought could include losses of landscaped areas if outdoor watering is restricted long term, and potential loss of business revenues if water supplies were severely restricted for a prolonged period. As this hazard has occurred to this degree in Hudson, 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.

Probability of Future Occurrences

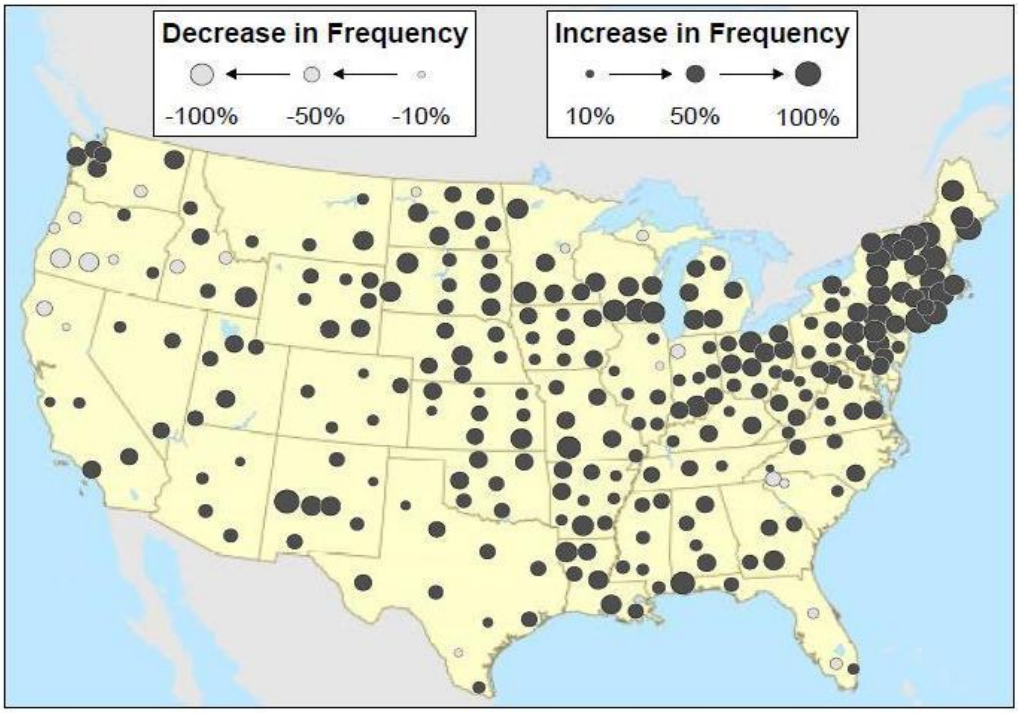
The state has experienced Emergency Droughts six times between 1850 and 2016. Even given that regional drought conditions may occur at a different interval than state data indicates, droughts remain primarily regional and state phenomena in Massachusetts. Emergency Drought conditions over the 162 period 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, 2013.

Impacts of Climate Change

Many of the natural hazards that Hudson 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.

Figure 5 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 Precipitation

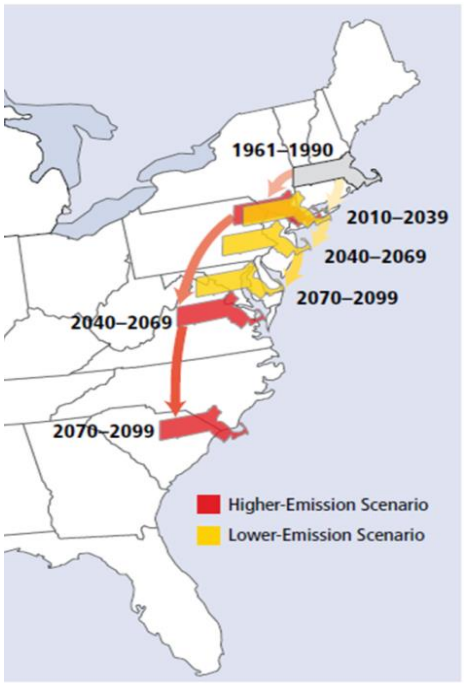
Hudson's average annual precipitation is 42 inches. While total annual precipitation has not changed significantly, according to the 2012 report *When It Rains It Pours – Global Warming and the Increase in Extreme Precipitation from 1948 to 2011* intense rainstorms and snowstorms have become more frequent and more severe over the last half century in the northeastern United States. Extreme downpours are now happening 30 percent more often nationwide than in 1948 (see Figure 5). 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.
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 6 MA Extreme Heat Scenarios



Source: Union of Concerned Scientists

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

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 19 shows the acreage and percentage of land in 22 categories. If the five residential categories are aggregated, residential uses make up 30% of the area of the town (2,288 acres). Commercial and industrial combined make up 7.7% of the town, or 583.6 acres. Recreation, urban public, and golf courses comprise a total of 3.6%, or 273 acres.

Table 19 2005 Land Use

Land Use Type	Acres	Percent
Crop Land, Pasture, Orchard	181.8	2.5%
Nursery	16.9	.2%
Non-Forested Wetlands	268.5	3.5%
Forested Wetland	498.2	6.6%
Mining	22.2	0.3%
Open & Urban Open Land	90.4	1.2%
Participation Recreation	94.0	1.2%
Multi-family Residential	265.1	3.5%
High Density Residential	50.2	0.7%
Medium Density Residential	1295.9	17.1%
Low Density Residential	613.1	8.1%
Very Low Density Residential	64.3	0.8%
Commercial	210.6	2.8%
Industrial	373.0	4.9%
Transportation	24.0	0.3%
Waste Disposal	39.0	0.5%
Forest	3045.6	40.1%
Water	194.4	2.6%
Golf Course Acres	92.5	1.2%
Urban Public Acres	86.5	1.1%
Cemetery Acres	47.6	0.6%
Brushland/Successional	14.9	0.2%
Total Acres	***7,588.7***	**100.0%**

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

Development Trends

Under current zoning, much of the Town of Hudson is occupied by existing residential neighborhoods, commercial districts and corridors, open space and recreational spaces, and conservation land and undevelopable wetlands. Many of the larger and more easily developed parcels in Hudson have already been developed or protected as conservation land, so the development that is occurring in the Town is largely infill development and redevelopment.

Development trends throughout the metropolitan region are tracked by MAPC's Development Database, which provides an inventory of new development over the last decade. The database tracks both completed developments and those currently under construction. The database includes 24 developments in the Town of Hudson since 2009.

The database also includes several attributes of the new development, including site acreage, housing units, and commercial space. The 25 developments in Hudson include a total of 812 housing units and 260,000 square feet of commercial space on a total of about 91 acres (see Table 20).

Of these 25 new developments, only are located on land parcels that are partially within a designated flood zone. The 145 Main Street site, a parking lot, is partially located in zone X (0.2%), and Rivers Edge is partially located in zone AE. None of the new developments are located within locally identified flood hazard areas or brushfire hazard areas, and all are within the area designated as low incidence for landslides. On the whole the recent development in Hudson does not significantly increase the town's vulnerability to natural hazards.

Table 20- Summary of Hudson Developments 2009-2015

DEVELOPMENTS COMPLETED 2009-2015	ACRES	HOUSING UNITS	COMMERCIAL (SQ FEET)	PROJECT TYPE
Falls Brook		19	0	Residential
River's Edge Hudson		10	0	Residential
Hammond Hill		6	0	Residential
Lauren Heights		12	0	Residential
Riverside Farms		10	0	Residential
Knott's Clearing		32	0	Residential
Walgreen's	10	0	15,0000	Retail
Coolidge Greene		30	0	Residential
TD Bank	0.28	0	3,000	Bank
Curious Kids	1.79	0	12,300	Childcare
Paquette Dentistry	0.67	0	3,360	Medical
13 Kane Industrial	0.68	0	8,000	Industrial
145 Main	0.55	0	24,054	Parking Lot
Masiero Woodworking	1.00	0	2,000	Industrial
Basha's Natural Marketplace	0.70	0	2,500	Retail
RK Plaza	9.00	0	29,000	Retail
Stop & Shop Gas	4.50	0		Retail
Village at Quail Run		150		Residential
Sauta Farm Condominiums		66		Residential
The Esplanade		140		Residential/Retail
Simrah Gardens		158		Residential
Hogan Tire	3	0	4,500	Retail
WalMart	21	0	21,000	Retail
Westridge Retirement Comm	31	146	0	Residential
Northridge Apartments	7	33	0	Residential
TOTAL	**91.16**	**812**	**259,714**	

Potential Future Development

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

The analysis shows that six of the sixteen developments are located partially within a flood zone. Five of these have small proportions of the parcel located in a flood zone, either A or AE. Only one parcel, the Cherry Street Complex, has a more significant proportion of the parcel, 52.9%, located in zone AE (see Table 21). All of these sites are located within the low hazard areas for brushfires and landslides, and none are located within a locally identified flood hazard area.

Cherry Street complex (A) – Light industrial/warehouse

Chestnut Street (E) – Potential Development
This sand pit area has been identified by town staff as a location for future potential development, as there have been several developer inquiries.

Chestnut Hill Estates Subdivision (5 lots) (F) – This subdivision located on Chestnut Street, contains 5 lots and is currently under construction, with one unit completed.

Deer Path Farms Condominiums (110 units) (H) – The Deer Path Farms condominium complex located on the west side of Hudson, is a recent development about 90% complete that includes approximately 110 detached residential units located on 30 acres.

Highland Commons Mall (K) – The Highland Commons Mall, located in western Hudson on Coolidge Street and in Berlin, is currently under construction. Designs for the site call for 400,000+ square feet of retail space.

Brigham Hill III Subdivision (36 lots) (M) – This proposed subdivision is located at Exeter Road and will contain 36 single-family homes.

Old North Woods Subdivision (4 lots) (P) – This subdivision, located on Old North Road, contains 4 lots and is currently under construction.

Main Street (Q) - This site has been identified by town staff as a location for future potential residential development, although nothing specific has yet been proposed.

Brigham Family Estate (V) – potential assisted living facility on Washington Street

Brigham II (W) – No specific proposal at this time; zoned for Single Family Residences

Matrix (X) – 40B Residential, 176 apartments, 25% affordable; off of Cabot Street

Rago Project (Y) – 10 condo units, Broad Street

Commercial Site (Z) – Former McDonalds; 32/36 Washington St, ½ acre Commercial

7 South Street (AA) – 4-story mixed use, commercial, office and loft apartments

Coolidge (BB) – Office./Retail

Danis (CC) – 266 apartment units, new and renovations

Table 21
Relationship of Potential Development in Hazard Areas

Parcel	Land Slide Risk	Flood Zone	Brush Fire Risk
A. Cherry Street Complex	Low	52.93% in AE:1% Annual Chance of Flooding	Low
E. Chestnut Street	Low	No flood zone	Low
F. Chestnut Hill Estates Subdivision (5 lots)	Low	No flood zone	Low
H. Deer Path Farms Condominiums (66 units)	Low	0.71% in AE:1% Annual Chance of Flooding	Low
K. Highland Commons Mall	Low	7.74% in A:1% Annual Chance of Flooding	Low
M. Brigham Hill III Subdivision (36 lots)	Low	No flood zone	Low
P. Old North Woods Subdivision (4 lots)	Low	No flood zone	Low
Q. Main Street	Low	No flood zone	Low
V. Brigham Family Estate	Low	No flood zone	Low
W. Brigham II	Low	No flood zone	Low
X. Matrix	Low	No flood zone	Low
Y. Rago Project	Low	No flood zone	Low
Z. Commercial Site 32/36 Washington St	Low	0.02% in AE: 1% Annual Chance of Flooding and 0.37% in AE: Regulatory Floodway	Low
AA. 7 South Street	Low	2.75% in AE: Regulatory Floodway	Low
BB. Coolidge	Low	19.01% in A: 1% Annual Chance of Flooding	Low
CC. Danis	Low	No flood zone	Low

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 97 facilities identified in Hudson. These are listed in Table 22 and are shown on the maps in Appendix B.

