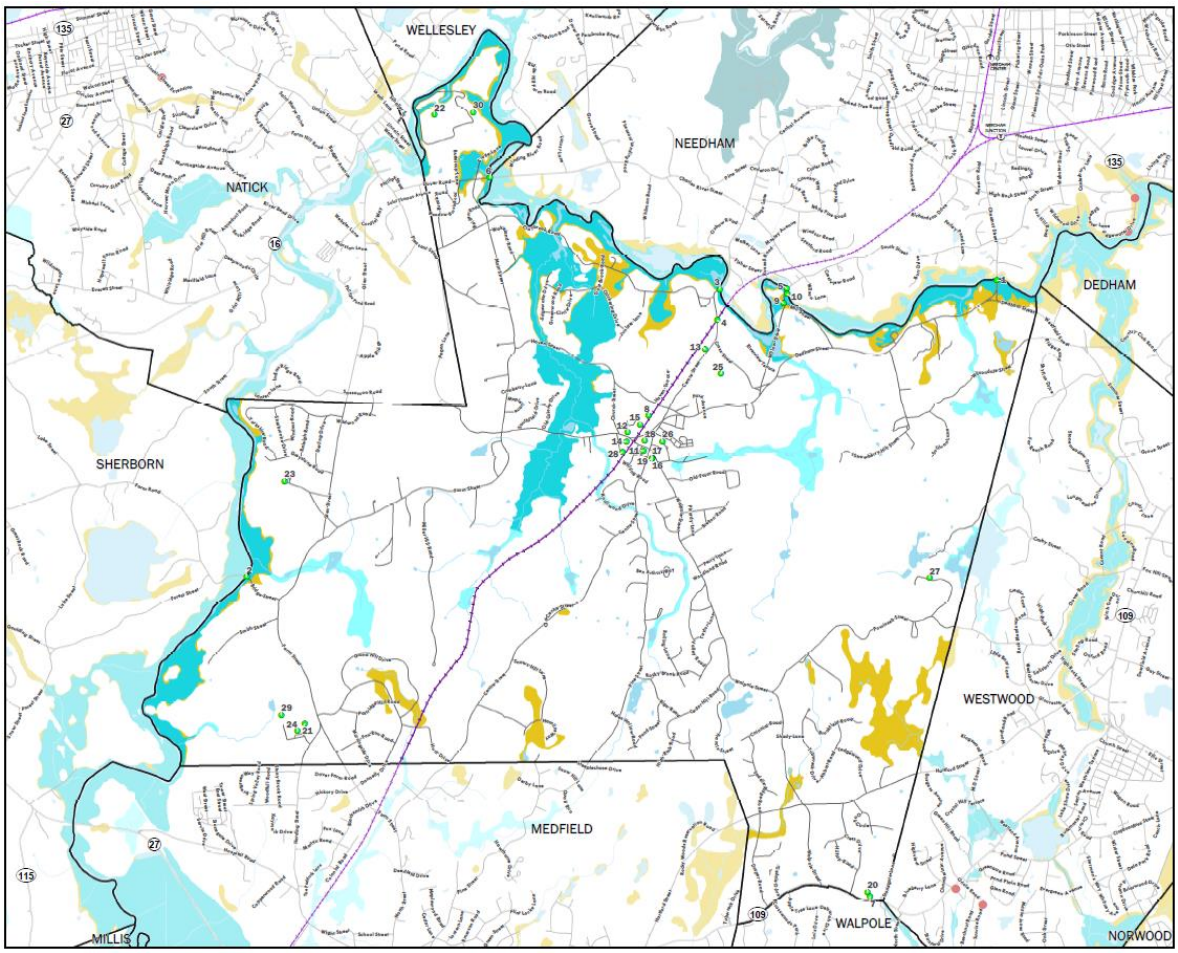
# TOWN OF DOVER
# HAZARD MITIGATION PLAN
# 2016 UPDATE




MAPC
METROPOLITAN AREA PLANNING COUNCIL

**Final Plan**
**Adopted by the Town of Dover**
**July 14, 2016**

**TOWN OF DOVER HAZARD MITIGATION PLAN**
**2016 UPDATE**

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**2016 UPDATE**

## ACKNOWLEDGEMENTS AND CREDITS

This plan was prepared for the Town of Dover 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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# I. EXECUTIVE SUMMARY

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

## Planning Process

Planning for the Hazard Mitigation Plan update was led by the Dover Local Hazard Mitigation Planning Team, composed of staff from a number of different Town Departments. After an introductory meeting with MEMA on June 16, 2004, the Local Team met on December 15, 2014, and May 7, 2015 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 Local Team hosted two public meetings, the first on April 6, 2015 and the second on July 27, 2015, and the draft plan update was posted on the Town's website for public review. Key Town stakeholders and neighboring communities were notified and invited to review the draft plan and submit comments.

## Risk Assessment

The Dover 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 Dover Local Hazard Mitigation Planning Team identified 32 Critical Facilities. These are also shown on the map series and listed in Table 21, 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 ($6.0 million to $19.5 million as well as earthquakes of magnitudes 5 and 7 ($76.8 million to $702million). Flood damage estimates range from $41 million to $208 million.

## Hazard Mitigation Goals

The Dover 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 identified natural hazards.

**Goal 2:** Build and enhance local mitigation capabilities to ensure individual safety, reduce damage to public and private property and ensure continuity of emergency services.

**Goal 3:** Increase cooperation and coordination among private entities, Town officials and Boards, State agencies and Federal agencies.

**Goal 4:** Increase awareness of the benefits of hazard mitigation through outreach and education.

**Goal 5:** Identify and seek funding for measures to mitigate or eliminate each known significant flood hazard area.

**Goal 6:** Integrate hazard mitigation planning as an integral factor in all relevant municipal departments, committees and boards.

**Goal 7:** Prevent and reduce the damage to public infrastructure resulting from all hazards.

**Goal 8:** Encourage the business community, major institutions and non-profits to work with the Town to develop, review and implement the hazard mitigation plan.

**Goal 9:** Work with surrounding communities to ensure regional cooperation and solutions for hazards affecting multiple communities.

**Goal 10:** Ensure that future development meets federal, state and local standards for preventing and reducing the impacts of natural hazards.

**Goal 11:** Take maximum advantage of resources from FEMA and MEMA to educate Town staff and the public about hazard mitigation.

## Hazard Mitigation Strategy

The Dover Local Hazard Mitigation Planning Team identified a number of mitigation measures that would serve to reduce the Town's vulnerability to natural hazard events.

Overall, the hazard mitigation strategy recognizes that mitigating hazards for Dover will be an ongoing process as our understanding of natural hazards and the steps that can be

taken to mitigate their damages changes over time. Global climate change and a variety of other factors impact the Town's vulnerability and in the future, and local officials will need to work together across municipal lines and with state and federal agencies in order to understand and address these changes. The Hazard Mitigation Strategy will be incorporated into the Town's other related plans and policies.

**Plan Review and Update Process**

**Table 1 - Plan Review and Update**

| Chapter | Reviews and Updates |
|---|---|
| III – Public Participation | The Local Hazard Mitigation Planning Team placed an emphasis on public participation for the update of the Hazard Mitigation Plan, discussing strategies to enhance participation opportunities at the first local committee meeting. During plan development, the plan was discussed at two public meetings hosted by the 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 Dover 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 2009 plan were reviewed and assessed as to whether they were completed, in-progress, or deferred. The Local Hazard Mitigation Planning Team determined whether to carry forward measures into the 2016 Plan Update, modify, or delete them. The Plan Update's hazard mitigation strategy reflects both new measures and measures carried forward from the 2009 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, Dover made some progress on implementing mitigation measures identified in the 2009 Hazard Mitigation Plan. Several projects have been completed including the Flagg Swamp parcel swap from MHD to MA Fish and Wildlife;

the redesign and reconstruction of the road section at Boundary Street Bridge that floods; and amending the Town's Floodplain and Wetland Ordinance.

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 2009 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 Dover Hazard Mitigation Implementation Team, as described in Section IX, Plan Adoption and Maintenance.

# II. INTRODUCTION

## Planning Requirements under the Federal Disaster Mitigation Act

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

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

## 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 Dover has experienced 21 natural hazards that triggered federal or state disaster declarations since 1991. These are listed in Table 2 below.

**Table 2 - Previous Federal/State Disaster Declarations**

| DISASTER NAME (DATE OF EVENT) | TYPE OF FEDERAL ASSISTANCE PROVIDED | DECLARED AREAS IN MA |
|---|---|---|
| Hurricane Bob (August 1991) | FEMA Public Assistance Project Grants | Counties of Barnstable, Bristol, Dukes, Essex, Hampden, Middlesex, Plymouth, Nantucket, Norfolk, Suffolk |
| | Hazard Mitigation Grant Program | Counties of Barnstable, Bristol, Dukes, Essex, Hampden, Middlesex, Plymouth, Nantucket, Norfolk, Suffolk (16 projects) |

| DISASTER NAME (DATE OF EVENT) | TYPE OF FEDERAL ASSISTANCE PROVIDED | DECLARED AREAS IN MA |
|---|---|---|
| No-Name Storm (October 1991) | FEMA Public Assistance Project Grants | Counties of Barnstable, Bristol, Dukes, Essex, Middlesex, Plymouth, Nantucket, Norfolk, Suffolk |
| | FEMA Individual Household Program | Counties of Barnstable, Bristol, Dukes, Essex, Middlesex, Plymouth, Nantucket, Norfolk, Suffolk |
| | Hazard Mitigation Grant Program | Counties of Barnstable, Bristol, Dukes, Essex, Middlesex, Plymouth, Nantucket, Norfolk, Suffolk |
| March Blizzard (March 1993) | FEMA Public Assistance Project Grants | Statewide |
| January Blizzard (January 1996) | FEMA Public Assistance Project Grants | Statewide |
| 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 |
| (1997) | Community Development Block Grant-HUD | Counties of Essex, Middlesex, Norfolk, Plymouth, Suffolk |
| June Flood (June 1998)<br><br>June Flood (June 1998 – cont) | 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 |
| | 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 |

| DISASTER NAME (DATE OF EVENT) | TYPE OF FEDERAL ASSISTANCE PROVIDED | DECLARED AREAS IN MA |
|---|---|---|
| February Snowstorm (Feb 17-18, 2003) | FEMA Public Assistance Project Grants | Statewide |
| January Blizzard (January 22, 2005) | FEMA Public Assistance Project Grants | Statewide |
| Hurricane Katrina (August 29, 2005) | FEMA Public Assistance Project Grants | Statewide |
| Rainstorm/ Flood (May 12-23, 2006) | Hazard Mitigation Grant Program | Statewide |
| April Nor'easter (April 15-27, 2007) | Hazard Mitigation Grant Program | Statewide |
| Flooding (March, 2010) | FEMA Public Assistance FEMA Individuals and Households Program SBA Loan | Bristol, Essex, Middlesex, Suffolk, Norfolk, Plymouth, Worcester |
| | Hazard Mitigation Grant Program | Statewide |
| Tropical Storm Irene August 27-28, 2011 | FEMA Public Assistance | Statewide |
| Hurricane Sandy October 27-30, 2012 | FEMA Public Assistance | Statewide |
| Severe snowstorm and Flooding February 8-09, 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**

Over the last 20 years the Town of Dover has not received funding from FEMA for any mitigation projects under the Hazard Mitigation Grant Program.

**Town Overview**

The Town of Dover is an affluent suburban community set between the western and southwestern axis of metropolitan Boston expansion.

The town is bordered by Medfield and Walpole on the south, Sherborn on the west, Natick on the northwest, Wellesley and Needham on the north and Westwood on the east. Dover is 16 miles southwest of Boston.

Incorporated in 1784, the town has an open town meeting form of government with a three member Board of Selectmen and a town administrator. The 2013 population was 5,677 and there were 1,969 housing units as of 2010. The Town maintains a website at http://www.doverma.org.

Dover relied on agriculture and grazing as the basis for its colonial economy although the ruggedness of its terrain plus the relative lack of water power limited its early growth. The damming of the Charles River in the late 18th century provided some power and allowed the development of mills which made nails and rolled iron, but the future of the community was not industrial.

By the late 19th century, Dover was a firmly suburban community some of whose residents had assembled large country estates. Wealthy Bostonians created at least 18 estates between 1901 and 1914 alone, some of them as large as 300-400 acres.

Modern Dover is a residential community that still retains a semi-rural character although there has been some development and subdividing of estate lands. The town has good access to Boston, though no numbered highways pass through the town itself. Additionally, commuter rail service into the city is available on the Needham Heights line, through several points in neighboring Needham.