Explanation of Columns in Table 22

Column 1: ID #: The first column in Table 22 is an ID number which appears on the maps that are part of this plan. See Appendix B.

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

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

***Column 4: FEMA Flood Zone*:** The fourth column addresses the risk of flooding. A "No" entry in this column means that the site is not within any of the mapped risk zones on the Flood Insurance Rate Maps (FIRM maps). If there is an entry in this column, it indicates the type of flood zone.

Column 5: Locally Identified Flood Area: This column shows

Column 6: 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. For more information on how landslide susceptibility was mapped, refer to http://pubs.usgs.gov/pp/p1183/pp1183.html.

***Column 7: Snowfall*.** Areas designated "low" receive an annual average of 36.1 to 48.0 inches of snow. Areas designated "high" receive an annual average of 48.1 to 72 inches of snow, as shown on Map 6 in Appendix B.

RISK ASSESSMENT

Table 22 Critical Facilities and Relationship to Hazard Areas

ID	Name	Type	FEMA Flood Zone	Locally-Identified Flood Area	Landslide Risk	Average Annual Snow Fall
1	First United Methodist Church	Place of Worship	No	No	Low	High
2	Grace Baptist Church	Place of Worship	No	No	Low	High
3	Seventh Day Adventist Church	Place of Worship	No	No	Low	High
4	Saint Michael's Church	Place of Worship	No	No	Low	High
5	Unitarian Church Of Marlborough & Hudson	Place of Worship	No	No	Low	High
6	Amvets	Place of Assembly	No	No	Low	High
7	Veterans of Foreign Wars	Place of Assembly	No	No	Low	High
8	Eagles	Place of Assembly	No	No	Low	High
9	Hudson Elks Lodge	Place of Assembly	No	No	Low	High
10	Hudson Portuguese Club	Place of Assembly	No	No	Low	High
11	Riverside Gun Club	Place of Assembly	No	No	Low	High
12	Roller Kingdom	Place of Assembly	No	No	Low	High
13	Boys & Girls Club	Place of Assembly	No	No	Low	High
14	Charter Oak Country Club	Hazardous Materials	No	No	Low	High
15	Police Department	Police Station	No	No	Low	High
16	Fire Station 1	Fire Station	No	No	Low	High
17	Fire Station 2	Fire Station	No	No	Low	High
18	Fire Department Headquarters	Fire Station	AE	No	Low	High
19	Hudson Town Hall	Municipal Office	No	No	Low	High
20	Police and Department of Public Works	Department of Public Works	No	No	Low	High
21	Hudson Light & Power Office	Municipal Office	No	No	Low	High
22	Hudson Light & Power - Power Station	Power Substation	AE	No	Low	High
23	Hudson School Department	Municipal	No	No	Low	High
24	Maine Drilling & Blasting	Hazardous Materials	No	No	Low	High
26	Natick Labs Military Housing	Federal Office	ANI	No	Low	High
27	National Guard	Armory	No	No	Low	High

ID	Name	Type	FEMA Flood Zone	Locally-Identified Flood Area	Landslide Risk	Average Annual Snow Fall
	Armory					
28	Knight Fuel	Hazardous Materials	No	No	Low	High
29	Warmer Fuel	Hazardous Materials	No	No	Low	High
30	Hudson Lock	Hazardous Materials	No	No	Low	High
31	Intel Massachusetts	Hazardous Materials	No	No	Low	High
32	J. Kittredge & Sons	Hazardous Materials	No	No	Low	High
33	Verizon Central Office	Communications/Utility	No	No	Low	High
34	CA Farley Elementary School	School	No	No	Low	High
35	Forest Avenue Elementary School	School	No	No	Low	High
36	Hudson High School	School	No	No	Low	High
37	Quinn Middle School	School	No	No	Low	High
38	JL Mulready Elementary School	School	No	No	Low	High
39	Brigham Circle Elderly Housing	Elderly Housing	No	No	Low	High
40	Meadowbrook Mobile Park	Elderly Housing	No	No	Low	High
41	Norma Oliver Elderly Housing	Elderly Housing	No	No	Low	High
42	Peter's Grove	Elderly Housing	No	No	Low	High
43	Wastewater Treatment Facility	Wastewater Treatment Facility	No	No	Low	High
44	Wastewater Pump Station	Wastewater Treatment Facility	X500	Avon Drive	Low	High
45	Wastewater Pump Station	Wastewater Treatment Facility	No	No	Low	High
46	First Federated Church	Place of Worship	No	No	Low	High
47	Hubert Kindergarten	School	No	No	Low	High
50	Chaps Early Childhood Center	School	No	No	Low	High
51	Hudson Children's Center	School	No	No	Low	High
52	First Steps Children's Center	School	No	No	Low	High
53	Woods Edge Children's Center II	School	No	No	Low	High
54	Montessori	School	No	No	Low	High

ID	Name	Type	FEMA Flood Zone	Locally-Identified Flood Area	Landslide Risk	Average Annual Snow Fall
	Children's Center					
55	Wastewater Pump Station	Wastewater Treatment Facility	No	No	Low	High
56	Wastewater Pump Station	Wastewater Treatment Facility	No	No	Low	High
57	Wastewater Pump Station	Wastewater Treatment Facility	No	No	Low	High
58	Wastewater Pump Station	Wastewater Treatment Facility	No	No	Low	High
59	Wastewater Pump Station	Wastewater Treatment Facility	No	No	Low	High
60	Wastewater Pump Station	Wastewater Treatment Facility	No	No	Low	High
61	Wastewater Pump Station	Wastewater Treatment Facility	No	No	Low	High
62	Wastewater Pump Station	Wastewater Treatment Facility	AE	No	Low	High
63	Wastewater Pump Station	Wastewater Treatment Facility	AE	No	Low	High
64	Wastewater Pump Station	Wastewater Treatment Facility	No	No	Low	High
65	Wastewater Pump Station	Wastewater Treatment Facility	No	No	Low	High
66	Wastewater Pump Station	Wastewater Treatment Facility	X500	No	Low	High
67	Gates Pond Water Treatment Facility	Water Treatment Facility				High
68	Chestnut Well Treatment Facility	Water Treatment Facility	No	No	Low	High
69	Cranberry Well	Well	A	No	Low	High
70	Cox Street Well Field	Well	X500	No	Low	High
71	Rimkus Well Field	Well	No	No	Low	High
72	Murphy Water Tank	Water Storage Tank	No	No	Low	High
73	Pope's Hill Water Tank	Water Storage Tank	No	No	Low	High
74	Potash Water Tank	Water Storage Tank	No	No	Low	High
75	Round Top Water Tank	Water Storage Tank	No	No	Low	High
76	Water Pump Station	Water Treatment Facility	No	No	Low	High
77	Water Pump Station	Water Treatment Facility	No	No	Low	High
78	Water Pump Station	Water Treatment Facility	No	No	Low	High
79	Water Pump	Water Treatment	No	No	Low	High

ID	Name	Type	FEMA Flood Zone	Locally-Identified Flood Area	Landslide Risk	Average Annual Snow Fall
	Station	Facility				
80	Water Pump Station	Water Treatment Facility	No	No	Low	High
81	Water Pump Station	Water Treatment Facility	No	No	Low	High
82	Water Pump Station	Water Treatment Facility	No	No	Low	High
84	Preschool Age Child Care Services	Child Care	No	No	Low	High
85	SMOC Head Start Hudson	Child Care	No	No	Low	High
88	Quinn Extended Day Program	Child Care	No	No	Low	High
89	KAPS - Kindergarten After School Program	Child Care	No	No	Low	High
91	Fort Meadow Brook Dam	Dam	AE	No	Low	High
92	Tripps Pond Dam	Dam	AE	No	Low	High
93	Washington Street Dam	Dam	AE	No	Low	High
94	Bruce's Pond Dam	Dam	AE	No	Low	High
95	St Luke's Episcopal Church	Place of Worship	No	No	Low	High
96	Carmel Mar Thoma Church	Place of Worship	No	No	Low	High
97	H LA Rosee & Sons Inc	Hazardous Maaterials	No	No	Low	High
98	Kane Well	Well	No	No	Low	High
99	Willis House Family Shelter	Homeless Shelter	No	No	Low	High
100	Brigham Hill Water Tank	Water Storage Tank	No	No	Low	High
101	Chestnut Well #1	Well	No	No	Low	High
102	Chestnut Well #2	Well	AE	No	Low	High
103	Chestnut Well #3	Well	AE	No	Low	High

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 Hudson, it does not capture all relevant information. In fact, the HAZUS-MH 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-MH software was used to model potential damages to the community from a 100 year and 500 year hurricane event; storms that are 1% and .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 23 - Estimated Damages from Hurricanes

	100 Year	500 Year
Building Characteristics		
Estimated total number of buildings	6,825	
Estimated total building replacement value (2006 $)	$2,549,000,000	
Building Damages		
# of buildings sustaining minor damage	137	879
# of buildings sustaining moderate damage	13	150
# of buildings sustaining severe damage	0	8
# of buildings destroyed	0	2
Population Needs		
# of households displaced	4	4393
# of people seeking public shelter	0	110
Debris		
Building debris generated (tons)	2,421	12,309
Tree debris generated (tons)	1,761	4,318
# of truckloads to clear building debris	28	140
Value of Damages		
Total property damage (buildings and content)	$ 12,866,000	$47,069,000
Total losses due to business interruption	$ 443,000	$ 2,786,000

Estimated Damages from Earthquakes

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

Table 24 - Estimated Damages from Earthquakes

	Magnitude 5.0	Magnitude 7.0
Building Characteristics		
Estimated total number of buildings	6,825	
Estimated total building replacement value (2006 $)	$2,549,000,000	
Building Damages		
# of buildings sustaining slight damage	1,965	209
# of buildings sustaining moderate damage	1,119	1,355
# of buildings sustaining extensive damage	342	1,873
# of buildings completely damaged	89	3,372
Population Needs		
# of households displaced	341	4,409
# of people seeking public shelter	187	2,387
Debris		
Building debris generated (tons)	80,000	610,000
# of truckloads to clear debris (@ 25 tons/truck)	3,240	24,200
Value of Damages (Millions of dollars)		
Total property damage	$ 322,422,600	$2,303,831,200
Total losses due to business interruption	$ 53,280,000	$321,640,000

Estimated Damages from Flooding

MAPC did not use HAZUS-MH to estimate flood damages in Hudson. The flood module is not a reliable indicator of flooding in areas where inadequate drainage systems, beaver activity, and increased impervious surfaces contribute to flooding even in areas outside of mapped flood zones. In lieu of using HAZUS, MAPC developed a methodology to give a rough approximation of flood damages.

Approximately 59 acres of Hudson's total land area of 7,589 acres have been identified by local officials as areas of flooding. This amounts to 0.78% of the land area. The number of structures in each flood area was estimated by applying the percentage of the total land area to the total number of structures (6,825) in Hudson, which is the same number of structures used by HAZUS for the hurricane and earthquake calculations. HAZUS uses an average value of

$373,480 per structure for the building replacement value in this community. The calculations were done for a low estimate of 10% building damages and a high estimate of 50% as suggested in the FEMA publication, "State and Local Mitigation Planning how-to guides" (Page 4-13). The range of estimates for flood damages is $1,988,221 to $9,941,104. These calculations are approximate only and are meant to show an order of magnitude of damage. These calculations are not based on a particular type of storm (i.e. 100 year flood).

Table 25 - Estimated Damages from Flooding

ID	Flood Hazard Area	Approx Area (Acres)	% of Total Land Area in Hudson	# of Struct.	Replacement Value	Low Estimate of Damages	High Estimate of Damages
1	Brigham St	16.88	0.222%	15	$5,658,782	$565,878.22	$2,829,391.11
2	Cox Street	1.39	0.018%	1	$458,820	$45,882.02	$229,410.09
3	Avon Drive	4.24	0.056%	4	$1,427,441	$142,744.06	$713,720.28
4	Cox St	2.71	0.036%	2	$917,640	$91,764.04	$458,820.18
5	Manning St	2.37	0.031%	2	$790,190	$79,019.03	$395,095.16
7	Lower Road	4.45	0.059%	4	$1,503,911	$150,391.06	$751,955.30
8	Causeway St	2.73	0.036%	2	$917,640	$91,764.04	$458,820.18
9	Causeway St	1.05	0.014%	1	$356,860	$35,686.01	$178,430.07
10	Brent Drive	1.40	0.018%	1	$458,820	$45,882.02	$229,410.09
11	White Pond Rd	12.01	0.158%	11	$4,027,422	$402,742.16	$2,013,710.79
13	Chapin Road	3.56	0.047%	3	$1,198,030	$119,803.05	$599,015.24
14	Main Street	3.75	0.049%	3	$1,249,010	$124,901.05	$624,505.25
15	Chestnut St. Well#3	2.74	0.036%	2	$917,640	$91,764.04	$458,820.18
	Total	**59.29**	**0.78%**	**53**	**$19,882,208**	**$1,988,221**	**$9,941,104**

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V. HAZARD MITIGATION GOALS

The Hudson Local Hazard Mitigation Planning Team reviewed and discussed the goals from the 2010 Hazard Mitigation Plan for the Town of Hudson. All of the goals are considered critical for the Town and they are not listed in order of importance.

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

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

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

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

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

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

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

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

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VI. EXISTING MITIGATION MEASURES

The existing protections in the Town of Hudson 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 26 below.

Flooding – Existing Town-Wide Mitigation

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

1. *National Flood Insurance Program (NFIP)* – Hudson participates in the NFIP with 54 policies in force as of the August 31, 2016. FEMA maintains a database on flood insurance policies and claims. This database can be found on the FEMA website at http://bsa.nfipstat.fema.gov/reports/1011.htm#MAT.

The following information is provided for the Town of Hudson:

Flood insurance policies in force (as of August 31,2016)	54
Coverage amount of flood insurance policies	$15,937,900
Premiums paid	$45,487
Total losses (all losses submitted regardless of the status)	13
Closed losses (Losses that have been paid)	7
Open losses (Losses that have not been paid in full)	0
CWOP losses (Losses that have been closed without payment)	6
Total payments (Total amount paid on losses)	$8,443.18

The Town complies with the NFIP by enforcing floodplain regulations, maintaining up-to-date floodplain maps, and providing information to property owners and builders regarding floodplains and building requirements.
2. All streets are swept at least once per year, starting in early April. The Central Business District is swept once per week. The town performs all of its own sweeping and has sufficient equipment.
3. All 2200 catch basins are cleaned in the spring. The town has typically done 50% of the basins each year, but are now aiming for 100% each year. Maintenance of drainage infrastructure other than catch basins is on an as-needed basis. The Central Massachusetts Mosquito Control assists in maintaining ditches and clogged waterways.
4. The Public Works Department has mapped almost all of the drainage system via GPS and is integrating it into a GIS system and database.
5. The town has an on-going replacement program of drainage pipes and outdated infrastructure, on an as-needed basis. For example, the Public Works Department replaced a 36-inch culvert on Lincoln Street to alleviate flooding, which has been successful. The town also recently replaced a culvert at Fort Meadow Brook on Causeway Street near the Sudbury border.

6. The State replaced culverts on Main Street (Route 62) where it crosses Fort Meadow Brook about 3 years ago.
7. The town uses a licensed trapper to mitigate beaver activity as necessary. A permit to do so is required by state law through the local Board of Health.
8. The town has a Floodplain/Wetland District designated in section 5.7 of the Zoning Bylaws. This district restricts certain activities and requires a special permit for activities located within or near a designated flood zone or wetland resource area.
9. The Massachusetts Stormwater Policy is applied to developments within the jurisdiction of the Conservation Commission.
10. The subdivision regulations encourage a preliminary submission to discuss development issues up-front with the Planning Board prior to a significant investment in design efforts. Runoff from subdivision developments may not increase in proposed conditions more than in existing conditions.
11. The town has Site Plan Approval requirements (Section 7.1.7 of the Zoning Bylaws). The drainage requirements for site plans are generic and require "adequate means of disposal" for stormwater. The town has a site plan review committee that meets every week to review designs with applicants.
12. Open Space Residential Development (OSRD) is allowed under 5.6 of the Zoning Bylaws. Residential developments are allowed to be clustered to protect tracts of open space. This bylaw encourages "soft" stormwater management techniques, such as Low-Impact Development practices.
13. The Watershed Protection District (3.3.10 of the Zoning Bylaws) requires minimum one-acre residential zoning and special permits for particular uses.
14. The town has acquired land for open space in the past and has a priority list of parcels identified in the Open Space Plan. The town also adopted the Community Preservation Act with a 1% surcharge in 2007.
15. The town continues to implement its NPDES Phase II stormwater program which includes public education programs such as a stormwater media campaign, lesson plans for teachers, outreach to businesses, and events coordinated with the SUASCO watershed organization.
16. The town is preparing a stormwater bylaw as part of the NPDES program.

Existing Dam Failure Mitigation Measure

17. DCR dam safety regulations – All dams are subject to the Division of Conservation and Recreation's dam safety regulations. The dams must be inspected regularly and reports filed with the DCR Office of Dam Safety.
18. Permits required for construction – State law requires a permit for the construction of any dam.
19. The Comprehensive Emergency Management Plan – The CEMP addresses dam safety.

Existing Wind Hazard Mitigation Measures

20. The Public Works Department trims and removes dead tree limbs and branches as notice is received. They also remove approximately 20-30 dead trees per year. They have in-house equipment to grind stumps and branches.
21. The Hudson Light and Power Department has an ongoing tree trimming program for around its power lines.
22. The Fire Department website provides several links to hurricane and tornado education and preparedness.

Existing Winter Hazard Mitigation Measures

23. The Public Works Department provides standard snow plowing operations, including salting and sanding. They have not had any significant problems with sanding and they do not use CaCl. The town contracts out the clearing of town sidewalks and parking lots to private contractors.
24. The town bans overnight parking on public streets from November 15 to April 1. Overnight parking is available in municipal lots in the downtown area.
25. The Public Works website provides public education on snow removal and winter storm safety.
26. The town has adequate snow storage space located at the Public Works yard.
27. Section 24 of the town bylaw prohibits vehicles on streets from interfering with snow clearing and authorizes the DPW to remove such vehicles.

Existing Brush Fire Hazard Mitigation Measures

28. Town bylaws allow controlled open burning in accordance with state regulations, but a permit is required from the Fire Chief for each day of intended burning.
29. The Fire department reviews all subdivision and site plans for compliance with site access, water supply needs, and all other applicable regulations.
30. The Fire Department maintains a website with substantial public education on fire prevention.

Existing Geologic Hazard Mitigation Measures

Earthquakes
31. The Fire Station and Emergency Operation Center is in a new building that is up to the latest building standards.
32. Rivers and ponds in town are available to be tapped into for water supply if necessary.
33. The town does have an evacuation plan as specified in its Comprehensive Emergency Management Plan (CEMP).
34.

Landslide
35. The subdivision regulations do have maximum slope requirements for new roads.
36. Section 25 of the Town bylaws covers earth removal from a site.

Existing Multihazard Mitigation Measures

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.

37. *Multi-Department Review of Developments* – Multiple departments, such as Planning, Zoning, Health, Public Works, Fire, Police, Building and Conservation, review all subdivision and site plans prior to approval.
38. *Comprehensive Emergency Management Plan (CEMP)* – Every community in Massachusetts is required to have a Comprehensive Emergency Management Plan. These plans address mitigation, preparedness, response and recovery from a variety of natural and man-made emergencies. These plans contain important information regarding flooding, dam failures and

winter storms. Therefore, the CEMP is a mitigation measure that is relevant to many of the hazards discussed in this plan. The CEMP is available online through secure access for town personnel.
39. *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.
40. *Local Emergency Management Planning Committee (LEPC)*
41. The fire department website provides significant public education regarding emergency management for various natural disasters and power outages.
42. The town has a Reverse 911 program.
43. The schools are designated as shelters if necessary.
44. The town's facilities have backup generators in the event of power outages. This includes town water and sewer pumps, emergency facilities, and town buildings.

TABLE 26 -- EXISTING MITIGATION MEASURES

Hazard	Area	Mitigation Measure	Update/Comments
Flood-Related	Town-Wide Flood Mitigation and Compliance with the National Flood Insurance Program	1) Participation in the National Flood Insurance Program 2) Annual street sweeping, business district swept weekly 3) Annual catch basin cleaning, mosquito control for ditches 4) Drainage mapped via GPS;,integrated into GIS 5) Ongoing drainage infrastructure replacement 6) Culvert at Rt. 62 and Fort Meadow Brook replaced 7) Licensed trapper for beaver issues 8) Floodplains/Wetlands District 9) Massachusetts Stormwater Policy 10) Runoff Requirements in Subdivision Regulations 11) Site Plan review for drainage 12) OSRD allowed, LID encouraged 13) Watershed Protection District 14) Open Space Protection and Community Preservation Act 15) NPDES Phase II enforcement 16) Preparing stormwater bylaw NPDES Phase II	Street sweeping and catch basin cleaning may need to be modified to meet the requirements of the EPA MS4 Stormwater Permit (NPDES permit under the Clean Water Act) Updated GIS mapping of drainage system is being planned by the town. Stormwater Bylaw, Runoff requirement in Subdivision Regulations, and Site Plan Review for drainage may need to be revised to meet the requirements of the EPA MS4 Stormwater Permit
Dams	Town-Wide	17) DCR Dam Safety Regulations 18) Construction permits required 19) CEMP addressed Dam Safety	Periodic update of CEMP
Wind-Related	Town-Wide	20) Tree Maintenance Program by the DPW 21) Tree Maintenance Program by the Power and Light Dept. 22) Fire Dept has website for education	Additional resources needed for more extensive tree trimming

Hazard	Area	Mitigation Measure	Update/Comments
Winter-Related	Town-Wide	23) Standard snow operations,do not use CaCl 24) Overnight parking ban 25) DPW provides education 26) Adequate snow storage 27) Vehicles prohibited from interfering with snow removal	Additional resources needed for more extensive tree trimming
Fire-Related	Town-Wide	28) Open burning permits required 29) Fire Department reviews all subdivision plans 30) Fire Department provides public education on its website	Existing measures effective
Geologic - *Earthquake*	Town-Wide	31) Fire and Emergency Operations built to latest standards 32) Rivers and ponds can be tapped for emergency water supply 33) Evacuation plan in CEMP	Periodic update of CEMP Assessment of additional facilities for earthquake vulnerabilities
Geologic - *Landslides*	Town-Wide	34) Maximum slopes for subdivision roads 35) Bylaw covers soil removal	Existing measures effective
Multi-Hazard	Town-Wide	36) Multi-department review of developments 37) Comprehensive Emergency Management Plan (CEMP) 38) Enforcement of State Building Code 39) Local Emergency Management Planning Committee (LEPC) 40) Fire Dept. website has extensive materials 41) Reverse 911 42) Schools are shelters if necessary 43) Town facilities have backup generators	Periodic update of CEMP Backup generators at additional facilities

Mitigation Capabilities Local Capacity for Implementation

Under the Massachusetts system of "Home Rule," the Town of Hudson is authorized to adopt and from time to time amend a number of local bylaws and regulations that support the town's capabilities to mitigate natural hazards. These include Zoning Bylaws, Subdivision and Site Plan Review Regulations, Wetlands Bylaws, Health Regulations, Public Works regulations, and local enforcement of the State Building Code. Local Bylaws may be amended each year at the annual Town Meeting to improve the town's capabilities, and changes to most regulations simply require a public hearing and a vote of the authorized board or commission.