*Narrative based on information provided by the Town of Dover*

**Table 3**
**Dover Characteristics**

Population = 5,677 (in 2013)
- 34.4% are under the age 19 (in 2013)
- 15.8% are age 65 or over (in 2013)

Number of Occupied Housing Units = 1,969 (in 2010)
- 5% are renter-occupied housing units

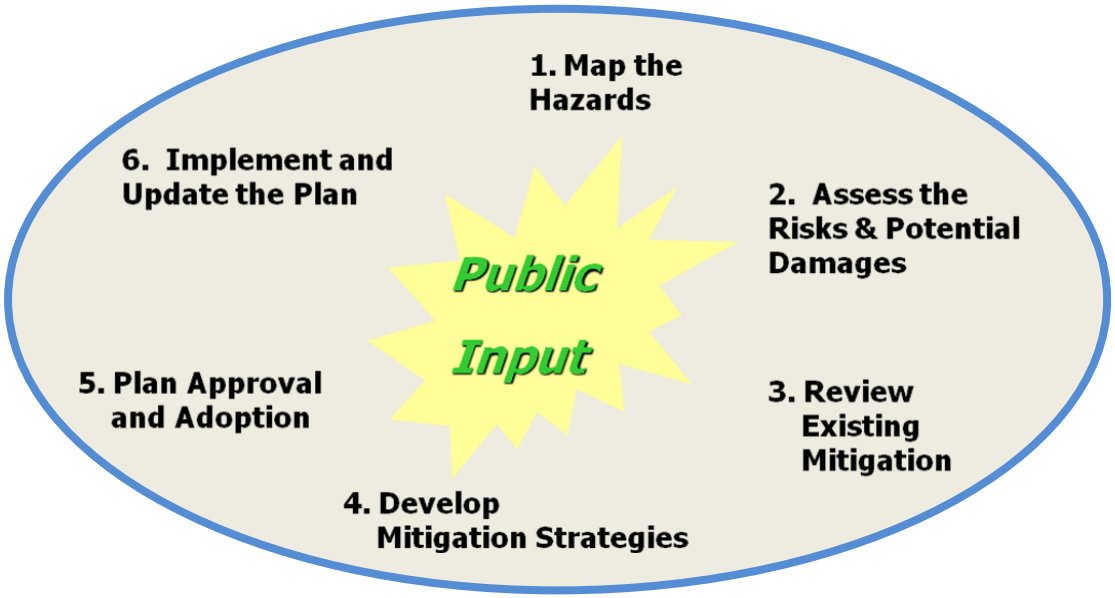
Source: U.S. Census Bureau, 2009-2013 American Community Survey

# 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 MAPC website, and invitations sent to neighboring communities, Town boards and commissions, the local chamber of commerce, and other local or regional entities to review the plan and provide comment.

**Planning Process Summary**

The six-step planning process outlined below is based on the guidance provided by FEMA in the Local Multi-Hazard Mitigation Planning Guidance. Public participation is a central element of this process, which attempts to focus on local problem areas and identify needed mitigation measures based on where gaps occur in the existing mitigation efforts of the municipality. 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:

    - FEMA, Local Mitigation Plan Review Guide; October 1, 2011
    - FEMA, Flood Insurance Rate Maps for Norfolk County, MA, 2012
    - Massachusetts State Hazard Mitigation Plan 2013
    - Metropolitan Area Planning Council, GIS Lab, Regional Plans and Data.
    - New England Seismic Network, Boston College Weston Observatory, http://aki.bc.edu/index.htm
    - NOAA National Climatic Data Center, http://www.ncdc.noaa.gov/
    - Northeast States Emergency Consortium, http://www.nesec.org/
    - Town of Dover Comprehensive Emergency Management Plan
    - Town of Dover Draft Master Plan (12/2/12)
    - Town of Dover Subdivision Regulations
    - Town of Dover Town Code (updated 5/12/14)
    - Town of Dover website: http://www.doverma.org/
    - USGS, National Water Information System, http://nwis.waterdata.usgs.gov/usa/nwis
    - US Census, 2009-2013 American Community Survey

- 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.

**The Local Multiple Hazard Community Planning Team**

MAPC worked with the local community representatives to organize a Local Hazard Mitigation Planning Team for Dover. 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 4 below.

The Local Hazard Mitigation Planning Team met on December 10, 2014, and May 7, 2015. The purpose of the first meeting was to introduce the Hazard Mitigation planning program, review and update hazard mitigation goals, and to gather information on local hazard mitigation issues and sites or areas related to these. The second meeting focused on verifying information gathered by MAPC staff and discussion of existing mitigation practices, the status of mitigation measures identified in the 2009 hazard mitigation plan, and potential new or revised mitigation measures. The agendas for these meetings are included in Appendix A.

**Table 4 - Membership of the Dover Hazard Mitigation Planning Team**

| Name | Representing |
|---|---|
| Peter McGowan | Chief of Police |
| David Ramsay | Town Administrator |
| Gino Carlucci | Town Planner |
| Craig Hughes | Highway Department |
| Walter Avallone | Building Department |

**Public Meetings**

Public participation in the hazard mitigation planning process is important, both for plan development and for later implementation of the plan. Residents, business owners, and other community members are an excellent source for information on the historic and

potential impacts of natural hazard events and particular vulnerabilities the community may face from these hazards. Their participation in this planning process also builds understanding of the concept of hazard mitigation, potentially creating support for mitigation actions taken in the future to implement the plan. To gather this information and educate residents on hazard mitigation, the Town hosted two public meetings, one during the planning process and one after a complete draft plan is available for review.

Natural hazard mitigation plans unfortunately rarely attract much public involvement in the Boston region, unless there has been a recent hazard event. One of the best strategies for overcoming this challenge is to include discussion of the hazard mitigation plan on the agenda of an existing board or commission. With this strategy, the meeting receives widespread advertising and a guaranteed audience of the board or commission members plus those members of the public who attend the meeting. These board and commission members represent an engaged audience that is informed and up to date on many of the issues that relate to hazard mitigation planning in the locality and will likely be involved in plan implementation, making them an important audience with which to build support for hazard mitigation measures. In addition, these meetings frequently receive press coverage, expanding the audience that has the opportunity to hear the presentation and provide comment.

The public had an opportunity to provide input to the Dover hazard mitigation planning process during a meeting of the Planning Board, on June 25, 2015 held in Dover Town Hall. The draft plan update was presented at a Board of Selectmen's meeting held on August 13, 2015 in Dover Town Hall. Both meetings were publicized as part of regular meetings of the Planning Board and Town Council according to the Massachusetts Public Meeting Law. See public meeting agendas in Appendix C.

**Local Stakeholder Involvement**

The local Hazard Mitigation Planning Team was encouraged to reach out to local stakeholders that might have an interest in the Hazard Mitigation Plan including neighboring communities, agencies, businesses, nonprofits, and other interested parties. Notice was sent to the following organizations and neighboring municipalities inviting them to review the Hazard Mitigation Plan and submit comments to the Town:

Town of Medfield
Town of Natick
Town of Needham
Town of Sherborn
Town of Walpole
Town of Wellesley
Town of Westwood

Dover Sherborn Cable Television
Dover Mothers' Association
Friends of the Dover Council on Aging
The Dover Historical Society
Dover Land Conservation Trust

The town received comments from one citizen (see Appendix C). The Town took this under advisement and appreciates the input. To respond to questions about "non-natural" hazards, these are not addressed by this natural hazard mitigation plan, but would be

addressed in the town's Comprehensive Emergency Management Plan. Other comments were focused on emergency preparedness and response issues, and the town will consider these in its emergency preparedness planning.

The draft Dover Hazard Mitigation Plan 2016 Update was posted on the MAPC website after the second public meeting. Members of the public could access the draft document and submit comments or questions on the plan.

**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. The Dover Emergency Management Coordinator will act as the coordinator for the Implementation Team. As updates and a review of the plan are conducted by the Hazard Mitigation Implementation Team, these will be placed on the Town's web site, and any meetings of the Hazard Mitigation Implementation Team will be publicly noticed in accordance with town and state open meeting laws.

**Planning Timeline**

| | |
|---|---|
| July 2, 2014 | Introductory Meeting with MEMA |
| December 15, 2014 | Meeting of the Dover Local Hazard Mitigation Planning Team |
| June 25, 2015 | First Public Meeting (Planning Board Meeting) |
| July 14, 2015 | Meeting of the Dover Local Hazard Mitigation Planning Team |
| August 13, 2015 | Second Public Meeting (Board of Selectmen's Meeting) |
| October 8, 2015 | Draft Plan Update submitted to MEMA |
| February 29, 2016 | Revised Draft Plan submitted to MEMA |
| May 26, 2016 | Notice of Approvable Pending Adoption issued by FEMA |

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# IV. RISK ASSESSMENT

The risk assessment analyzes the potential natural hazards that could occur within the Town of Dover 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 Dover'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 5 below summarizes the hazard risks for Dover. 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 Dover using the definitions for hazard frequency and severity listed below. Based on this, the Town set an overall priority for each hazard.

**Table 5 Hazard Risks Summary**

| Hazard | Frequency | | Severity | |
|---|---|---|---|---|
| | Massachusetts | Dover | Massachusetts | Dover |
| Flooding | High | Medium | 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 |
| Tornadoes | Medium | Very 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 Dover

**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 Dover. 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 Dover have included:

- The Blizzard of 1978 - Storm surge flooding associated with northeast wind, heavy wet snowfall and long storm duration.
- January 1979
- April 1987
- October 1991 ("The Perfect Storm") Considered to be a 100-year storm.
- October 1996 –
- June 1998 –
- March 2001
- April 2004
- May 2006
- April 2007
- March 2010
- December 2010

Local data for previous flooding occurrences are not collected by the Town of Dover. The best available local data is for Norfolk County through the National Climatic Data Center (see Table 6). Norfolk County, which includes the Town of Dover, experienced 45 flood events from 1996 –2014. No deaths or injuries were reported and the total reported property damage in the county was $26.2 million dollars. Of that total, $24.9 million is attributed to the two major events of March 2010.

**Table 6 Norfolk County Flood Events, 1996-2014**

| Date | Type | Deaths | Injuries | Property Damage |
|---|---|---|---|---|
| 01/27/1996 | Flood | 0 | 0 | 0.00K |
| 09/18/1996 | Flood | 0 | 0 | 0.00K |
| 10/21/1996 | Flood | 0 | 0 | 0.00K |
| 05/12/1998 | Flood | 0 | 0 | 0.00K |
| 06/13/1998 | Flood | 0 | 0 | 570.00K |
| 06/15/1998 | Flood | 0 | 0 | 0.00K |
| 03/05/2001 | Flood | 0 | 0 | 0.00K |
| 03/22/2001 | Flood | 0 | 0 | 0.00K |
| 03/22/2001 | Flood | 0 | 0 | 0.00K |
| 04/01/2001 | Flood | 0 | 0 | 0.00K |
| 03/28/2005 | Flood | 0 | 0 | 0.00K |
| 10/15/2005 | Flood | 0 | 0 | 30.00K |
| 10/15/2005 | Flood | 0 | 0 | 40.00K |
| 10/15/2005 | Flood | 0 | 0 | 200.00K |
| 10/15/2005 | Flood | 0 | 0 | 60.00K |
| 10/15/2005 | Flood | 0 | 0 | 40.00K |
| 10/15/2005 | Flood | 0 | 0 | 140.00K |
| 10/25/2005 | Flood | 0 | 0 | 35.00K |
| 05/13/2006 | Flood | 0 | 0 | 5.00K |
| 06/07/2006 | Flood | 0 | 0 | 20.00K |
| 06/07/2006 | Flood | 0 | 0 | 0.00K |
| 06/07/2006 | Flood | 0 | 0 | 0.00K |
| 10/28/2006 | Flood | 0 | 0 | 8.00K |
| 11/24/2006 | Flood | 0 | 0 | 0.00K |
| 03/02/2007 | Flood | 0 | 0 | 5.00K |
| 04/18/2007 | Flood | 0 | 0 | 5.00K |
| 02/13/2008 | Flood | 0 | 0 | 10.00K |
| 07/02/2008 | Flood | 0 | 0 | 5.00K |
| 08/15/2008 | Flood | 0 | 0 | 3.00K |

| | | | | |
|---|---|---|---|---|
| 05/24/2009 | Flood | 0 | 0 | 0.00K |
| 06/27/2009 | Flood | 0 | 0 | 15.00K |
| 03/14/2010 | Flood | 0 | 0 | 16.640M |
| 03/29/2010 | Flood | 0 | 0 | 8.320M |
| 04/01/2010 | Flood | 0 | 0 | 0.00K |
| 07/24/2010 | Flood | 0 | 0 | 20.00K |
| 08/05/2010 | Flood | 0 | 0 | 0.00K |
| 08/25/2010 | Flood | 0 | 0 | 8.00K |
| 08/28/2011 | Flood | 0 | 0 | 0.00K |
| 08/15/2012 | Flood | 0 | 0 | 0.00K |
| 10/29/2012 | Flood | 0 | 0 | 0.00K |
| 06/07/2013 | Flood | 0 | 0 | 0.00K |
| 07/29/2013 | Flood | 0 | 0 | 0.00K |
| 08/09/2013 | Flood | 0 | 0 | 15.00K |
| 10/22/2014 | Flood | 0 | 0 | 0.00K |
| 10/23/2014 | Flood | 0 | 0 | 0.00K |
| **TOTAL** | | **0** | **0** | **26.2 M** |

Source: NOAA, National Climatic Data Center

The flooding vulnerability analysis estimates a range of damages from flooding of $456,138.54 to $2,280,692.70 (see Table 19).

The most severe recent flooding occurred during the major storms of March 2010, when a total of 14.83 inches of rainfall accumulation was officially recorded by the National Weather Service (NWS). The weather pattern that caused these floods consisted of early springtime prevailing westerly winds that moved three successive storms, combined with tropical moisture from the Gulf of Mexico, across New England. Torrential rainfall caused March 2010 to be the wettest month on record.

One indication of the extent of flooding is the level of flow in the Charles River during this record flood. The river at the USGS gage in Dover exceeded flood stage of 5 feet on March 15, 2010 and rose to a peak of 7.9 feet on March 18. The river peaked again on April 3 at 8.0 feet and the cumulative impact of multiple storms kept river levels above flood stage until April 10. All told, the river was above flood stage for 26 days.

**Figure 1 - Charles River Gage Height, March 2010 Floods**

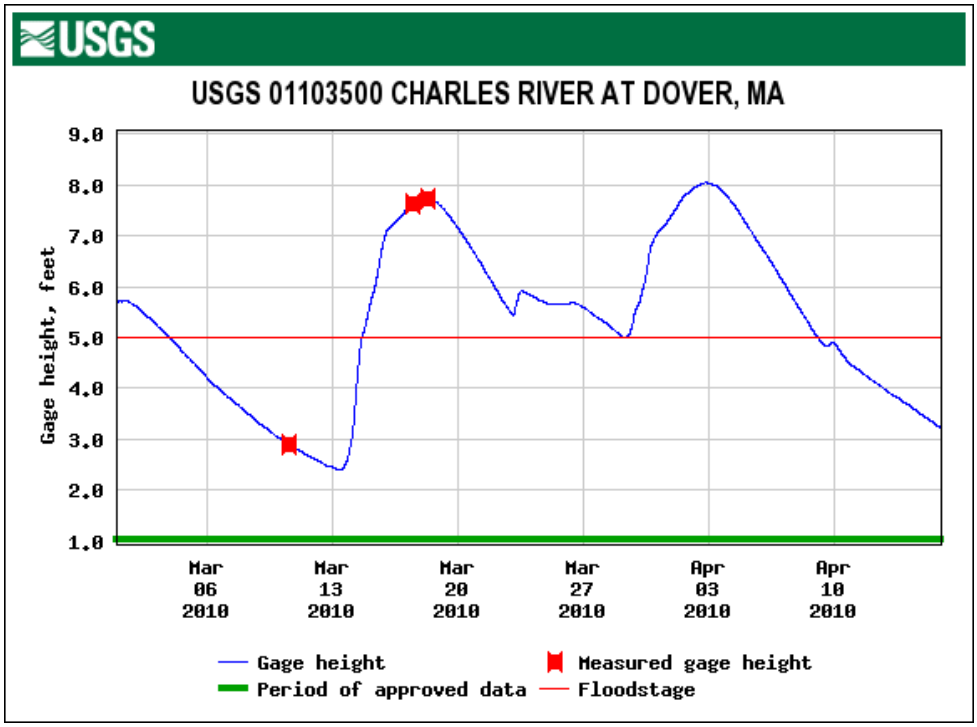



**Figure 2 – Charles River Flooding at Mill Street, March 2010**

Photo: M. Pillsbury

## Overview of Town-Wide Flooding Impacts and Vulnerability

Overview of Water Resources and Flooding Background

Dover is primarily impacted by the Charles River, which creates a natural border for the town on its Western edge with Sherborn and then along its northern boundary with Wellesley and Needham. Dover's waterways also consist of tributary brooks, such as Trout Brook and Powissett Brook, as well as low-lying wetland areas, and naturally formed ponds.

Flooding occurs in Dover on a routine basis, ranging from minor nuisance roadway flooding, to basement flooding, to roadway closures, and to bridge scouring. The causes can be due to proximity to floodplain, improperly functioning drainage systems, beaver activity, and dam breaches. More detail on specific flooding regions within the town is provided in the site-specific flooding section below.

In the event of a large storm event, the greatest concerns are property damage, blockages of roadways or bridges vital for emergency response, and breaching of dams.

Potential Flood Hazard Areas

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

**Flood Insurance Rate Map Zone Definitions**

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

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

**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

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

**(1) Dedham Street at Needham town line** – According to Hughes, this area is a low severity flood area with a frequency of once every ten years or so. There is an existing culvert that needs to be cleaned and maintained. The culvert had formerly been owned by the state, but is now under the care of the town. Hughes noted that this is a low priority flood area and noted that future maintenance of the culvert is the only further mitigation that is recommended at this time.

(2) **Turtle Lane near intersection of Dover Road** – Flooding severity here can be quite high as it has flooded homes and the road way in the past. Hughes estimated that flooding at Turtle Lane occurs every other year or so and indicated that there is no existing flood mitigation here, because the road is a private way. Hughes also said that he believes residents of Turtle Lane would object to the town taking any action there on their behalf, but said that the impacted area could use some study and that it might be possible to convince residents of the need to elevate utilities to avoid flooding damage. Priority to take corrective action here would be high, but again Hughes said that residents of the neighborhood accept it and rarely complain of or even report the flooding. The road is built right along the banks of the Charles River and several homes there are close to the water's edge.

(3) **Clay Brook Road, near Cullen Road** – Hughes rated this area as a moderate severity flooding hazard with flooding occurring approximately every seven years. There is an existing culvert that Hughes said is probably too small to handle large rain events, especially when coupled with spring runoff. Hughes and Homer suggested that enlarging/replacing the existing culvert would be the best way to address the problems here, but said that the priority to do something here was only moderate.

(4) **Clay Brook Road at Trout Brook** – This area is a severe flood threat, with flooding occurring every other year, and it is close to where Trout Brook merges with the Charles River. According to Hughes, there is an existing culvert under the road at this spot, but the culvert is not large enough to handle flow during heavy rain events, particularly during the spring, when snow melt is also impacting the brook. Enlarging the culvert is one option, but no plan for such a project has been put forward to this point. Still, Hughes indicated that

this would be a high priority project for his department.

(5) **Wilsondale Street at Powissett Brook** – This is described as a low severity flooding threat, with rare or infrequent flooding, which is related to a small private dam in the area, which is manually controlled with the placement of boards or planks. There is an existing culvert beneath Wilsondale Street, that could be enlarged to alleviate the rare flooding and Hughes indicated that this would be a moderate priority for the town.

(6) **USGS gauging station at Mill Street on the Charles River** – This is a rare flooding threat with low severity. Homer estimated that the area floods every 10 years or less. There is no existing mitigation and Hughes indicated no need to develop mitigation for the site.

(7) **544 Yorkshire Road** – This hazard is considered a moderate flooding hazard, with a frequency of every five to seven years, but the flooding doesn't typically impact the home itself. There is no existing mitigation for the site and Hughes indicated that raising the utilities or septic system might be a possible mitigation measure, but indicated that the river would have to rise eight- to ten-feet in order to impact the home that severely. This would be a moderate priority.

(13) **USGS gauging station at Haven Street on Trout Brook** – This is considered a moderate flooding threat, occurring every ten years. There is an existing culvert and Hughes indicated that expansion of that culvert would likely reduce the frequency and severity of flooding here.

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 the Town of Dover.

Based on the record of previous occurrences flooding events in Dover 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 Dover.

According to data provided by the Massachusetts Department of Conservation and Recreation (DCR) and the Town, there are three dams located in Dover. Cochrane Dam on the Charles River is owned by DCR and is classified as a low hazard dam by DCR. This dam was rebuilt by the state about 12 years ago. The Willow Street Spillway is also a DCR owned facility and is classified as a low hazard dam. The Worthington Pond Dam is privately owned and is classified as a low hazard dam by DCR. The dams are summarized in Table 7.

**Table 7 DCR Inventory of Dams**

| Dam Name | River/Pond | Owner -Type | Hazard Potential |
|---|---|---|---|
| Cochran Dam | Charles River | DCR Flood Control | Low Hazard |
| Willow Street Bypass Dam | Charles River | DCR Flood Control | Low Hazard |
| Worthington Pond. Dam | Worthington Pond | Private-Hale Reservation | Low Hazard |

Source: Mass. DCR Inventory of Dams

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 no previous occurrences dam failure in Dover this 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 Dover. 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. Given its location approximately 13 miles from the coast, the town's entire area is vulnerable to hurricanes. Hurricanes occur between June and November. A tropical storm has similar characteristics, but wind speeds are below 74 miles per hour.

Since 1900, 39 tropical storms have impacted New England (NESEC). Massachusetts has experienced approximately 32 tropical storms, nine Category 1 hurricanes, five Category 2 hurricanes and one Category 3 hurricane. A hurricane or storm track is the line that delineates the path of the eye of a hurricane or tropical storm. There have been four hurricane tracks through Dover, in 1861, 1869, 1876, and 1944. However, Dover 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 8) The hazard mapping indicates that the 100 year wind speed in Dover is 110 miles per hour (see Appendix B).

**Table 8 Hurricane Records for Massachusetts, 1938 - 2012**

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

*Category 3. Source: National Oceanic and Atmospheric Administration

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

| 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, and they are a potential town-wide hazard for Dover. 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 Dover. Potential hurricane damages to Dover have been estimated using HAZUS-MH. Total damages are estimated at $6.0 million for a Category 2 hurricane and $19.5 Million for a Category 4 hurricane. Other potential impacts are detailed in Table 22.

Based on records of previous occurrences, hurricanes in Dover 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.

Tornadoes

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

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

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

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

Source: Massachusetts State Hazard Mitigation Plan, 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 Dover, since 1956 there have been 10 tornadoes in surrounding Norfolk 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 8.

**Table 9 - Tornado Records for Norfolk County**

| Date | Fujita | Fatalities | Injuries | Width | Length | Damage |
|---|---|---|---|---|---|---|
| 11/21/1956 | 2 | 0 | 0 | 17 | 0.1 | $500-$5000 |
| 8/9/1972 | 1 | 1 | 6 | 30 | 4.9 | $5K-$50K |
| 9/6/1973 | 1 | 0 | 0 | 10 | 1.1 | $5K-$50K |
| 7/10/1989 | 0 | 0 | 0 | 23 | 0.1 | $500-$5000 |
| 5/18/1990 | 0 | 0 | 0 | 10 | 0.2 | $500-$5000 |
| 5/18/1990 | 0 | 0 | 0 | 10 | 0.2 | $500-$5000 |
| 6/30/2001 | 0 | 0 | 0 | 80 | 0.1 | - |
| 8/21/2004 | 1 | 0 | 0 | 40 | 6 | $1,500,000 |
| 5/9/2013 | 0 | 0 | 0 | 50 | 0.38 | $20,000 |

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 Dover, tornado impacts are relatively localized compared to severe storms and hurricanes. Damages from any tornado in Dover would greatly depend on the track of the tornado, as most the town is not densely developed. The town center area would be the most vulnerable to tornadoes.

Based on the record of previous occurrences since 1950, tornado events in Dover 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 often resulting in heavy snow, high winds, and rain. The storm radius is often as much as 1,000 miles, reaching from the Carolinas to the Gulf of Maine. These storms occur most often in late fall and early winter, occurring one to two times a year. These winter weather events are notorious for producing heavy rain or snow, depending on the temperature, and strong winds. Sustained wind speeds of 20-40 mph are common during a nor'easter, with short-term wind speeds gusting up to 70 mph. Nor'easters may also sit stationary for several days, affecting multiple tide cycles and extended heavy precipitation.

Previous occurrences of Nor'easters include the following which are listed in the Massachusetts State Hazard Mitigation Plan 2013:

**Table 10 - Nor'easters in Massachusetts**

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

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.

Dover 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 Dover 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 Dover 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. Generally defined as a storm that includes thunder, which always accompanies lightning, a thunderstorm is a storm event featuring lightning, strong winds, and rain and/or hail. Thunderstorms sometime give rise to tornados. On average, these storms are only around 15 miles in diameter and last for about 30 minutes. A severe thunderstorm can include winds of close to 60 mph and rain sufficient to produce flooding. The town's entire area is potentially subject to severe thunderstorms.

The best available data on previous occurrences of thunderstorms in Dover is for Norfolk County through the National Climatic Data Center (NCDC). Between n the years 1995 and 2014 NCDC records show 24 thunderstorm events in Norfolk County (Table 11). These storms resulted in a total of $155,000 in property damages. There were no injuries or deaths reported.