The Town of Hudson has recognized several existing mitigation measures that require implementation or improvements, and has the capacity based on these Home Rule powers within its local boards and departments to address these. The Hudson Department of Public Works will address the needs for improvements and upgrades to culverts and stormwater drainage infrastructure. The town's Planning Board will address the updates to the Zoning Ordinance,

Floodplain District, and Subdivision Rules and Regulations. The Conservation Commission will oversee implementation of the Wetlands Bylaw and the new Open Space Plan. The Building Commissioner will oversee issues related to building snow loads and earthquake resilience. The Public Works Department will address potential contamination of the Chestnut Street wells due to flooding, and manage the town's water supply system's impacts from drought.

VII. MITIGATION MEASURES FROM THE 2010 PLAN

Implementation Progress on the Previous Plan

At a meeting of the Hudson Hazard Mitigation Planning Committee, Town staff reviewed the mitigation measures identified in the 2010 Hudson 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 2017 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 27 summarizes the status of mitigation measures, and mitigation projects completed are described in more detail below.

Table 27 Mitigation Measures from the 2010 Plan

Mitigation Measure	Priority	Lead Implementation	Current Status	Include in 2017 Update? Priority
A) Fire Equipment Upgrades to Address Brush Fires	High	Fire Department	Completed	NO
B) Setback Requirements for Fire Protection	High	Fire Department / Zoning Board	Not Completed – To be included as part of Zoning Revisions	YES / Medium
C) Tree Maintenance Program Funding	High	Public Works	Not Completed	YES / Medium
D) Assessment of Potential Contamination and Solutions at Chestnut Street Wells #2 and #3	High	Public Works / Health	Not Completed	YES / High
E) Culvert and Drainage Upgrades	NFIP High	Public Works	Not Completed	YES / High
F) Open Space Protection / Land Acquisition	NFIP High	Conservation	Partially Completed, New Open Space Plan	YES / Medium
G) Update of FEMA Flood Maps	NFIP High	Public Works / FEMA	Not Completed – To be included as part of Zoning Revisions	YES / High
H) Assessment of Upgrades to the Police Station	Medium	Police Department	Completed – New Police & DPW under construction	NO

Hudson has made progress on implementing some mitigation measures identified in the 2010 Hazard Mitigation Plan. A new combined Police Station and Public Works Facility is under construction, and new fire equipment upgrades were completed. The town's Open Space Plan was updated in 2016, and three new open space parcels have been acquired, totaling 43 acres.

Overall, six of the eight mitigation measures from the 2010 plan will be continued in this plan update. All of these were categorized as "High" priority in the 2010 plan. Based on the Town's prioritization of mitigation measures for this plan update in Section VII below, three of these mitigation measures will retain the same priority in this plan update, and three will be revised to "Medium" priority in this 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.

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.

VIII. HAZARD MITIGATION STRATEGY [1]

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*)

[1] The following strategy is a combination of updated mitigation measures from the 2010 Plan that have been carried over into this updated plan as well as new mitigation measures, and a prioritization of these as well as an identification of lead implementation partners, timeline, cost estimates and funding sources.

Regional and Inter-Community Considerations

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

Regional Partners

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

Regional Facilities within Hudson

Major facilities owned, operated and maintained by federal, state, regional or private entities in Hudson include: Routes 62, 85 and 495 (MassDOT); the Assabet River National Wildlife Refuge (US FWS); and the Marlborough-Sudbury State Forest (MA DCR).

Inter-Community Considerations

One inter-community consideration for Hudson is the fire risk at the Assabet River National Wildlife Refuge. This land, administered by the US FWS, was recently opened up for public use. The land is difficult to access for fire apparatuses, therefore towns that share this land must coordinate to share resources in the event of a brush fire.

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

Finally, as identified in the Hudson draft Community Development Strategy for 2008, the town should: "Plan and Coordinate Regionally. When addressing housing, transportation, and economic development projects, consider the impacts on neighbors and the needs for such projects that are already being filled by neighboring communities. Share review of plans and projects."

New Development and Infrastructure

As part of the process of developing recommendations for new mitigation measures for this plan update, the Town considered the issues related to new development, redevelopment, and infrastructure needs in order limit future risks. Taking into consideration the town's Zoning District enforced for new development by the Zoning Board, the stormwater requirements enforced for new development by the Department of Public Works, the Wetlands Protection Act enforced for new development by the Conservation Commission, the recently revised Comprehensive Plan (2014), and the new 2016 Open Space Plan, the town determined that existing regulatory measures are taking advantage of available Home Rule land use regulatory authority to minimize natural hazard impacts of new development and redevelopment. The town is pursuing one recommended regulatory change, listed below, to ensure that the local zoning district is consistent with the most recent FIRM mapping for Hudson.

Recommended Mitigation Measures

The recommended mitigation measures are provided in this section and summarized in Table 28, and prioritization is summarized in Table 29..

Flooding

A) Implement Culvert and Drainage Upgrades
The town should monitor and alleviate localized flooding problems with culvert or drainage upgrades. This effort will proceed in two phases, with the first consisting of a system-wide assessment to identify specific problem areas that need to be addressed, and in the second phase should consist of implementing the culvert and drainage upgrades identified in Phase 1.

B) Update Zoning to Reflect new FIRM Flood maps
FEMA is recently updated the Flood Insurance Rate Maps (FIRM) for Middlesex County. The Town's Floodplain Protection Zoning District should be amended to reflect the boundaries of flood hazard zones in the current FIRM for Hudson.

C) Open Space Protection / Land acquisition
Protection of open space is important in order to ensure future development does not increase flooding. The town should implement priority open space protection and acquisitions, such as through the Community Preservation Act, and per the recommendations of the parcels identified in the 2016 Open Space Plan.

D) Develop a Long-Term Management Plan To Control Beaver Activity
Several waterways in town have had beaver activity in the past few years. Development of a long-term management plan for beaver mitigation and for areas impacted by beaver dams is a priority for the town and the region.

Wind Hazards

E) Implement an Enhanced Tree Maintenance Program
In order to better mitigate against downed trees and power outages, due to wind and winter hazards, additional funding for the town's tree maintenance program is necessary. Currently the

Public Works department has just enough resources to trim or remove trees on an as-needed basis, but additional funding would help formalize a program to inventory trees and implement a regular rotation schedule for proactive preventative trimming.

Winter Hazards

F) Implement Building Snow Load Mitigation
Evaluate public buildings for ability of roofs to withstand snow loads; retrofit if needed to greatest degree feasible

G) Install Snow Barriers:
In order to prevent snow drifting along town roads, the town should install snow barriers such as snow fences within Rights-of-Way or encourage adjacent property owners to install snow barriers to prevent drifting onto public roadways.

Earthquakes

H) Implement Earthquake Building Mitigation
Conduct structural assessments to determine which public buildings may be most vulnerable to earthquake damage and implement any feasible options to reduce earthquake risk.

Fire Hazards

I) Implement Setback Requirements for Fire Protection
Implement a town regulation for a minimum setback to structures from forested or wild land growth areas in order to help minimize risk to property and personal injury from brush fires by maintaining a fire buffer around structures.

Extreme Temperatures

J) Site Design Guidelines for Tree Plantings
Implement Site Design guidelines to increase tree plantings for shade and heat mitigation, increase the percentage of trees used in parking areas, and along public ways.

K) Building Guidelines for Green Buildings and Cool Roofs
Implement development guidelines for Green Building and Cool Roof designs.

Drought

L) Site Design Guidelines for Drought Tolerant Landscaping
Implement development guidelines for the use of drought-tolerant landscaping in new development and redevelopment

M) Assessment of Potential Contamination and Solutions at Chestnut Street Wells #2 &3
The Chestnut Street drinking water wells #2 and #3 have experienced flooding in the past and as a result there is a risk for contamination at these wells in the event of a future flood event. A further assessment of the risk to these wells should be prepared, including potential solutions such as structural measures or back-up well sites.

Climate Change

N) Climate Resilience and Adaptation
Incorporate climate resilience/adaptation components into the Town's next Comprehensive Plan

Introduction to Potential Mitigation Measures Table (Table 28)

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 considered by the local Hazard Mitigation Team.

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

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

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

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

Army Corps of Engineers (ACOE) – The website for the North Atlantic district office is http://www.nae.usace.army.mil/. The ACOE provides assistance in a number of types of projects

including shoreline/streambank protection, flood damage reduction, flood plain management services and planning services.

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

Abbreviations Used in Table 28

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

ACOE =	Army Corps of Engineers.
DHS/EOPS =	Department of Homeland Security/Emergency Operations
DEP (SRF) =	Department of Environmental Protection (State Revolving Fund)
USDA =	United States Department of Agriculture
Mass DOT =	Massachusetts Department of Transportation
DCR =	MA Department of Conservation and Recreation

Table 28
Recommended Mitigation Measures

Mitigation Measure	Priority	Lead Implementation	Time Frame	Estimated Cost	Potential Funding Sources
FLOODING					
A-1) Culvert and drainage upgrades – Whole system Assessment and Evaluation	High	Public Works	2017-2018	$66,000	Town of Hudson General Fund
A-2) Culvert and drainage upgrades – Implementation	High	Public Works	2018-2022	$75,000 - $100,000	Town of Hudson General Fund / FEMA Mitigation
B) Open Space protection / land acquisition	Medium	Conservation Commission	2017-2022	$100,000+ Varies by parcel value	Town of Hudson General Fund / State O.S. Grants
C) Update of Floodplain Zoning to reflect new FIRM flood maps	High	Zoning Board	2018-2019	Part of larger zoning review $84,000 total	Town of Hudson General Fund
D) Develop a Long-term management plan to control beaver activity	Medium	Public Works/ Conservation Commission	2018-2020	$10,000 to $100,000	Town of Hudson General Fund
WIND RELATED HAZARDS					
E) Provide tree maintenance program funding	Medium	Public Works	2017 - 2022	$10,000 to $100,000 per year	Town of Hudson General Fund
WINTER STORMS					
F) Implement snow load mitigation for public buildings	Low	Building Dept	2019-2020	Staff time, possible consultant	Town of Hudson General Fund
G) Install Snow Barriers	Low	Public Works	2018-2020	Low -Staff time	Town of Hudson General Fund
EARTHQUAKES					
H) Implement earthquake mitigation for public buildings	Low	Building Dept	2019-2020	Staff time, possible consultant	Town of Hudson General Fund
BRUSHFIRES					
I) Implement Setback Requirements for Fire Protection	Medium	Fire Department /Zoning Board	2018-2019	Part of larger zoning review $84,000 total	Town of Hudson General Fund
EXTREME TEMPERATURES					

Table 28
Recommended Mitigation Measures

Mitigation Measure	Priority	Lead Implementation	Time Frame	Estimated Cost	Potential Funding Sources
J) Implement Site Design guidelines for to increase tree plantings for shade	Medium	Planning Board/ Conservation Commission	2018-2020	Low – Staff time	Town of Hudson General Fund
K) Implement development guidelines for Green Building and Cool Roof designs	Medium	Building Dept/ Planning Board	2018-2020	Low – Staff time	Town of Hudson General Fund
DROUGHT					
L) Implement Site Design guidelines for drought tolerant landscaping and site design measures	Medium	Planning Board/ Conservation Commission	2018-2020	Low – Staff time	Town of Hudson General Fund
M) Assess potential contamination & solutions at Chestnut Street Wells 2 & 3	High	Public Works / Health Dept.	2017 - 2022	$5,000 - $20,000 for consultant	Town of Hudson General Fund
CLIMATE RESILIENCE / ADAPTATION					
N) Incorporate climate resilience/adaptation components into the next Comprehensive Plan	High	Planning Board/ Conservation Commission/ Public Works	2020-2022	$10,000 TO $25,000	Town of Hudson General Fund

Process for Setting Priorities for Mitigation Measures

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

Priority setting was based on local knowledge of the hazard areas, including impacts of hazard events, the extent of the area impacted, and the relation of a given mitigation measure to the Town's goals. In addition, the local Hazard Mitigation Planning Team also took into consideration factors such as the number of homes and businesses affected, whether or not road closures

occurred and what impact closures had on delivery of emergency services and the local economy, anticipated project costs, whether any environmental constraints existed, and whether the Town would be able to justify the costs relative to the anticipated benefits.