**Table 11 Norfolk County Thunderstorm Events, 1995-2014**

| BEGIN_DATE | EVENT_TYPE | MAGNITUDE | DEATHS | INJURIES | DAMAGE |
|---|---|---|---|---|---|
| 4/4/1995 | Thunderstorm | 53 | 0 | 0 | 0 |
| 7/15/1995 | Thunderstorm | 55 | 0 | 0 | 0 |
| 10/28/1995 | Thunderstorm | 0 | 0 | 0 | 0 |
| 5/21/1996 | Thunderstorm | 63 | 0 | 0 | 0 |
| 7/6/1999 | Thunderstorm | 70 | 0 | 0 | 0 |
| 7/24/1999 | Thunderstorm | 50 | 0 | 0 | 0 |
| 4/9/2000 | Thunderstorm | 61 | 0 | 0 | 0 |
| 6/2/2000 | Thunderstorm | 50 | 0 | 0 | 0 |
| 6/27/2000 | Thunderstorm | 50 | 0 | 0 | 0 |
| 7/18/2000 | Thunderstorm | 50 | 0 | 0 | 0 |

| | | | | | |
|---|---|---|---|---|---|
| 8/10/2001 | Thunderstorm | 50 | 0 | 0 | 5,000 |
| 7/15/2002 | Thunderstorm | 62 | 0 | 0 | 25,000 |
| 7/23/2002 | Thunderstorm | 50 | 0 | 0 | 5,000 |
| 8/5/2005 | Thunderstorm | 50 | 0 | 0 | 5,000 |
| 8/14/2005 | Thunderstorm | 50 | 0 | 0 | 15,000 |
| 5/21/2006 | Thunderstorm | 51 | 0 | 0 | 15,000 |
| 7/21/2006 | Thunderstorm | 50 | 0 | 0 | 10,000 |
| 6/28/2007 | Thunderstorm | 50 | 0 | 0 | 5,000 |
| 7/2/2008 | Thunderstorm | 50 | 0 | 0 | 2,000 |
| 7/2/2008 | Thunderstorm | 54 | 0 | 0 | 15,000 |
| 5/24/2009 | Thunderstorm | 50 | 0 | 0 | 1,000 |
| 6/20/2010 | Thunderstorm | 50 | 0 | 0 | 25,000 |
| 6/24/2010 | Thunderstorm | 50 | 0 | 0 | 2,000 |
| 6/23/2012 | Thunderstorm | 50 | 0 | 0 | 25,000 |
| **Total** | | | **0** | **0** | **$155,000** |

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

Severe thunderstorms are a town-wide hazard for Dover. 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 Dover 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 Dover 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 |
| Blizzard of 2013 | February 2013 |
| Blizzard of 2015 | January 2015 |

The Town of Dover does not keep local records of winter storms. Data for Norfolk County, which includes Dover, is the best available data to help understand previous occurrences and impacts of heavy snow events. According to NCDC records, from 1996

to 2014 Norfolk County experienced 68 heavy snowfall events, resulting in no deaths, one injury, and $8.8 million dollars in property damage. See Table 13.

**Table 13 - Heavy Snow events and Impacts in Norfolk County 1996 –2014**

| Date | Type | Deaths | Injuries | Property Damage |
|---|---|---|---|---|
| 1/2/1996 | Heavy Snow | 0 | 0 | - |
| 1/7/1996 | Heavy Snow | 0 | 0 | 1,400,000 |
| 1/7/1996 | Heavy Snow | 0 | 0 | 2,000,000 |
| 1/10/1996 | Heavy Snow | 0 | 0 | - |
| 2/2/1996 | Heavy Snow | 0 | 0 | - |
| 2/16/1996 | Heavy Snow | 0 | 0 | - |
| 3/2/1996 | Heavy Snow | 0 | 0 | - |
| 3/7/1996 | Heavy Snow | 0 | 0 | - |
| 4/7/1996 | Heavy Snow | 0 | 0 | - |
| 4/9/1996 | Heavy Snow | 0 | 0 | - |
| 12/6/1996 | Heavy Snow | 0 | 0 | - |
| 1/11/1997 | Heavy Snow | 0 | 0 | - |
| 2/16/1997 | Heavy Snow | 0 | 0 | - |
| 3/31/1997 | Heavy Snow | 0 | 0 | - |
| 4/1/1997 | Heavy Snow | 0 | 0 | 2,500,000 |
| 12/23/1997 | Heavy Snow | 0 | 0 | - |
| 1/15/1998 | Heavy Snow | 0 | 0 | - |
| 1/15/1998 | Heavy Snow | 0 | 0 | - |
| 12/24/1998 | Heavy Snow | 0 | 0 | - |
| 1/14/1999 | Heavy Snow | 0 | 0 | - |
| 2/25/1999 | Heavy Snow | 0 | 0 | - |
| 3/6/1999 | Heavy Snow | 0 | 0 | - |
| 3/15/1999 | Heavy Snow | 0 | 0 | - |
| 1/13/2000 | Heavy Snow | 0 | 0 | - |
| 2/18/2000 | Heavy Snow | 0 | 0 | - |
| 12/30/2000 | Heavy Snow | 0 | 0 | - |
| 1/20/2001 | Heavy Snow | 0 | 0 | - |
| 2/5/2001 | Heavy Snow | 0 | 0 | - |
| 3/5/2001 | Heavy Snow | 0 | 0 | - |
| 3/9/2001 | Heavy Snow | 0 | 0 | - |
| 3/26/2001 | Heavy Snow | 0 | 0 | 250,000 |

| Date | Type | Deaths | Injuries | Property Damage |
|---|---|---|---|---|
| 12/8/2001 | Heavy Snow | 0 | 0 | - |
| 12/5/2002 | Heavy Snow | 0 | 0 | - |
| 3/16/2004 | Heavy Snow | 0 | 0 | - |
| 2/21/2005 | Heavy Snow | 0 | 0 | - |
| 2/24/2005 | Heavy Snow | 0 | 0 | - |
| 12/13/2007 | Heavy Snow | 0 | 0 | - |
| 12/16/2007 | Heavy Snow | 0 | 0 | 7,500 |
| 12/19/2007 | Heavy Snow | 0 | 0 | - |
| 1/14/2008 | Heavy Snow | 0 | 0 | 36,000 |
| 1/14/2008 | Heavy Snow | 0 | 0 | 30,000 |
| 1/14/2008 | Heavy Snow | 0 | 0 | 55,000 |
| 1/27/2008 | Heavy Snow | 0 | 0 | - |
| 2/22/2008 | Heavy Snow | 0 | 0 | - |
| 12/19/2008 | Heavy Snow | 0 | 0 | 10,000 |
| 12/19/2008 | Heavy Snow | 0 | 0 | 3,000 |
| 12/31/2008 | Heavy Snow | 0 | 0 | - |
| 1/18/2009 | Heavy Snow | 0 | 0 | - |
| 1/19/2009 | Heavy Snow | 0 | 0 | - |
| 2/3/2009 | Heavy Snow | 0 | 0 | - |
| 3/1/2009 | Heavy Snow | 0 | 0 | - |
| 3/2/2009 | Heavy Snow | 0 | 0 | - |
| 12/19/2009 | Heavy Snow | 0 | 0 | - |
| 2/16/2010 | Heavy Snow | 0 | 0 | - |
| 12/20/2010 | Heavy Snow | 0 | 0 | - |
| 1/12/2011 | Heavy Snow | 0 | 0 | - |
| 1/26/2011 | Heavy Snow | 0 | 0 | - |
| 1/21/2012 | Heavy Snow | 0 | 0 | - |
| 12/29/2012 | Heavy Snow | 0 | 0 | 5,000 |
| 2/8/2013 | Heavy Snow | 0 | 0 | - |
| 3/7/2013 | Heavy Snow | 0 | 0 | - |
| 3/18/2013 | Heavy Snow | 0 | 0 | - |
| 12/14/2013 | Heavy Snow | 0 | 0 | - |
| 12/17/2013 | Heavy Snow | 0 | 0 | - |
| 1/2/2014 | Heavy Snow | 0 | 0 | - |

| Date | Type | Deaths | Injuries | Property Damage |
|---|---|---|---|---|
| 1/21/2014 | Heavy Snow | 0 | 0 | - |
| 2/5/2014 | Heavy Snow | 0 | 0 | - |
| 2/15/2014 | Heavy Snow | 0 | 0 | 5,000 |
| **Total** | **50** | **0** | **1** | **8.8 M** |

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 vulnerability to the town 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 Dover. The best available local data is county level data through the National Climatic Data Center (NCDC). The NCDC does not have any occurrences of ice storms on record for Norfolk County. The closest recorded ice storms are for adjacent Middlesex County, which has four ice storms on record (see Table 14). No deaths or injuries were reported in Dover and the total reported property damage in the county was $3.1 million dollars.

**Table 14 Middlesex County Ice Storm Events, 1998 –2008**

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

Source: NOAA, National Climatic Data Center.

NCDC records also show 8 hail storm events in Norfolk County from 1969 –2014.

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.

Overall, Winter Storms are a town-wide hazard in Dover. Map 6 in Appendix B displays areas of average annual snowfall, which is in the range of 36 to 48 inches throughout the town.

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.

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.

### 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 some structures which pre-date the most recent building code. Information on geologic hazards in Dover 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. Dover 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 Dover.

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 potential town-wide hazard in Dover. The Town has many un-reinforced, older buildings which would be vulnerable in the event of a severe earthquake. Potential earthquake damages to Dover have been estimated using HAZUS-MH. Total damages are estimated at $76.8 million for a 5.0 magnitude earthquake and $702 million for a 7.0 magnitude earthquake. Other potential impacts are detailed in Table 19.

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.

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

All of Dover is classified as having a low risk for landslides, while the western half is classified as low risk. Local officials did not identify any significant issues related to landslides (see Appendix B - Map 4).

Although potentially a town-wide hazard, there are no documented previous occurrences of landslides in Dover. Should a landslide occur in the future in Dover, 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 Dover.

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

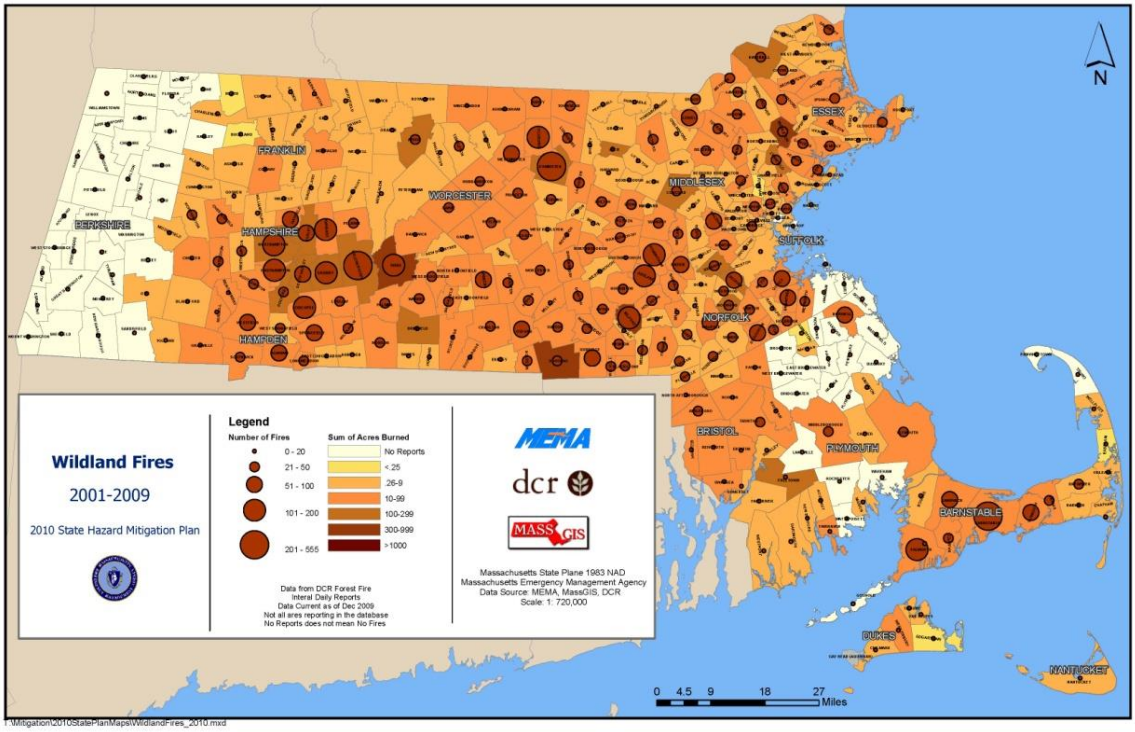
These fires can present a hazard where there is the potential for them to spread into developed or inhabited areas, particularly residential areas where sufficient fuel materials

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 3 below, indicates that the wildfire extent in Dover consists of less than 10 acres burned, with fewer than 20 recordable fires from 2001 to 2009.

**Figure 3 Massachusetts Wildfires 2001-2009**




Source: Massachusetts State Hazard Mitigation Plan

Dover is not densely developed and has some large open spaces that could be susceptible to wild fires. According to local officials, though, natural fires in Dover are not a major issue. Locally identified areas susceptible to wildfires include the following:

(11) **Springdale Avenue to Hunt Road**

(12) **Pine Street/Center Street to Medfield town line**

(13) **Cedar Hill at High Rock Road**

The severity of fires in this area is considered higher because the wooded areas are close to residential neighborhoods and are harder to get into. This fire threat

also shares a border with Medfield and is potentially a fire threat for that community as well. Existing mitigation measures here include trails maintained by the Trustees of the Reservation and police foot patrols aimed at keeping teen aged youth out of the area. Neighborhood fire watch and improved fire prevention education are considered appropriate measures here and Hughes indicated that such measures would likely be a high priority of the town.

(14) **Noannet Woods at Walpole Street and Bretton Road**
A moderate fire threat, occurring every other year. Existing measures include park rangers and trail grooming. Future mitigation measures should include improved and expanded fire prevention education for trail walkers.

(15) **Pegan Hill at Pegan Lane and Farm Street** – brush fires –
A moderate fire threat occurring every three to four years, according to Hughes. Only existing mitigation includes maintenance of trails and Hughes suggested a watch tower or watch program could help alleviate the threat, along with improved education program.

These are shown on Map 8 in Appendix B, with the numbers on the list corresponding to the areas mapped.

Potential vulnerabilities to wildfires include damage to structures and other improvements, and impacts on natural resources. 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. However, given the low extent of wildfires in the town and the immediate response times to reported fires in Dover, the likelihood of injuries and casualties is minimal. There are none that have been recorded in the past.

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 the there is prolonged period of excessively hot or cold weather.

Dover 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.

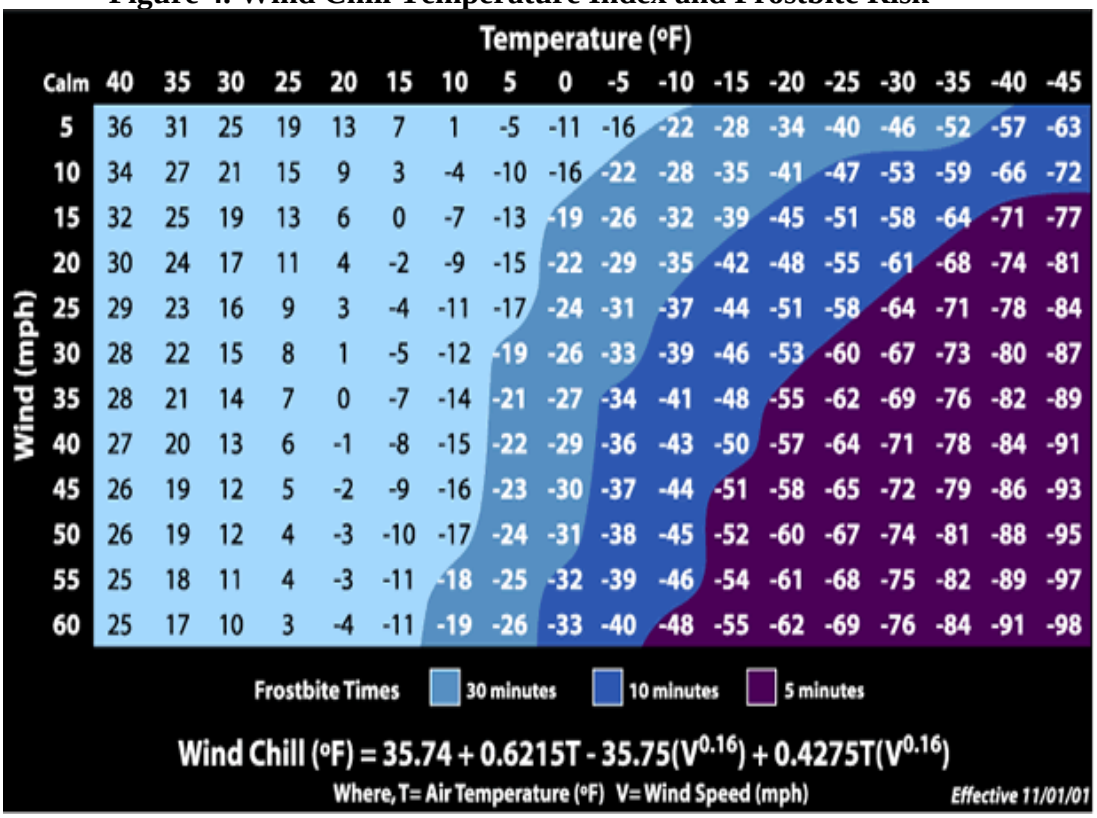
*Extreme Cold*

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 4 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 greatest vulnerability to the town would be a power outage during a winter storm, which could temporarily leave many residents without heat.

**Figure 4. Wind Chill Temperature Index and Frostbite Risk**




The Town of Dover does not collect data for previous occurrences of extreme cold. The best available local data are for Norfolk County, where the Town of Dover is located through the National Climatic Data Center (NCDC). There is one extreme cold event on record in February 2007, which caused one death and no injuries or property damage (see Table 16).

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

| Date | Type | Deaths | Injuries | Property Damage |
|---|---|---|---|---|
| 02/03/2007 | Extreme Cold/wind Chill | 1 | 0 | 0.00K |

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 5) is forecast to exceed 100 degree Fahrenheit (F) for 2 or more hours; an excessive heat advisory is issued if forecast predicts the temperature to rise above105 degree F.

**Figure 5 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. |

Extreme heat poses a potentially greater risk to vulnerable populations, including the elderly, children, and people with certain medical conditions, such as heart disease. However, even young and healthy individuals can succumb to heat if they participate in strenuous physical activities during hot weather. Hot summer days can also worsen air pollution. With increased extreme heat, urban areas of the Northeast are likely to experience more days that fail to meet air quality standards.

The Town of Dover does not collect data on excessive heat occurrences. The best available data is from the National Climatic Data Center (NCDC) for Norfolk County, which includes Dover. The NCDC records include 9 extreme heat events for Norfolk County since 1999 (Table 17). There were no reported deaths, injuries or property damage resulting from excessive heat.

**Table 17 – Norfolk County Extreme Heat Occurrences**

| DATE | DEATHS | INJURIES | DAMAGE |
|---|---|---|---|
| 6/7/1999 | 0 | 0 | 0 |
| 7/5/1999 | 2 | 0 | 0 |
| 7/16/1999 | 0 | 0 | 0 |
| 7/17/1999 | 0 | 0 | 0 |
| 7/18/1999 | 0 | 0 | 0 |
| 9/7/1999 | 0 | 0 | 0 |
| 9/8/1999 | 0 | 0 | 0 |
| 7/6/2010 | 0 | 0 | 0 |
| 7/22/2011 | 0 | 0 | 0 |
| **TOTAL** | **2** | **0** | **0** |

Source: NOAA, National Climatic Data Center

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.

**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.

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. Dover is located in the Northeast Region. In Dover 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.

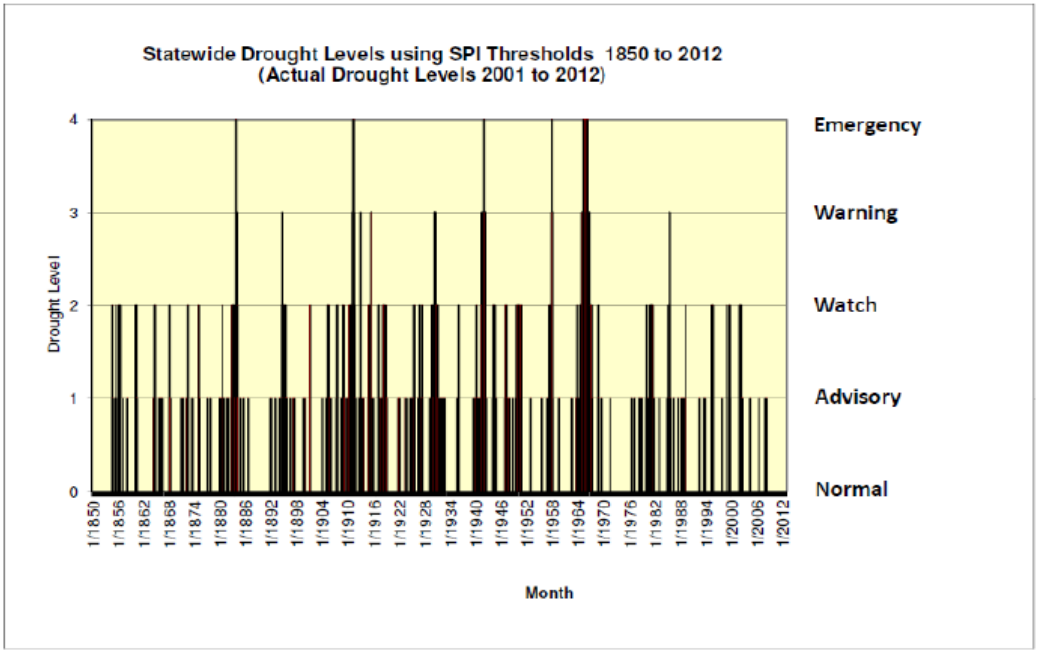
Determinations regarding the end of a drought or reduction of the drought level focus on two key drought indicators: precipitation and groundwater levels. These two factors have the greatest long-term impact on stream flow, water supply, reservoir levels, soil moisture and potential for forest fires.

Previous Occurrences

Dover 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 6 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.

**Figure 6 - Statewide Drought Levels using SPI Thresholds 1850 – 2012**




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.

Drought Watch

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

The town's vulnerability to drought could include impacts on agriculture, water supply, aquatic ecology, wildlife, and plant life. The Town of Dover depends on wells for its public and private water supplies, and prolonged drought could lower water tables and reduce the amount of water available from pumping wells. A severe drought could also increase the risk of wildfire on forested lands and other vegetated areas.

Probability of Future Occurrences

The state has experienced Emergency Droughts five times between 1850 and 2012. Even given that regional drought conditions may occur at a different interval than state data indicates, droughts remain primarily regional and state phenomena in Massachusetts. Emergency Drought conditions over the 162 period of record in Massachusetts are a Low Frequency natural hazard event that can occur from once in 50 years to once in 100 years (1% to 2% chance per year), as defined by the Massachusetts State Hazard Mitigation Plan, 2013.

## Land Use and Development Trends

Existing Land Use

The most recent land use statistics available from the state are from aerial photography done in 2005. Table 19 shows the acreage and percentage of land in 20 categories. If the five residential categories are aggregated, residential uses make up 57% of the area of the town (2,493 acres). Commercial and industrial combined make up 4.9% of the town, or 214.6 acres. Recreation, urban public, and golf courses comprise a total of 17.1%, or 748.1 acres.

**Table 19 2005 Land Use**

| Land Use Type | Acres | Percent |
|---|---|---|
| Brushland/Successional | 13.6 | 0.1 |
| Cemetery | 11.6 | 0.1 |
| Commercial | 30.4 | 0.3 |
| Cropland | 296.8 | 3.0 |
| Forest | 5659.8 | 57.4 |
| Forested Wetland | 849.7 | 8.6 |
| Low Density Residential | 1478.1 | 15.0 |
| Medium Density Residential | 34.4 | 0.3 |
| Multi-Family Residential | 10.0 | 0.1 |
| Non-Forested Wetland | 197.5 | 2.0 |
| Open Land | 67.8 | 0.7 |
| Participation Recreation | 74.2 | 0.8 |
| Pasture | 352.7 | 3.6 |
| Powerline/Utility | 46.5 | 0.5 |
| Transitional | 4.2 | 0.0 |
| Transportation | 16.8 | 0.2 |
| Urban Public/Institutional | 84.4 | 0.9 |
| Very Low Density Residential | 465.5 | 4.7 |
| Waste Disposal | 3.1 | 0.0 |
| Water | 169.3 | 1.7 |
| Water-Based Recreation | 1.3 | 0.0 |
| **TOTAL** | **9867.7** | **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.

Economic Elements *

The Town of Dover has developed around a town center. The Town Center is the governmental, institutional, retail, social and service center of the Town. It is surrounded by residential development built at a density of one housing unit per half-acre. Surrounding this core, there is a corridor of one-acre zoning running from the south end of Town along the Walpole town line through the center to the north part of Town where it abuts Natick, Wellesley and Needham. Except for the corner of Town that abuts Natick and Sherborn (which is also zoned for one-acre house lots), the remainder of the Town is zoned for two-acre residential lots. (from the Draft Dover Master Plan)

Natural, Historic and Cultural Resource Areas*

Dover's natural, historic and cultural resources include all the vestiges and products of its natural and cultural history that its residents use or can use to enrich life in this community. Town policies and strategies for protection and management of these resources are guided by the belief that these resources are intertwined. It is fundamental that policies in these areas regard Dover's natural and cultural resources not separately, but as interdependent and mutually-reinforcing - historically, at present, and very likely in the future.

Outstanding resources in Dover include the following:

Land
Dover's topography is highly variegated. Its lowest point is 90 feet above sea level, where Dover, Westwood, Needham, and Dedham meet Its highest points are 449 feet at Snow Hill, 442 feet at Cedar Hill just south of the Medfield line, and 410 feet at, Powissett Peak; 410 feet at Pegan Hill, just over the South Natick line. At slightly lower elevations are Strawberry Hill, at 391 feet, Juniper Hill at 315 feet and Oak Hill at 375 feet.

Water
Dover lies within the watersheds of both the Charles River and the Neponset River. Proceeding down the Charles River from the Medfield line are the following streams: Otter Brook, running through the Medfield State Hospital property from Juniper Hill to the Charles River; several small streams taking runoff from the Saltonstall property; Fisher Brook, with three main branches from the east and west sides of Juniper Hill and east of Glen Road; Wight Brook, draining St. Stephen's Priory and neighboring properties; several unnamed small streams draining Elm Bank and neighboring properties; Trout Brook, by far the largest drainage area, covering one-third of the Town; Clay Brook and minor streams; Noannet Brook, which is the second major drainage area

from the Medfield corner north to the Charles River at Willow Street, including much of the Noannet Woodlands; Powissett Brook, flowing from Worthington Pond and draining much of the Hale Reservation in Westwood and Wilsondale Street to the Charles River one thousand feet west of the Chestnut Street Bridge. Streams in the southern part of Town include Mill Brook, flowing southeasterly from Strawberry Hill; Tubwreck Brook from Cedar Hill; and another Mill Brook draining into Medfield, south of Juniper, Oak and Snow Hills. Approximately 10 % of Dover's 10,600 acres consist of ponds and rivers (107 acres) and swamp (990 acres). Figure 7 presents Dover's water resources.