Table 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
Flood Hazard Mitigation				
A) Implement culvert and drainage upgrades	Town-Wide	High	High	High
B) Open Space protection / land acquisition	Town-Wide	High	High	Medium
C) Update of Zoning to reflect new FIRM Flood maps	Flood Zones	Medium	Low	High
D) Long-term management plan to control beaver activity	Beaver dam areas	Medium	Low	Medium
Wind Mitigation Measures				
E) Provide tree maintenance program funding	Town-Wide	Medium	Medium	Medium
Winter Storm Hazard Mitigation				
F) Implement snow load mitigation for public buildings	Public Buildings	Medium	Medium	Low
G) Install Snow Barriers	Town-Wide	Low	Medium	Low
Earthquake Mitigation				
H) Implement earthquake mitigation for public buildings	Public Buildings	Medium	Medium	Low
Brushfire Mitigation				
I) Implement Setback Requirements for Fire Protection	Town-Wide	Medium	Low	Medium
Extreme Temperature Mitigation				
J) Implement Site Design guidelines to increase tree plantings	Town-Wide	Medium	Low	Medium
K) Implement development guidelines for Green Building and Cool Roof designs	Town-Wide	Medium	Low	Medium
Drought Mitigation				
L) Implement guidelines for drought tolerant landscaping and site design measures	Town-Wide	Medium	Low	Medium
M) Assess potential contamination and solutions at Chestnut Street Wells 2 &3	Chestnut Street Wells	High	Medium	High
Climate Resilience/Adaptation				
N) Incorporate climate resilience/adaptation components into the next Comprehensive Plan	Town-Wide	High	Medium	High

IX. PLAN ADOPTION AND MAINTENANCE

Plan Adoption

The *Town of Hudson Hazard Mitigation Plan 2017 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].

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 Hudson Hazard Mitigation Planning Team to prepare this plan. After approval of the plan by FEMA, this group will meet to function as the Hazard Mitigation Implementation Team, with the Fire Chief 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 Fire Chief, will have primary responsibility for tracking progress, evaluating, and updating the plan.

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

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

Prepare and Adopt an Updated Local Hazard Mitigation Plan –Once the resources have been secured to update the plan, the Hazard Mitigation Implementation Team may decide to undertake the update themselves, contract with the Metropolitan Area Planning Council to update the plan or to hire another consultant. However the Hazard Mitigation Implementation Team decides to update the plan, the group will need to review the current FEMA hazard mitigation plan guidelines for any changes. The Hudson 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 *Town of Hudson Hazard Mitigation Plan 2017 Update* by FEMA, the Local Hazard Mitigation Team will provide all interested parties and implementing departments with a copy of the plan and will initiate a discussion regarding how the plan can be integrated into that department's ongoing work. At a minimum, the plan will be reviewed and discussed with the following departments:

- Fire Department
- Emergency Management
- Police Department
- Public Works Department
- Engineering
- Planning and Community Development
- Zoning Board
- Conservation Commission
- Parks and Recreation
- Building Department

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 Hudson Comprehensive Plan, Open Space Plan, Comprehensive Emergency Management Plan, and Capital Investment Program.

X. LIST OF REFERENCES

Hudson Comprehensive Plan, 2014

Hudson Open Space Plan, 2016

Hudson Town By-Laws

Hudson Zoning By-Law, Floodplain Overlay District

Hudson Comprehensive Emergency Management Plan

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 Middlesex County, MA, 2012

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

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

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

MA Office of Dam Safety, Inventory of Massachusetts Dams

Metropolitan Area Planning Council, Geographic Information Systems Lab

New England Seismic Network, Weston Observatory, http://aki.bc.edu/index.htm

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

NOAA, National Climatic Data Center, website

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

USGS, National Water Information Center, website

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APPENDIX A

HAZARD MITIGATION PLANNING TEAM MEETING AGENDAS

Hudson Hazard Mitigation Plan Update

LOCAL HAZARD MITITGATION PLANNING TEAM

Meeting #1

Tuesday, September 29, 2015; 9:00 am

Hudson Fire Department HQ, 296 Cox Street, Hudson, MA 01749

AGENDA

1. Review Hazard Map Series and Digital Ortho Photo Map

2. Identify/Update Potential New Development Sites

3. Review/Update Local Hazard Areas of Concern

4. Review/Update Critical Facilities Inventory

5. Discuss Public Involvement and Outreach

    a) Identify local stakeholders
    b) Schedule first public meeting

6. Meeting Adjourn

Hudson Hazard Mitigation Plan Update

LOCAL HAZARD MITITGATION PLANNING TEAM

Meeting #2

Wednesday, April 20, 2016, 10:00 AM

Hudson Fire Department HQ, 296 Cox Street, Hudson, MA

AGENDA

1. WELCOME AND INTRODUCTIONS

2. REVIEW AND UPDATE PLAN GOALS

3. IDENTIFY/UPDATE NEW DEVELOPMENT SITES

4. UPDATE STATUS OF MITIGATION MEASURS FROM PREVIOUS PLAN

5. REVIEW UPDATED LISTS AND MAPS

Hudson Hazard Mitigation Plan Update

LOCAL HAZARD MITITGATION PLANNING TEAM

Meeting #3

Thursday, September 29, 2016, 10:00 AM

Hudson Fire Department HQ, 296 Cox Street, Hudson, MA

AGENDA

1. **WELCOME AND INTRODUCTIONS**
2. **REVIEW AND UPDATE EXISTING MITIGATION**
3. **UPDATE RECOMMENDED MITIGATION MEASURES**
4. **PRIORITIZE RECOMMENDED MITIGATION MEASURES**
5. **PLAN FOR 2ND PUBLIC MEETING**

APPENDIX B
HAZARD MAPPING

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

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

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

Map1: Population Density – This map uses the US Census block data for 2010 and shows population density as the number of people per acre in seven categories with 60 or more people per acre representing the highest density areas.

Map 2: Development – This map shows potential future developments, and critical infrastructure sites. MAPC consulted with town staff to determine areas that were likely to be developed or redeveloped in the future. The map also depicts current land use.

Map 3: Flood Zones – The map of flood zones used the FEMA NFIP Flood Zones as depicted on the FIRMs (Federal Insurance Rate Maps) for Middlesex County as its source. This map is not intended for use in determining whether or not a specific property is located within a FEMA NFIP flood zone. The currently adopted FIRMS for Hudson are kept by the Town. For more information, refer to the FEMA Map Service Center website http://www.msc.fema.gov. The definitions of the flood zones are described in detail on this site as well. The flood zone map for each community also shows critical infrastructure and repetitive loss areas.

Map 4: Earthquakes and Landslides – This information came from NESEC. For most communities, there was no data for earthquakes because only the epicenters of an earthquake are mapped.

The landslide information shows areas with either a low susceptibility or a moderate susceptibility to landslides based on mapping of geological formations. This mapping is highly general in

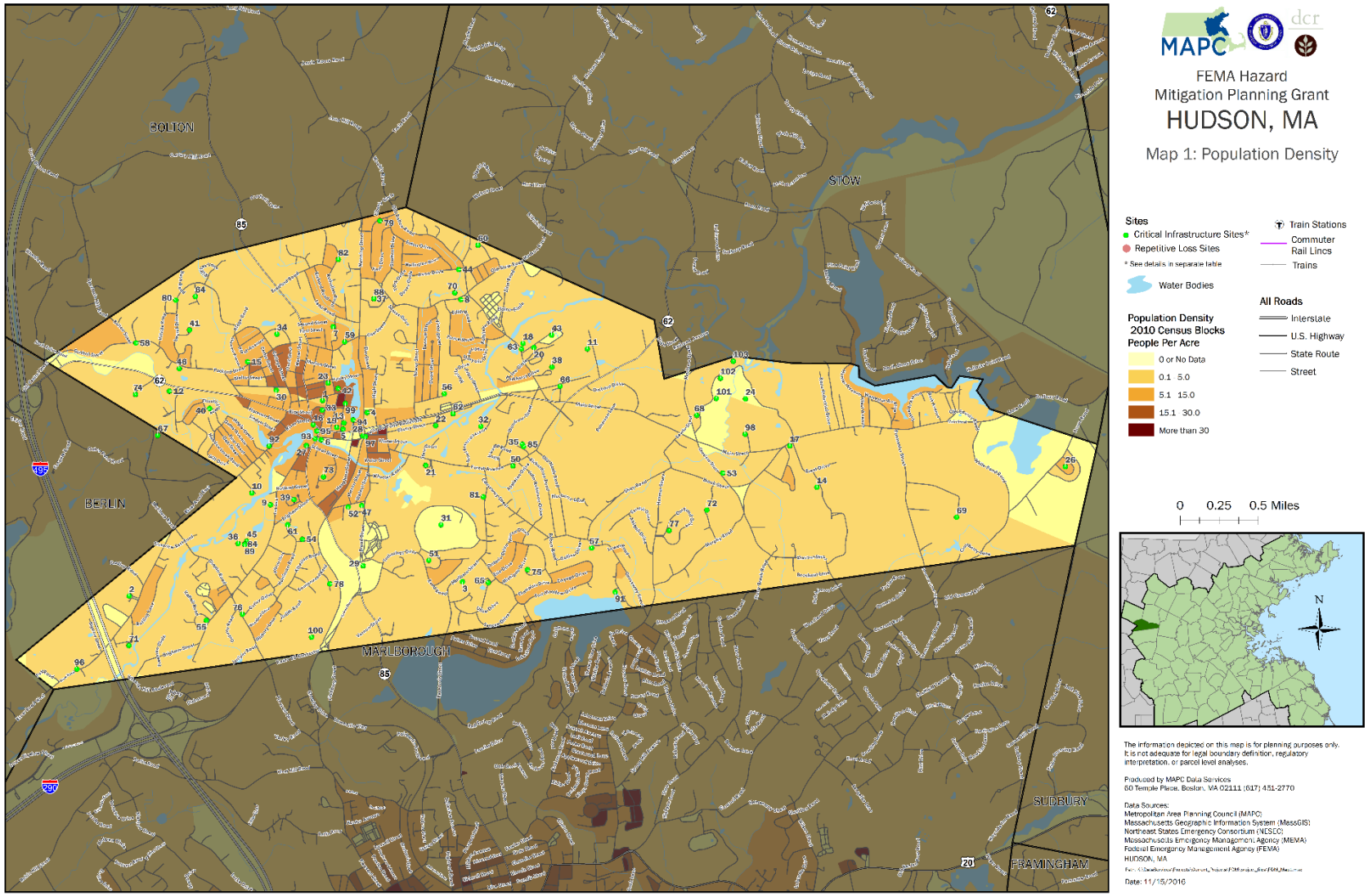
nature. For more information on how landslide susceptibility was mapped, refer to http://pubs.usgs.gov/pp/p1183/pp1183.html.

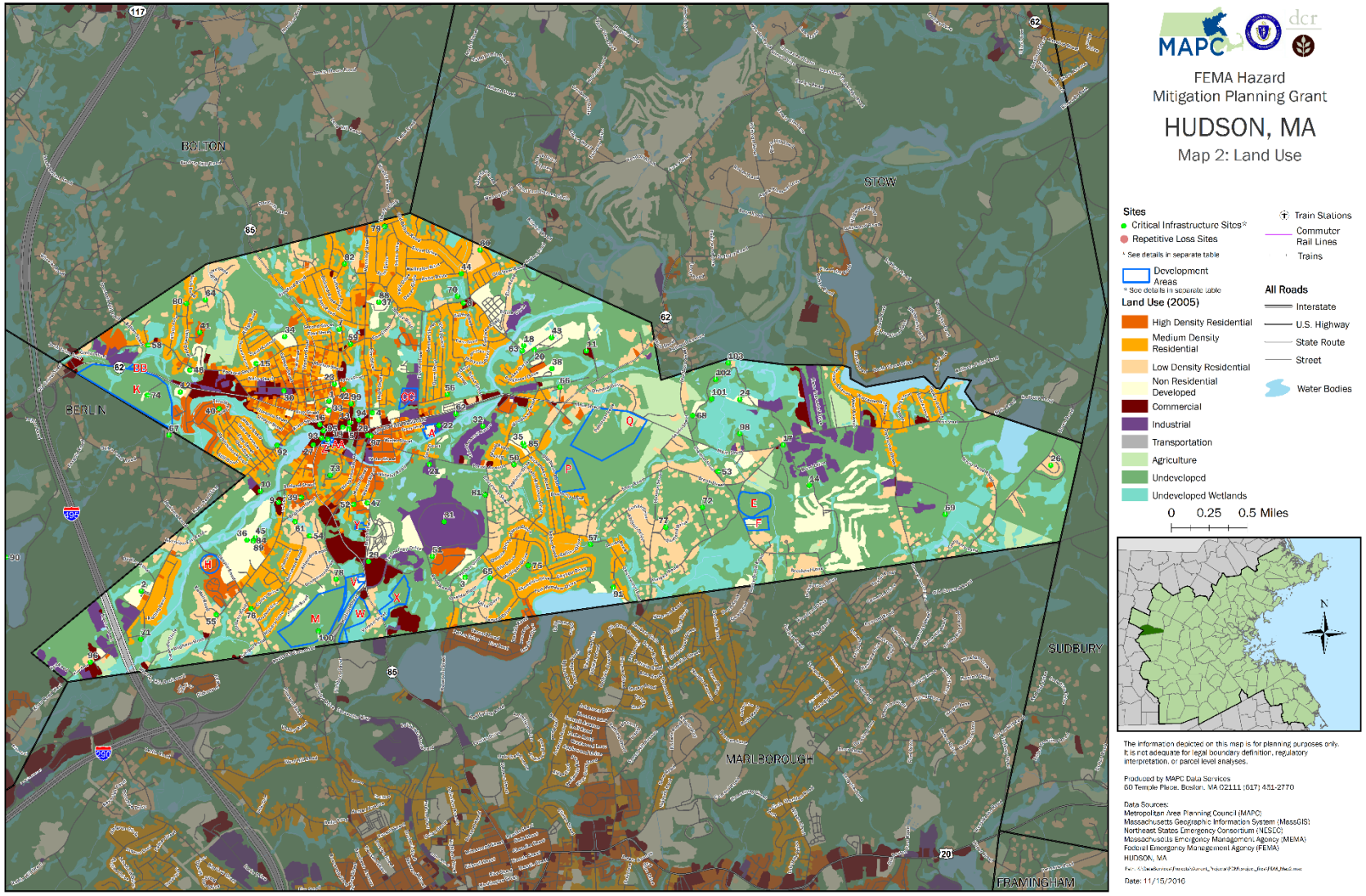
Map 5: Hurricanes and Tornadoes – This map shows a number of different items. The map includes the storm tracks for both hurricanes and tropical storms, if any occurred in this community. This information must be viewed in context. A storm track only shows where the eye of the storm passed through. In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

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

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

Map 8: Hazard Areas – For each community, locally identified hazard areas are overlaid on an aerial photograph dated April, 2008. The critical infrastructure sites are also shown. The source of the aerial photograph is Mass GIS.


BOLTON
STOW
BERLIN
MARLBOROUGH
SUDBURY
FRAMINGHAM
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
HUDSON, MA
Map 1: Population Density
Sites
Critical Infrastructure Sites*
Repetitive Loss Sites
* See details in separate table
Water Bodies
Train Stations
Commuter Rail Lines
Trains
All Roads
Interstate
U.S. Highway
State Route
Street
Population Density
2010 Census Blocks
People Per Acre
0 or No Data
0.1 5.0
5.1 15.0
15.1 30.0
More than 30
0 0.25 0.5 Miles
N
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel level analyses.
Produced by MAPC Data Services
60 Temple Place, Boston, MA 02111 (617) 451-2770
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
HUDSON, MA
Date: 11/15/2016


MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
HUDSON, MA
Map 2: Land Use
BOLTON
STOW
BERLIN
MARLBOROUGH
SUDBURY
FRAMINGHAM
Sites
Critical Infrastructure Sites*
Repetitive Loss Sites
* See details in separate table
Development Areas
* See details in separate table
Land Use (2005)
High Density Residential
Medium Density Residential
Low Density Residential
Non Residential Developed
Commercial
Industrial
Transportation
Agriculture
Undeveloped
Undeveloped Wetlands
Train Stations
Commuter Rail Lines
Trains
All Roads
Interstate
U.S. Highway
State Route
Street
Water Bodies
0 0.25 0.5 Miles
N
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel level analyses.
Produced by MAPC Data Services
60 Temple Place, Boston, MA 02111 (617) 451-2770
Data Sources:
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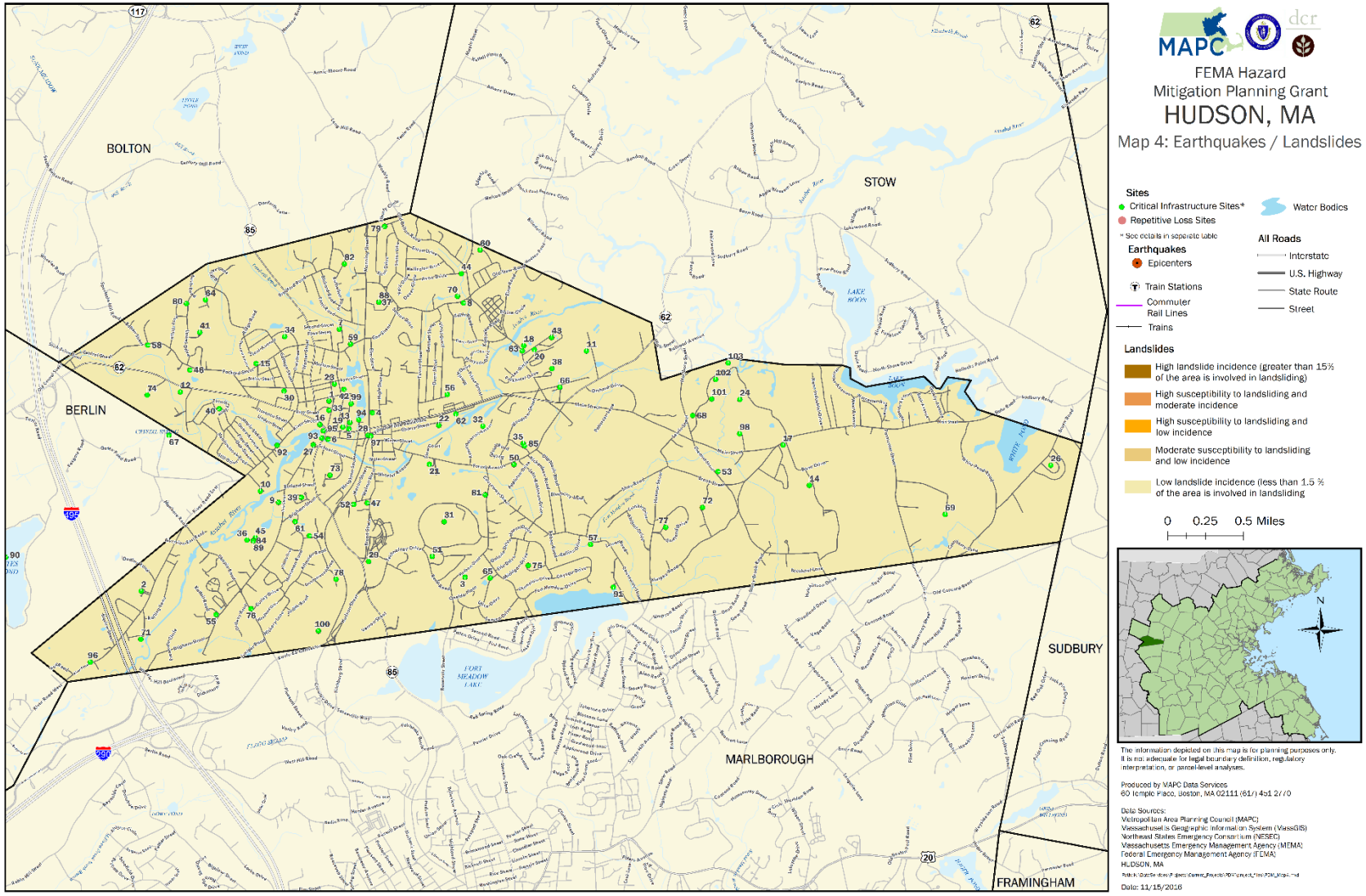
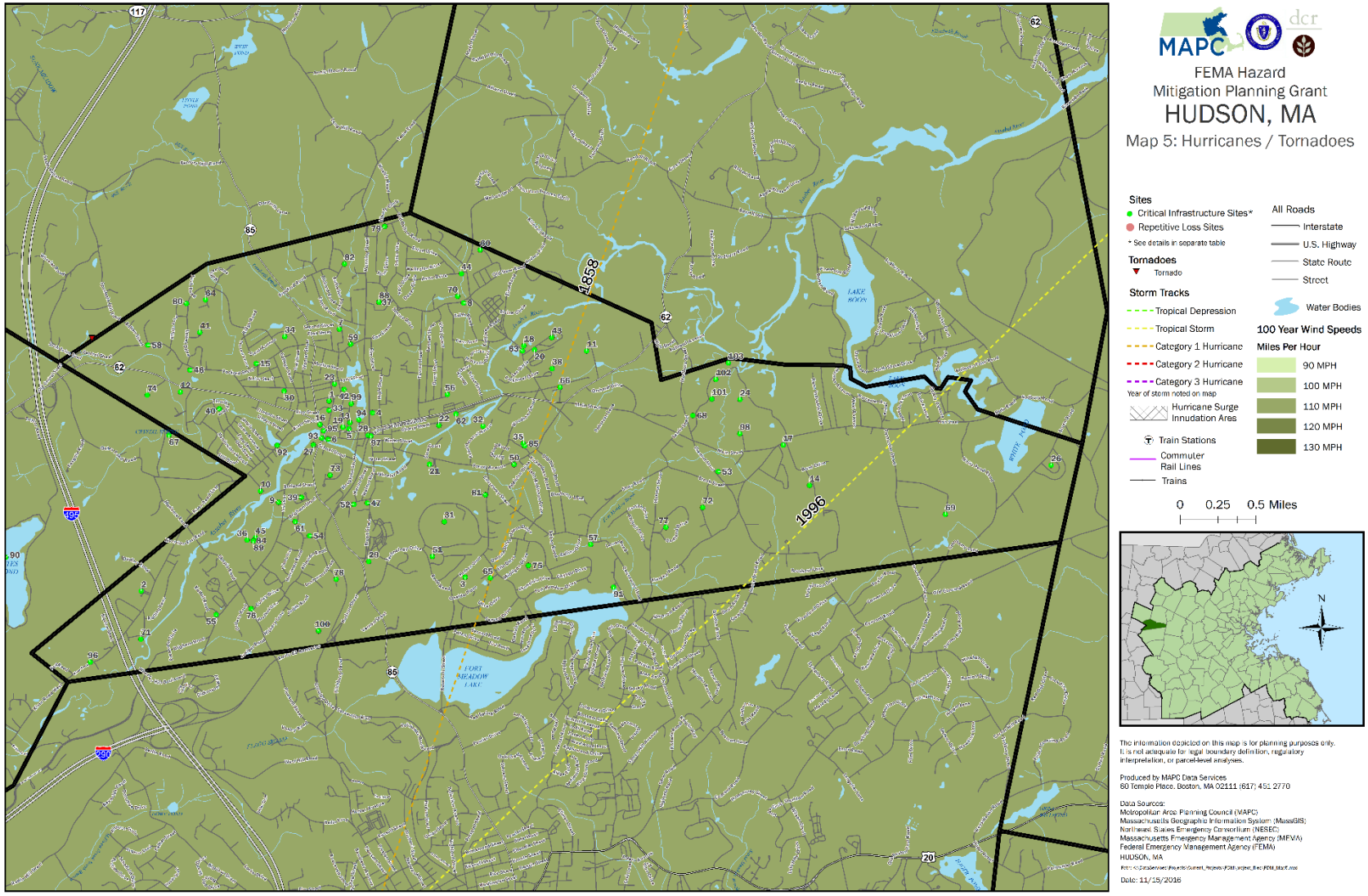
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
HUDSON, MA
Date: 11/15/2016