Historic & Cultural Resources

The current inventory list of Dover's Cultural Resources includes significant archeological and historic sites, buildings and structures dating back to the Native American and Colonial periods Dover has one historical preservation institution: the Dover Historical Society (DHS) which is privately funded and governed and open to public membership. The Society's mission is to preserve, collect, and share the cultural and material history of the town. It has detailed listings of more than 150 historic Dover houses and buildings and is currently cooperating with the Dover Historical Commission in a joint house marker program. The Society's headquarters is located in the Sawin Museum, which focuses on Dover local history and archeology. The Society also collects and conserves significant material pertaining to culture and history. The Society also maintains and interprets the two town-owned historic properties: the Caryl House (1777), the home of the Reverend Benjamin Caryl, Dover's first minister from 1762 to 1811, and the Fisher Barn (1777).

A major cultural resource is a branch of the venerable Massachusetts Horticultural Society, located on 36 acres of the 188-acre Elm Bank Estate, now owned and managed by the Commonwealth's Department of Conservation and Recreation. The estate attracts large numbers of visitors and tourists to Dover, not just from our neighboring communities but also from all over the Commonwealth, New England, and the nation.

The Dover Town Library, which has been slightly expanded and made accessible to the physically challenged, also serves as a site for community meetings and cultural programs and exhibits. The 2011 survey found that 86% of respondents believe that the library is adequate for future needs without major improvements or renovations. The library became a full member of the Minuteman Library Network in 1997 which network allows residents access to the collections of 40 other public and college libraries. (from the Draft Dover Master Plan)

Development Trends

Dover has experience moderate growth since the last Hazard Mitigation was approved in 2009, all of which residential projects. Dover's Town Planner provided the following information on developments that have occurred since the last Hazard Mitigation was

approved. None of these development sites are located within the FIRM flood hazard areas (see Table 20).

**Table 20 Summary of New Developments in Dover Since 2009**

| PROJECTS UNDER CONSTURCTION OR COMPLETED SINCE 2009 | PROJECT TYPE | ACRES | HOUSING UNITS | COMMENTS |
|---|---|---|---|---|
| Atwood Circle | Housing | 13 | 7 | 6 lots plus 2 ANR lots; one undeveloped lot remains |
| Dover Farms (40B) | Housing | 4 | 24 | Some units not yet built out |
| The Meadows (40B) | Housing | 5 | 20 | Completed |
| Dancer Farms | Housing | 12.2 | 8 | Under construction |
| Kirby Farms | Housing | 14 | 8 | Under construction |
| **TOTAL** | | **48.4** | **67** | |

Potential Future Development

MAPC consulted with Town staff to determine areas that may be developed in the future, based on the Town's current planning initiatives and current trends and projects. These areas are described below. None of these sites are in a flood hazard zone (see Table 21).

**A. Centre Street 40B Project – "Dover Farm"**
A 20-unit housing project being built near the center of town under the state's Chapter 40B law.

**B. Atwood Circle subdivision on Betsey Lane & Hunters Path 6-lot housing**
6-lot housing development; four houses have been developed with one under construction

**C. "Kirby Farm" on Stagecoach Dr.**
8-lot housing development

**D. "Dancer Farm"**
8-unit housing development under construction

**E. "Dover Village"**

4-unit 40B project on a one-acre site is going through approvals

| Table 21 Relationship of Potential Development to Hazard Areas | | | |
|---|---|---|---|
| | | | |
| **ID** | **Parcel** | **Landslide risk** | **Flood Zone** |
| A | Center St. 40B "Dover Farm" | Low | No |
| B | Atwood Circle subdivision | Low | No |
| C | Kirby Farm | Low | No |
| D | Dancer Farm | Low | No |
| E | Dover Village | Low | No |

## Critical Infrastructure in Hazard Areas

Critical infrastructure includes facilities that are important for disaster response and evacuation (such as emergency operations centers, fire stations, water pump stations, etc.) and facilities where additional assistance might be needed during an emergency (such as nursing homes, elderly housing, day care centers, etc.).

The purpose of mapping the natural hazards and critical infrastructure is to present an overview of hazards in the community, how they relate to critical infrastructure, and to better understand which facilities may be vulnerable to particular natural hazards.

There are 32 facilities identified in Dover. These are listed in Table 21 and are shown on the maps in Appendix B.

**Explanation of Columns in Table 22**

***Column 1: ID #:*** The first column in Table 21 is an ID number which appears on the maps that are part of this plan. See Appendix B.

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

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

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

***Column 5: 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.

***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. This mapping is highly general in nature. For more information on

**Table 22**
**Relationship of Critical Infrastructure to Hazard Areas**

| ID | Name | Type | FEMA Flood Zone | Average Area Snowfall | Landslide Risk |
|---|---|---|---|---|---|
| 1 | Protective Agency Division | EOC | No | 36” – 48” | Low |
| 2 | Protective Agency Division | Police Station | No | 36” – 48” | Low |
| 3 | Protective Agency Division | Fire Station | No | 36” – 48” | Low |
| 4 | Town House | Municipal Office | No | 36” – 48” | Low |
| 5 | DPW Garage | DPW Garage | No | 36” – 48” | Low |
| 6 | Charles River School | School | No | 36” – 48” | Low |
| 7 | Chickering School | School | No | 36” – 48” | Low |
| 8 | Dover/Sherborn Regional School | School | No | 36” – 48” | Low |
| 9 | Connors Family Retreat & Conference Ctr | School | No | 36” – 48” | Low |
| 10 | Bridge Street Bridge | Bridge | AE | 36” – 48” | Low |
| 11 | Fisher Bridge | Bridge | AE | 36” – 48” | Low |
| 12 | Centre Railroad Bridge | Bridge | No | 36” – 48” | Low |
| 13 | Willow Street Bridge | Bridge | AE | 36” – 48” | Low |
| 14 | Cochran Dam | Dam | AE | 36” – 48” | Low |
| 15 | Willow Street Spillway | Dam | AE | 36” – 48” | Low |
| 16 | Chestnut Street Bridge | Bridge | AE | 36” – 48” | Low |
| 17 | Dover Road Bridge | Bridge | AE | 36” – 48” | Low |
| 18 | Mass Horticultural Society | School | No | 36” – 48” | Low |
| 19 | Natick Water Treatment Plant | Water treatment plant | No | 36” – 48” | Low |
| 20 | NStar Power Substation | Power substation | No | 36” – 48” | Low |
| 21 | ATT Cell Tower | Cellular Tower | No | 36” – 48” | Low |
| 22 | Grossman Camp | School | No | 36” – 48” | Low |

| ID | Name | Type | FEMA Flood Zone | Average Area Snowfall | Landslide Risk |
|---|---|---|---|---|---|
| 23 | ATT Cell Tower | Cellular Tower | No | 36” – 48” | Low |
| 24 | Dover Church | Daycare | No | 36” – 48” | Low |
| 25 | St. Dunstan Church | Daycare | No | 36” – 48” | Low |
| 26 | Dover/Sherborn Child Development Center | Daycare | No | 36” – 48” | Low |
| 27 | Grace Church | Church | No | 36” – 48” | Low |
| 28 | The Meadows | Sewer treatment plant | No | 36” – 48” | Low |
| 29 | Dover/Sherborn Regional Complex | Sewer treatment plant | No | 36” – 48” | Low |
| 30 | Dover/Sherborn Regional Middle School | School | No | 36” – 48” | Low |
| 31 | DCR Fire tower on Pine Street | Fire tower | No | 36” – 48” | Low |
| 32 | Worthington Pond Dam | Dam | Yes | 36” – 48” | Low |

## 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 Dover, it does not capture all relevant information. In fact, the HAZUS training manual notes that the default data is "subject to a great deal of uncertainty."

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

Estimated Damages from Hurricanes

The HAZUS software was used to model potential damages to the community from a 100 year and 500 year hurricane event; storms that are 1% and .0.2% likely to happen in a given year, and roughly equivalent to a Category 2 and Category 4 hurricane. The damages caused by these hypothetical storms were modeled as if the storm track passed directly through the Town, bringing the strongest winds and greatest damage potential.

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

**Table 23 - Estimated Damages from Hurricanes**

| | 100 Year | 500 Year |
|---|---|---|
| **Building Characteristics** | | |
| Estimated total number of buildings | 1,000 | |
| Estimated total building replacement value (2010 $) | $858,000,000 | |
| | | |
| **Building Damages** | | |
| # of buildings sustaining minor damage | 60 | 327 |
| # of buildings sustaining moderate damage | 2 | 40 |
| # of buildings sustaining severe damage | 0 | 2 |
| # of buildings destroyed | 0 | 1 |
| | | |
| **Population Needs** | | |
| # of households displaced | 0 | 6 |
| # of people seeking public shelter | 0 | 1 |
| | | |
| **Debris** | | |
| Building debris generated (tons) | 7,919 | 10.083 |
| Tree debris generated (tons) | 1,173 | 3,138 |
| # of truckloads to clear building debris | 7 | 35 |
| | | |
| **Value of Damages** | | |
| Total property damage (buildings and content) | $ 6,030,000 | $ 19,500,780 |
| Total losses due to business interruption | $ 156,380 | $ 799,780 |

Estimated Damages from Earthquakes

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

**Table 24**
**Estimated Damages from Earthquakes**

| | **Magnitude 5.0** | **Magnitude 7.0** |
|---|---|---|
| **Building Characteristics** | | |
| Estimated total number of buildings | 1,000 | |
| Estimated total building replacement value (2010 $) | $858,000,000 | |
| | | |
| **Building Damages** | | |
| # of buildings sustaining slight damage | 554 | 55 |
| # of buildings sustaining moderate damage | 231 | 413 |
| # of buildings sustaining extensive damage | 39 | 612 |
| # of buildings completely damaged | 6 | 839 |
| | | |
| **Population Needs** | | |
| # of households displaced | 13 | 850 |
| # of people seeking public shelter | 6 | 436 |
| | | |
| **Debris** | | |
| Building debris generated (tons) | 10,000 | 120,000 |
| # of truckloads to clear debris (@ 25 tons/truck) | 325 | 4,880 |
| | | |
| **Value of Damages (Millions of dollars)** | | |
| Total property damage | $76,860,000 | $ 702,040,000 |
| Total losses due to business interruption | $6,630,000 | $ 65,480,000 |

Estimated Damages from Flooding

Although HAZUS-MH was used to estimate damages from hurricanes and tornadoes, MAPC did not use HAZUS-MH to estimate flood damages in Dover. The riverine module is not a reliable indicator of flooding in areas, where stormwater drainage systems and beaver activity contribute to flooding even when structures are not within a mapped flood zone. In lieu of using HAZUS, MAPC developed a methodology to give an approximation of flood damages.

Approximately 26.4 acres of Dover's total land area of 9,878 acres have been identified by local officials as areas of flooding. This amounts to 0.27 percent of the town's total land area. The number of structures in the locally identified flood area was estimated by applying the percentage of the total land area to the total number of structures (1,969) in Dover, HAZUS uses an average value of $858,000 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 September 2002 publication, "State and Local Mitigation Planning how-to guides" (Page 4-13). The range of estimates for flood damages is $456,138.54 to $2,280,692.70. These calculations are approximate only and are meant to show an order of magnitude of damage. The results are summarized in Table 25.

**Table 25**
**Estimated Damages from Flooding**

| ID | Flood Hazard Area | Approximate Area in Acres | % of Total Land Area | # of Structures | Replacement Value-$ | Low Estimate of Damages$ | High Estimate of Damages $ |
|---|---|---|---|---|---|---|---|
| 1 | Dedham Street at Needham town line | 8.6 | 0.09% | 1.8 | $ 1,520,461.80 | $ 152,046.18 | $760,230.90 |
| 2 | Turtle Lane, near intersection with Dover Road | 1.2 | 0.01% | 0.2 | $168,940.20 | $16,894.02 | $ 84,470.10 |
| 3 | Claybrook Road at Cullen Road | 1.4 | 0.01% | 0.2 | $168,940.20 | $16,894.02 | $ 84,470.10 |
| 4 | Claybrook Road at Trout Brook | 0.9 | 0.01% | 0.2 | $ 168,940.20 | $16,894.02 | $ 84,470.10 |
| 5 | Wilsondale Street at Powissett Brook | 3.6 | 0.04% | 0.8 | $ 675,760.80 | $67,576.08 | $ 337,880.40 |
| 6 | Mill Street at USGS river gauging station | 2.5 | 0.03% | 0.6 | $ 506,820.60 | $50,682.06 | $ 253,410.30 |
| 7 | 54 Yorkshire Road | 3.9 | 0.04% | 0.8 | $675,760.80 | $67,576.08 | $337,880.40 |
| 13 | Haven Street | 4.3 | 0.04% | 0.8 | $675,760.80 | $67,576.08 | $ 337,880.40 |
| | **TOTAL** | **26.4** | | **5.3** | **$4,561,385.40** | **$ 456,138.54** | **$2,280,692.70** |

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# V. HAZARD MITIGATION GOALS

The Dover Local Hazard Mitigation Planning Team reviewed and discussed the goals from the 2009 Hazard Mitigation Plan for the Town of Dover. 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 identified natural hazards.