BOLTON
STOW
BERLIN
SUDBURY
MARLBOROUGH
FRAMINGHAM
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
HUDSON, MA
Map 3: Flood Zones
Sites
Critical Infrastructure Sites*
Repetitive Loss Sites
* See details in separate table
Water Bodies
Flood Zones, 2014
(Annual Chance)
A: 1% Annual Chance of Flooding, no BFE
AE: 1% Annual Chance of Flooding, with BFE
AE: Regulatory Floodway
D: Possible But Undetermined Hazard
X: 0.2% Annual Chance of Flooding
Locally Identified Hazard Areas*
Flooding
* See Section IV Risk Assessment
Development Areas*
* See details in separate table
Train Stations
Commuter Rail Lines
Trains
All Roads
Interstate
U.S. Highway
State Route
Street
0 0.25 0.5 Miles
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel level analyses.
Produced by MAPC Data Services
60 Temple Place, Boston, MA 02111 (617) 451-2770
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Flood Zones datalayer updated by MassGIS October 2013 from finalized data provided by Federal Emergency Management Agency (FEMA)
HUDSON, MA
Date: 11/15/2016


BOLTON
STOW
BERLIN
SUDBURY
MARLBOROUGH
FRAMINGHAM
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
HUDSON, MA
Map 4: Earthquakes / Landslides
Sites
Critical Infrastructure Sites*
Repetitive Loss Sites
* See details in separate table
Earthquakes
Epicenters
Train Stations
Commuter Rail Lines
Trains
Water Bodies
All Roads
Interstate
U.S. Highway
State Route
Street
Landslides
High landslide incidence (greater than 15% of the area is involved in landsliding)
High susceptibility to landsliding and moderate incidence
High susceptibility to landsliding and low incidence
Moderate susceptibility to landsliding and low incidence
Low landslide incidence (less than 1.5 % of the area is involved in landsliding
0 0.25 0.5 Miles
N
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analyses.
Produced by MAPC Data Services
60 Temple Place, Boston, MA 02111 (617) 451 2770
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
HUDSON, MA
Date: 11/15/2016


MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
HUDSON, MA
Map 5: Hurricanes / Tornadoes
Sites
Critical Infrastructure Sites*
Repetitive Loss Sites
* See details in separate table
Tornadoes
Tornado
Storm Tracks
Tropical Depression
Tropical Storm
Category 1 Hurricane
Category 2 Hurricane
Category 3 Hurricane
Year of storm noted on map
Hurricane Surge Innudation Area
Train Stations
Commuter Rail Lines
Trains
All Roads
Interstate
U.S. Highway
State Route
Street
Water Bodies
100 Year Wind Speeds
Miles Per Hour
90 MPH
100 MPH
110 MPH
120 MPH
130 MPH
0 0.25 0.5 Miles
1858
1996
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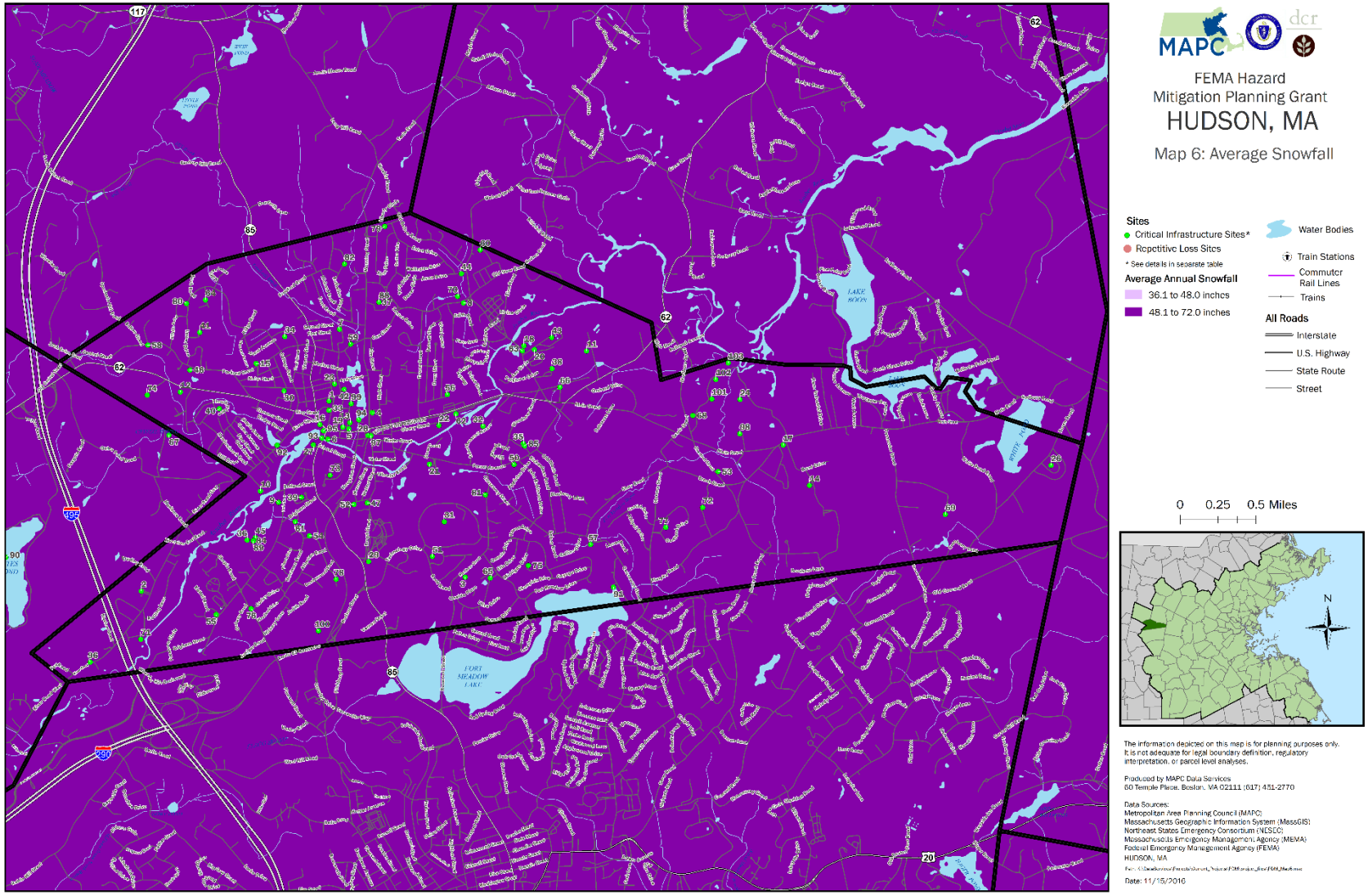
MAPC
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FEMA Hazard
Mitigation Planning Grant
HUDSON, MA
Map 6: Average Snowfall
Sites
Critical Infrastructure Sites*
Repetitive Loss Sites
* See details in separate table
Average Annual Snowfall
36.1 to 48.0 inches
48.1 to 72.0 inches
Water Bodies
Train Stations
Commuter Rail Lines
Trains
All Roads
Interstate
U.S. Highway
State Route
Street
0 0.25 0.5 Miles
N
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel level analyses.
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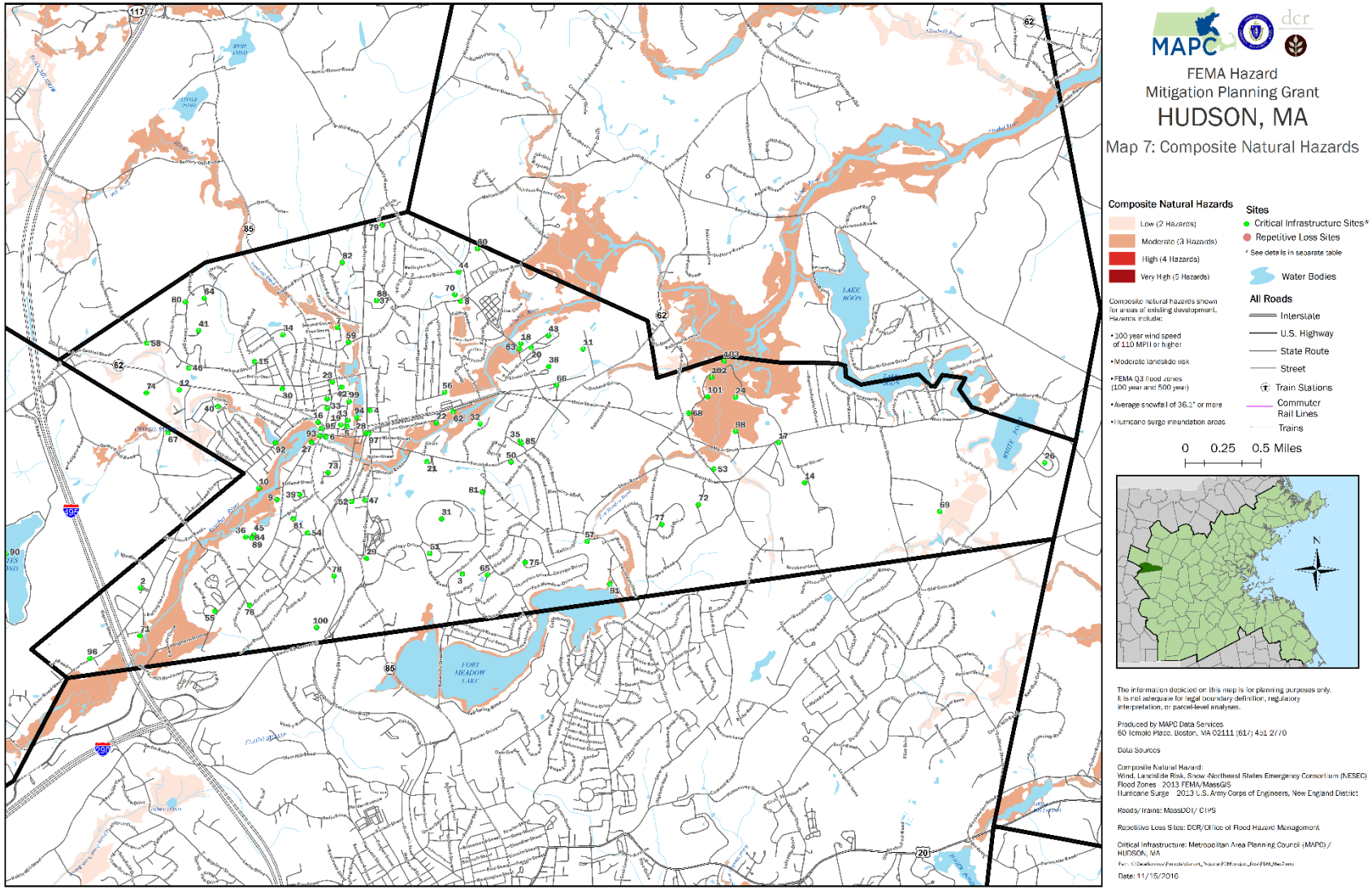
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
HUDSON, MA
Map 7: Composite Natural Hazards
Composite Natural Hazards
Low (2 Hazards)
Moderate (3 Hazards)
High (4 Hazards)
Very High (5 Hazards)
Composite natural hazards shown for areas of existing development. Hazards include:
• 100 year wind speed of 110 MPH or higher
• Moderate landslide risk
• FEMA Q3 flood zones (100 year and 500 year)
• Average snowfall of 36.1" or more
• Hurricane surge innundation areas
Sites
Critical Infrastructure Sites*
Repetitive Loss Sites
* See details in separate table
Water Bodies
All Roads
Interstate
U.S. Highway
State Route
Street
Train Stations
Commuter Rail Lines
Trains
0 0.25 0.5 Miles
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analyses.
Produced by MAPC Data Services
60 Temple Place, Boston, MA 02111 (617) 451 2770
Data Sources
Composite Natural Hazard:
Wind, Landslide Risk, Snow: Northeast States Emergency Consortium (NESEC)
Flood Zones 2013 FEMA/MassGIS
Hurricane Surge 2013 U.S. Army Corps of Engineers, New England District
Roads/ trains: MassDOT/ CTPS
Repetitive Loss Sites: DCR/Office of Flood Hazard Management
Critical Infrastructure: Metropolitan Area Planning Council (MAPC) / HUDSON, MA
Date: 11/15/2016