**Goal 2:** Build and enhance local mitigation capabilities to ensure individual safety, reduce damage to public and private property and ensure continuity of emergency services.

**Goal 3:** Increase cooperation and coordination among private entities, Town officials and Boards, State agencies and Federal agencies.

**Goal 4:** Increase awareness of the benefits of hazard mitigation through outreach and education.

**Goal 5:** Identify and seek funding for measures to mitigate or eliminate each known significant flood hazard area.

**Goal 6:** Integrate hazard mitigation planning as an integral factor in all relevant municipal departments, committees and boards.

**Goal 7:** Prevent and reduce the damage to public infrastructure resulting from all hazards.

**Goal 8:** Encourage the business community, major institutions and non-profits to work with the Town to develop, review and implement the hazard mitigation plan.

**Goal 9:** Work with surrounding communities to ensure regional cooperation and solutions for hazards affecting multiple communities.

**Goal 10:** Ensure that future development meets federal, state and local standards for preventing and reducing the impacts of natural hazards.

**Goal 11:** 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 Dover 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. The Town's existing mitigation measures are listed by hazard type here and are summarized in Table 26 below.

**Mitigation Measures Relating to Multiple Hazards**

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

*Comprehensive Emergency Management Plan (CEMP)*

Every community in Massachusetts is required to have a Comprehensive Emergency Management Plan. These plans address mitigation, preparedness, response and recovery from a variety of natural and man-made emergencies. These plans contain important information regarding flooding, hurricanes, tornadoes, dam failures, earthquakes, and winter storms. Therefore, the CEMP is relevant to most of the hazards discussed in this plan.

- Multi-department review of developments
- Comprehensive Emergency Management Plan (CEMP)
- Enforcement of State Building Code
- Local Emergency Management Planning Committee (LEPC)
- Emergency Preparedness public education on the town website
- Dover/Sherborn High School is designated as a community shelter (although it has no generator)
- Police and Fire Stations have backup generators (although they are on natural gas or are limited diesel)
- Medical Reserve Corps
- Spectra Gas Energy company monitors its gas line; Columbia and Eversource also have lines through town
- Sheltering available for elderly during extreme heat and cold

**Flood Related Hazards**

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

*National Flood Insurance Program (NFIP)* – Dover participates in the NFIP with xxx policies in force as of July 31, 2015. FEMA maintains a database on flood insurance policies and claims. This database can be found on the FEMA website at http://www.fema.gov/business/nfip/statistics/pcstat.shtm

The following information is provided for the Town of Dover:

| | |
|---|---|
| Flood insurance policies in force ( as of July 31, 2015) | 42 |
| Coverage amount of flood insurance policies | $11,628,600 |
| Premiums paid | $27,977 |
| Total losses (all losses submitted regardless of the status) | 13 |
| Closed losses (Losses that have been paid) | 11 |
| Open losses (Losses that have not been paid in full) | 0 |
| CWOP losses ( Losses that have been closed without payment) | 2 |
| Total payments (Total amount paid on losses) | $83,449.38 |

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.

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

Other existing flood mitigation measures include the following:

- Annual catch basin cleaning and annual street sweeping
- Drainage system maintenance is performed as needed, under a general maintenance permit
- Long-term stormwater plan and funding, and ongoing system improvements
- Beaver mitigation
- Flood Plain District
- Wetlands Conservancy District
- Massachusetts Stormwater Policy
- Stormwater Requirements in Subdivision Regulations and Site Plan Review
- Open Space Residential Developments allowed
- Protected open space and proactive land preservation programs
- Public Education on stormwater through the NPDES Phase II program

**Dam Failures**

*DCR dam safety regulations* –In 2002 the Massachusetts legislature enacted revisions of the Dam Safety Statute, MGL Chapter 253 §§ 44-50, which significantly changes the responsibilities of dam owners to register, inspect and maintain dams in good operating condition. Amendments to Dam Safety Regulations 302 CMR 10.00-10.16 became

effective November 4, 2005 and are reflective of the statutory changes. MGL Chapter 253 and 302 CMR 10.00 requires Emergency Action Plans be prepared, maintained and updated by dam owners, for High Hazard Potential dams and certain Significant Hazard Potential dams. There are no High Hazard or Significant Hazard Potential Dams in Dover.

**Wind-Related Hazards**

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

A Tree Maintenance Program is conducted by the Dover Tree Warden.

**Winter-Related Hazards**

*Snow Removal*: The town conducts regular snow removal operations and has a restricted salt application policy.

*Massachusetts State Building Code:* The town enforces the Massachusetts State Building Code, which contains regulations regarding snow loads on building roofs. The town has adopted the state building code.

Other existing mitigation measures for winter related hazards include:

- Public Education on snow operations and winter maintenance is on the town website
- Snow and Ice Disposal Bylaw
- Public Education on how to prevent roof collapses from snow loads
- Sufficient space for municipal snow storage

**Brush Fire-Related Hazards**

- Open burning permits required
- Fire Department reviews all development plans
- Fire Department provides public education on its website

**Geologic Hazards – Landslides and Earthquakes**

*Massachusetts State Building Code* – The State Building Code contains a section on designing for earthquake loads (780 CMR 1612.0). Section 1612.1 states that the purpose of these provisions is "to minimize the hazard to life to occupants of all buildings

and non-building structures, to increase the expected performance of higher occupancy structures as compared to ordinary structures, and to improve the capability of essential facilities to function during and after an earthquake". This section goes on to state that due to the complexity of seismic design, the criteria presented are the minimum considered to be "prudent and economically justified" for the protection of life safety. The code also states that absolute safety and prevention of damage, even in an earthquake event with a reasonable probability of occurrence, cannot be achieved economically for most buildings.

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

Other existing mitigation measures for geologic hazards include:

- Maximum slopes for subdivision roads
- Earth Removal Bylaw
- State open trench permits
- Shelters and backup facilities available (see multi-hazard mitigation above)
- Evacuation plan in CEMP

**Local Capacity for Implementation**

The Town of Dover has recognized several existing mitigation measures that require implementation or improvements, and has the capacity within its local boards and departments to address these. The Dover Highway Department will address the needs for catch basin cleaning, repairs and upgrades to drainage infrastructure. The town's Planning Board will address implementation of the Zoning Ordinance, Floodplain District, and Subdivision Rules and Regulations. The Conservation Commission will oversee implementation of the Wetlands Conservancy District and the Open Space Plan.

**Table 26**
**Existing Mitigation Measures**

| Mitigation Measure | Area Covered | Effectiveness /Changes |
|---|---|---|
| **MITIGATION MEASURES RELATING TO MULTIPLE HAZARDS** | | |
| A) Multi-department review of developments<br>B) Comprehensive Emergency Management Plan (CEMP)<br>C) Enforcement of State Building Code<br>D) Local Emergency Management Planning Committee (LEPC)<br>E)Emergency Preparedness public education on the town website<br>F)Dover/Sherborn High School is designated as a community shelter (although it has no generator)<br>G) Police and Fire Stations have backup generators (although they are on natural gas or are limited diesel)<br>I) Medical Reserve Corps<br>J) Spectra Gas Energy company monitors its gas line; *Columbia and Eversource* also have lines through town<br>K) Sheltering available for elderly during extreme heat and cold | Town-wide | Effective; the former Caryl School is now a community center and has generators, so it could serve as an alternate shelter to Dover/Sherborn High School. |
| **FLOOD RELATED HAZARDS** | | |
| A) Participation in the National Flood Insurance Program | Town-wide | Effective, the town has 42 policies in force |
| B) Annual catch basin cleaning and annual street sweeping | | Effective; catch basins cleaned twice a year now; town is also anticipating new MS4 Stormwater Regulation requirements from EPA. |
| C) Drainage system maintenance is performed as needed, and under a general maintenance permit issued by the Natural Resources Commission | | |
| D) Long-term stormwater plan and funding, and ongoing system improvements | | New EPA MS4 Stormwater Permit will likely require additional improvements |
| E) Beaver mitigation | | |
| F) Flood Plain District | | Effective |

| Mitigation Measure | Area Covered | Effectiveness /Changes |
|---|---|---|
| G) Wetlands Conservancy District<br>H) Massachusetts Stormwater Policy<br>I) Stormwater Requirements in Subdivision Regulations and Site Plan Review<br>J) Open Space Residential Developments allowed<br>K) Groundwater Conservancy District<br>L) Protected open space and proactive land preservation programs<br>M) Public Education on stormwater through the NPDES Phase II program | | Effective<br>May be modified by new EPA MS4 Permit<br>Effecti ve<br>Effective<br>Effective<br>New EPA MS4 Permit may require modifications |
| Existing culvert requires regular maintenance to operate properly and remove excess water from storm events and spring runoff. | Dedham Street at Needham town line (1) | Effective |
| Turtle Lane is built along banks of Charles River and can flood frequently. Residents of this private way have resisted town offers to mitigate the impacts | Turtle Lane at intersection of Dover Road (2) | Town took over the street from the State and it is now fixed. |
| Existing culverts need maintenance but may be too small already. | Clay Brook Road near Cullen Road (3) | Effective with proper maintenance |
| Existing culvert requires regular maintenance and monitoring during snowmelt. | Clay Brook Road at Trout Brook (4) | Effective with proper maintenance |
| Infrequent flood threat managed with small private dam that requires manual alteration. Existing culvert and adjacent roadway requires regular maintenance. | Wilsondale Street at Powissett Brook (5) | Effective with proper maintenance |
| Small culvert under the roadway requires regular maintenance. Additional measures could be sought. | Springdale Avenue at Trout Brook (8) | Effective with proper maintenance |

| Mitigation Measure | Area Covered | Effectiveness /Changes |
|---|---|---|
| Existing culvert at this site is regularly maintained but may need to be expanded or enlarged to handle the volume of that causes moderate flooding problems here. | USGS Gauging Station at Haven Street on Trout Brook (16) | Effective with proper maintenance |
| **DAM FAILURES** | | |
| A) DCR Dam Safety Regulations;<br>B) Construction permits required | State-wide; Town-wide | Effective |
| **WIND-RELATED HAZARDS** | | |
| Tree Maintenance Program by Public Works | Town-wide | Effective; there is a 5year plan and the town is working with Eversource utility |
| **WINTER-RELATED HAZARDS** | | |
| A) Standard snow operations, restricted salt<br>B) Public Education on snow operations and winter maintenance is on the town website<br>C) Snow and Ice Disposal Bylaw<br>D) Public Education on how to prevent roof collapses from snow loads<br>E) Sufficient space for municipal snow storage | Town-wide | Effective |
| **BRUSH FIRE RELATED HAZARDS** | | |
| A) Open burning permits required<br>B) Fire Department reviews all development plans<br>C) Fire Department provides public education on its website<br>D) Town provides public education on drought watches<br>E) | Town-wide | Effective |
| **GEOLOGIC HAZARDS - Landslides** | | |

| Mitigation Measure | Area Covered | Effectiveness /Changes |
|---|---|---|
| A) Maximum slopes for subdivision roads<br>B) Earth Removal Bylaw<br>C) State open trench permits | Town-wide | Effective |
| **GEOLOGIC HAZARDS - Earthquakes** | | |
| A) Shelters and backup facilities available (see multi-hazard mitigation above)<br>B) Evacuation plan in CEMP | Town-wide | Effective |

# VII. MITIGATION MEASURES FROM THE 2009 PLAN

### Implementation Progress on the Previous Plan

At a meeting of the Dover Hazard Mitigation Planning Committee, Town staff reviewed the mitigation measures identified in the 2009 Dover 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 2016 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 2009 Plan**

| Mitigation Measure | Priority | Lead Implementation | Status | Include in 2016 Plan? | Priority in 2016 Plan |
|---|---|---|---|---|---|
| Enlarge Culvert at Claybrook Road | High | Public Works | Not Completed | Yes | High |
| Install Drainage Pipe to Mill Brook | High | Public Works | No longer an issue | No | N/A |
| Elevate Utilities in Homes on Turtle Lane | High | Public Works | Not Completed | Yes | Medium |
| Institute Neighborhood Fire Watches and Education | High | Fire Department | In Progress | Yes | Medium |
| Open Space Protection and Land Acquisition | High | Natural Resources / Planning | In Progress | Yes | High |
| Regulatory Revisions for Stormwater Management | High | Planning / Natural Resources | In Progress | Yes | High |
| Become Fully "Storm Ready" / TV alert notification | High | Police, Fire Departments | Completed | No | N/A |
| Increase Size/Capacity at other Drainage structures | Medium | Public Works | Completed | No | N/A |
| Utilities at lower Yorkshire Rd. | Medium | Public Works | Completed | No | N/A |

| Mitigation Measure | Priority | Lead Implementation | Status | Include in 2016 Plan? | Priority in 2016 Plan |
|---|---|---|---|---|---|
| Assessment of Municipal Structures for Susceptibly to Snow Loads | Other | Public Works / Building | Not Completed | Yes | Medium |
| Raise Walpole St. in low Spot | Other | Public Works | Completed | No | N/A |
| Slow Train Policies | Other | Fire Department/ Zoning Boards | No more trains in town | No | N/A |

As shown in Table 27, four of the mitigation measures from the 2009 plan have been completed, and six measures from that plan will be carried over to this plan update. Three of those will retain the same priority in this plan update as originally listed in the 2009 plan: the culvert at Claybrook Road, Open Space protection, and regulatory revisions for stormwater management will continue to be "high" priority. The priority of two measures have changed from "high" in 2009 to "medium" in this plan update: elevation of utilities in Homes on Turtle Lane; and neighborhood fire watches and education. One mitigation measure, assessment of municipal structures for susceptibly to snow loads, was listed as "other" in the 2009 plan and is now a "medium" priority in this plan update.