BOLTON
STOW
BERLIN
MARLBOROUGH
SUDBURY
FRAMINGHAM
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
HUDSON, MA
Map 8: Local Hazard Areas
Sites
Critical Infrastructure Sites*
Repetitive Loss Sites
* See details in separate table
Locally Identified
Hazard Areas
Brush Fires
Flooding
Drifting Snow
* See Section IV Risk Assessment
Development Sites
* See details in separate table
Train Stations
Commuter
Rail Lines
Trains
All Roads
Interstate
U.S. Highway
State Route
Street
0
0.5
1 Miles
N
The information depicted on this map is for planning purposes only.
It is not adequate for legal boundary definition, regulatory
interpretation, or parcel level analyses.
Produced by MAPC Data Services
60 Temple Place, Boston, MA 02111 (617) 451-2770
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
HUDSON, MA
Date: 11/15/2016

APPENDIX C
DOCUMENTATION OF PUBLIC MEETINGS

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

CALENDAR LISTING / MEDIA ADVISORY

HUDSON'S DRAFT HAZARD MITIGATION PLAN TO BE PRESENTED AT DECEMBER 15 PUBLIC MEETING

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

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

What: At the Hudson Planning Board meeting on Tuesday, December 15 at 7:00 PM, a presentation will be made by the Metropolitan Area Planning Council (MAPC), which is assisting the Town on the 2015 update of its Hazard Mitigation Plan.

The Town of Hudson adopted its first Hazard Mitigation Plan in 2010, which was approved by the Federal Emergency Management Agency (FEMA). The plan identifies natural hazards affecting Hudson such as floods, hurricanes, winter storms, and earthquakes, as well as actions that the Town can take to reduce its vulnerability to these hazards.

When: Tuesday, December 15, 2015, 7:00 PM

Where: Selectmen's Hearing Room, Town Hall, 78 Main Street, Hudson, 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.

##

Hudson Stakeholders Email Notification

Dear Town of Hudson stakeholder:

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

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

Tuesday, December 15, 2015 at 7pm
Selectmen's Hearing Room, Town Hall
78 Main Street, Hudson, MA

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

Best,
Tanya

Tanya Paglia
Regional Planner
Minuteman Advisory Group on Interlocal Coordination (MAGIC) Subregional Coordinator
Metropolitan Area Planning Council
60 Temple Place | Boston, MA 02111
617-933-0781
tpaglia@mapc.org
www.mapc.org

HAZARD MITIGATION PLAN PUBLIC MEETING

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



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

Date: **Tuesday, December 15, 2015**
Time: **7:00 PM**
Location: **Selectmen's Hearing Room, Town Hall**
78 Main Street, Hudson, MA

For more information, please contact Tanya Paglia via phone at (617) 933-0781 or email tpaglia@mapc.org

MAPC
METROPOLITAN AREA PLANNING COUNCIL

Town of Hudson
Planning Department
78 Main Street, Hudson, MA 01749
Tel: (978) 562-9963 Fax: (978) 568-9641
Email: jhunter@townofhudson.org

MEETING AGENDA
December 15, 2015
7:00 PM
Selectmen's Hearing Room, Town Hall

7:00 PM – Site Plans

- 542 Main Street - Site Plan Review, *Cont.*
- 304 Cox Street, Site Plan Review
- 1 Municipal Drive, Site Plan Review, *Police/DPW Headquarters*

Hudson Hazard Mitigation Plan Update, Tanya Paglia, MAPC

Brigham Hill III – Request extension of time to complete subdivision

Brigham Hill III – bond reduction request

C-1 Zoning Update

Minutes

- November 17, 2015

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

CALENDAR LISTING / MEDIA ADVISORY

HUDSON'S DRAFT HAZARD MITIGATION PLAN 2016 UPDATE TO BE PRESENTED AT NOVEMBER 18 PUBLIC MEETING

Public Meeting to present the Draft Hudson Hazard Mitigation Plan 2016 Update

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

What: A public presentation will be made on the town's Draft Hazard Mitigation Plan 2016 Update at the Hudson Internal Traffic Committee meeting on Tuesday, November 18 at 10:00 AM in Town Hall. The presentation will be made by the Metropolitan Area Planning Council (MAPC), which is assisting the town in preparing the 2016 update to the Hazard Mitigation Plan.

The Town of Hudson adopted its first Hazard Mitigation Plan in 2010, which was approved by the Federal Emergency Management Agency (FEMA). The plan identifies natural hazards affecting Hudson such as floods, hurricanes, winter storms, and earthquakes, as well as actions that the Town can take to reduce its vulnerability to these hazards. The plan is now being updated to reflect current conditions and priorities for the town's hazard mitigation measures.

When: Friday, November 18, 2016, 10:00 AM

Where: Town Hall, 2nd Floor Selectmen's Hearing Room, 78 Main Street, Hudson, 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.

##

HAZARD MITIGATION PLAN PUBLIC MEETING

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



The Hudson Hazard Mitigation Plan is being updated to help the town reduce its vulnerability to natural hazard events such as flooding, hurricanes, winter storms and wild fires. Please join the Town for a public presentation on the draft 2016 update to the plan and an opportunity to ask questions and provide comments. The presentation will be made by the Metropolitan Area Planning Council, which is assisting the town in preparing the updated plan.

Date: Friday, November 18, 2016
Time: 10:00 AM
Location: Selectmen's Hearing Room, Town Hall
78 Main Street, Hudson, MA

For more information, please contact Martin Pillsbury via phone at (617) 933-0747 or email mpillsbury@mapc.org

MAPC

Hudson Stakeholders Email Notification

Dear Town of Hudson stakeholder:

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

Please join the Town for a presentation of the Draft Hudson Hazard Mitigation Plan 2016 Update at a public meeting on the following date and location:

Friday, November 18, 2016 at 10:00 AM
Internal Traffic Control Meeting
Selectmen's Hearing Room, 2nd Floor, Town Hall
78 Main Street, Hudson, MA

Please feel free to forward the attached flyer to residents, business owners and anyone who may interested in the town's Hazard Mitigation Plan.

Best Regards,

Marti Pillsbury
Environmental Planning Director
Metropolitan Area Planning Council
60 Temple Place | Boston, MA 02111
617-933-0747
mpilsbury@mapc.org
www.mapc.org

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

Town of Hudson

Planning and Community Development Department

78 Main Street, Hudson, MA 01749
Tel: (978) 562-9963 Fax: (978) 568-9641
Email: kjohnson@townofhudson.org

INTERNAL TRAFFIC COMMITTEE MEETING AGENDA
November 18, 2016
10:00 AM
Selectman's Hearing Room, Town Hall

Transportation Issues

1) Town Hall employee parking- possible removal of the two, 15-minute parking spaces
2) Signal timing at the Brigham Street/Washington Street intersection (continued from October 28, 2016)
3) Grove Street

Other Business

1) Hazardous Mitigation Plan, Martin Pillsbury, Environmental Director, MAPC

Minutes

October 28, 2016 – Discussion and possible vote

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APPENDIX D
DOCUMENTATION OF PLAN ADOPTION

<TOWN LETTERHEAD>

CERTIFICATE OF ADOPTION
BOARD OF SELECTMEN
TOWN OF HUDSON, MASSACHUSETTS

A RESOLUTION ADOPTING THE
TOWN OF HUDSON HAZARD MITIGATION PLAN 2017 UPDATE

WHEREAS, the Town of Hudson established a Committee to prepare the *Town of Hudson Hazard Mitigation Plan 2017 Update*; and

WHEREAS, the *Town of Hudson Hazard Mitigation Plan 2017 Update* contains several potential future projects to mitigate potential impacts from natural hazards in the Town of Hudson, and

WHEREAS, duly-noticed public meetings were held by the PLANNING BOARD on December 15, 2015, and the Internal Traffic Committee on November 18, 2016;

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

NOW, THEREFORE BE IT RESOLVED that the Town of Hudson BOARD OF SELECTMEN adopts the *Town of Hudson Hazard Mitigation Plan 2017 Update*, in accordance with M.G.L. 40 §4 or the charter and bylaws of the Town of Hudson.

ADOPTED AND SIGNED this Date. _____

Name(s)

Title(s)

Signature(s)

ATTEST