The challenges the Town of Dover faces in implementing these measures are primarily due to limited funding and available staff time. This plan update should help the Town prioritize the best use of its limited resources for enhanced mitigation of natural hazards. Moving forward into the next five year plan implementation period the Town will pursue opportunities to implement priority mitigation projects and incorporate hazard mitigation into the town's decision making processes, as described in Section IX below.

# VIII. HAZARD MITIGATION STRATEGY

## What is Hazard Mitigation?

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

http://www.fema.gov/government/grant/hmgp/index.shtm
http://www.fema.gov/government/grant/pdm/index.shtm
http://www.fema.gov/government/grant/fma/index.shtm

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

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

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

## Regional and Inter-Community Considerations

Some hazard mitigation issues are strictly local. The problem originates primarily within the municipality and can be solved at the municipal level. Other issues are inter-community 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 developed areas such as the metropolitan Boston region, mitigating natural hazards, particularly flooding, is more than a local issue. The drainage systems that serve these communities are complex systems of storm drains, roadway drainage structures, pump stations and other facilities owned and operated by local and state agencies including the Town of Dover, the Department of Conservation and Recreation (DCR), and the Massachusetts Department of Transportation (MassDOT). The planning, construction, operation and maintenance of these structures are integral to the flood hazard mitigation efforts of communities. These agencies must be considered the communities' regional partners in hazard mitigation. These agencies also operate under the same constraints as communities do including budgetary and staffing constraints and they must make decisions about numerous competing priorities.

### Regional Issues

The Local Team did not identify site-specific regional issues impacting the town but did agree that all communities within the region share common concerns including the following:

- Maintenance and drainage from state highways
- Inspection and maintenance of state and privately owned dams
- Coordinated response to wildfires on state and privately owned properties
- Emergency Planning and Community Right to Know (EPCRA) filers (local Local Emergency Planning Committees(LEPC) would have a list and significant Hazardous Waste Sites that could impact a community during a disaster
- Transportation of hazardous materials through communities by rail or truck

## 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 Floodplain Zoning District, the Stormwater Management bylaw enforced for new development, the Subdivision Rules and Regulations enforced for new development, and the Draft Master Plan, the town determined that existing regulatory measures are taking full advantage of local Home Rule land use regulatory authority to minimize natural hazard impacts of development.

## Proposed Hazard Mitigation Measures

Flood Hazard Mitigation Measures

A) Enlarge Culvert at Claybrook Road

B) Elevate Utilities in Homes on Turtle Lane

C) Regulatory Revisions for Stormwater Management

D) Open Space Protection and Land Acquisition: acquire undeveloped parcels to absorb stormwater and reduce runoff and flooding impacts.

E) Replace deteriorating old stone culvert at Wilsondale Street at Powissett Brook with a box culvert.

Winter Storm Hazard Mitigation Measures

F) Assessment of Municipal Structures for Susceptibly to Snow Loads

Drought Mitigation Measures

G) Promote drought-tolerant landscaping and site design and rain barrels

Extreme High Temperatures Mitigation Measures

H) Promote Green Building and Cool Roof designs

Wind Hazard Mitigation Measures

I) Public Education: Educate homeowners about proper clearance

Brush Fire Mitigation Measures

J) Institute Neighborhood Fire Watches and Education

Geologic Hazard Mitigation Measures

K) Investigate options to make all public safety buildings earthquake resistant

## Prioritization of Mitigation Activities

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 Committee has limited access to detailed analyses of the cost and benefits of any given measure, so prioritization is based on the committee member's knowledge of the existing and potential hazard impacts and an approximate sense of the costs associated with pursuing any given measure.

Prioritization occurred through discussion at the meeting of the local committee and through subsequent review by committee members and public comment. Priority setting was based on local knowledge of the hazard areas, including impacts of hazard events and the extent of the area impacted and the relation of a given mitigation measure to the Town's identified goals. In addition, through the discussion, the local committee 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 the Town currently had the technical and administrative capability to carry out the mitigation measures, whether any environmental constraints existed, and whether the Town would be able to justify the costs relative to the anticipated benefits.

The table below demonstrates the prioritization. For each mitigation measure, the geographic extent of the potential benefiting area is identified. The benefits, costs, and priority were evaluated in terms of the following factors:

**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 |

Priorities for all mitigation measures are shown in Table 28 below, and the project type, implementing responsibility, timeframe, and potential funding sources are shown in the following table, Table 29.

**Table 28 - Mitigation Measure Prioritization**

| Mitigation Measure | Benefit | Estimated Cost | Priority | Time Frame |
|---|---|---|---|---|
| **Flood Hazard Mitigation Measures** | | | | |
| A. Enlarge Culvert at Claybrook Road | High | High ($200k) | High | 2019 |
| B. Elevate Utilities in Homes on Turtle Lane | Medium | High | Medium | 2016-21 |
| C. Regulatory Revisions for Stormwater Management | High | Low | High | 2017-18 |
| D. Open Space Protection and Land Acquisition of parcels to mitigate stormwater runoff | High | High | High | 2016-21 |
| E. Replace old stone culvert at Wilsondale Street at Powissett Brook with a box culvert | High | High ($200-300k) | High | 2019 |
| **Winter Storm Hazard Mitigation Measures** | | | | |
| F. Assessment of Municipal Structures for Susceptibly to Snow Loads | Medium | Medium | Medium | 2016-21 |
| **Drought Mitigation Measures** | | | | |
| G. Promote drought-tolerant landscaping and site design and rain barrels | Medium | Low | Medium | 2016-21 |
| **Extreme Temperature Mitigation Measures** | | | | |
| H. Promote Green Building and Cool Roof designs | Low | Low | Low | 2016-21 |
| **Wind Mitigation Measures** | | | | |
| I. Public Education: Tree warden to educate homeowners about proper | Medium | Low | Medium | 2016-21 |

**Table 28 - Mitigation Measure Prioritization**

| Mitigation Measure | Benefit | Estimated Cost | Priority | Time Frame |
|---|---|---|---|---|
| clearance | | | | |
| **Brush Fire Hazards** | | | | |
| J. Institute Neighborhood Fire Watches and Education | Medium | Low | Medium | 2016-21 |
| **Geologic Hazards** | | | | |
| K. Investigate options to make all public safety buildings earthquake resistant | Low | Low | Low | 2016-21 |

**Notes on Mitigation Measures Table (Table 29)**

Implementation Responsibility – The designation of implementation responsibility was done by MAPC 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 committee 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.

United States Department of Agriculture – The USDA has programs by which communities can get grants for firefighting needs. See the link below for some example. http://www.rurdev.usda.gov/rd/newsroom/2002/cfg.html

## Table 29
## Mitigation Measure Prioritization

| Mitigation Measure | Priority | Lead Implementation | Time Frame | Potential Funding Sources |
|---|---|---|---|---|
| **Flood Hazard Mitigation Measures** | | | | |
| A. Enlarge Culvert at Claybrook Rd. | High | Public Works | 2019 | MassDOT, Town General Fund, FEMA |
| B. Elevate Utilities in Homes on Turtle Lane | Medium | Public Works | 2016-21 | Town General Fund, FEMA |
| C. Open Space Protection and Land Acquisition of parcels to mitigate storm water runoff | High | Natural Resources/ Planning | 2017-18 | Town General Fund, Community Preservation Act Funds, Gifts |
| D. Regulatory Revisions for Stormwater Management | High | Natural Resources/ Planning | 2016-21 | Town General Fund, , MET grants, |
| E. Replace old stone culvert at Wilsondale Street at Powissett Brook with a box culvert | High | Public Works | 2019 | Town General Fund, FEMA |
| **Winter Storm Hazard Mitigation Measures** | | | | |
| F. Assessment of Municipal Structures for Susceptibly to Snow Loads | Medium | Public Works/ Building | 2016-21 | Town General Fund |
| **Drought Hazard Mitigation Measures** | | | | |
| *G. Promote drought-tolerant landscaping and site design and rain barrels* | Medium | Public Works, Planning, Building | 2016-21 | Town General Fund |

| Mitigation Measure | Priority | Lead Implementation | Time Frame | Potential Funding Sources |
|---|---|---|---|---|
| | | | | |
| **Extreme Temperature Mitigation Measures** | | | | |
| H. Promote Green Building and Cool Roof designs | Low | Planning Dept | 2016-21 | Town General Fund |
| **Wind Mitigation Measures** | | | | |
| *I. Public Education: to educate homeowners about proper clearance* | Medium | Tree Warden | 2016-21 | Town General Fund |
| **Fire Hazards** | | | | |
| J. Institute Neighborhood Fire Watches and Education | Medium | Fire Dept | 2016-21 | Town General Fund |
| **Geologic Hazard Mitigation Measures** | | | | |
| K. Investigate options to make all public safety buildings earthquake resistant | Low | | 2016-21 | Town General Fund |

**Abbreviations Used in Table 29**

DCR = MA Department of Conservation and Recreation

DHCD = MA Department of Housing and Community Development

DHS/EOPS = Department of Homeland Security/Emergency Operations

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

Mass DOT = Massachusetts Department of Transportation

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# IX. PLAN ADOPTION AND MAINTENANCE

## Plan Adoption

The Dover Hazard Mitigation Plan was adopted by the Board of Selectmen on July 14, 2016. 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 Dover Hazard Mitigation Planning Team to prepare this plan. After approval of the plan by FEMA, this group will meet on a regular basis to function as the Hazard Mitigation Implementation Team, with the Chief of Police 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 Schedule

Mid-Term Survey on Progress – The coordinator of the Hazard Mitigation Implementation Team (which the Town has identified as the Chief of Police) 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 Chief of Police, 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 Dover Hazard Mitigation Plan 2015 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 Dover Hazard Mitigation Plan 2015 Update by FEMA, the Local Hazard Mitigation Team will provide all interested parties and implementing departments with a copy of the plan and will initiate a discussion regarding how the plan can be integrated into that department's ongoing work.

At a minimum, the plan will be reviewed and discussed with the following departments:

- Fire
- Emergency Management
- Police
- Public Works
- Engineering
- Planning
- Forestry
- Health
- Building

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

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

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# X. LIST OF REFERENCES

Dover Comprehensive Emergency Management Plan

Town of Dover Draft Master Plan (12/2/12)

Town of Dover Town Code (updated 5/12/14)

Town of Dover Subdivision Regulations

Town of Dover website: http://www.doverma.org/

FEMA, Flood Insurance Rate Maps for Norfolk 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, GIS Lab, Regional Plans and Data.

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 System, http://nwis.waterdata.usgs.gov/usa/nwis

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# APPENDIX A

# HAZARD MITIGATION PLANNING TEAM MEETING AGENDAS

# Meeting Agenda
Dover Natural Hazard Mitigation Planning Team
July 2, 2014, 10:00 AM
Dover Town Hall

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## 1) Introduction: Hazard Mitigation

*Mitigation: Action taken to reduce or eliminate long term risk of hazards*

## 2) Overview of Scope for the Plan Update

a) Update 2009 plan hazards affecting Dover
b) Update map of Critical Facilities
c) Update map of locally identified hazard areas
d) Update Existing Mitigation Measures
e) Review status of Mitigation Measures from the 2009 plan
f) Develop new Mitigation measures for the plan update

## 3) Planning Process

a) Local Team Meetings
b) Two Public Meetings
c) Public outreach and stakeholder involvement
d) Draft plan submitted to MEMA and FEMA for approval
e) Approved plan adopted by vote of Board of Selectmen.

## 4) Getting Started: Data Update (Meeting #1)

a) Review and update Mitigation Plan Goals
b) Update map and inventory of Critical Facilities
c) Update locally identified hazard areas
d) Update potential future development areas
e) Discuss Public Involvement and Outreach

## 5) Next Steps (Meeting #2 & 3)

a) Review Existing Mitigation Measures
b) Review Mitigation Measures from the 2009 Plan
c) Discuss Potential Mitigation Measures
d) Prioritize Mitigation Measures

# Meeting Agenda
# Dover Natural Hazard Mitigation Plan
# Dover Town House
# December 15, 2014, 1:30 PM

## Local Team Meeting #2 (Information Gathering)

e) Hazard Mitigation Planning Map Series and Digitized Ortho Photo Map

f) Review Plan Goals and Objectives (page 2)

g) Identify/update local hazards (attachment & map)
   a. Flood Hazard Areas
   b. Fire Hazard Areas (brushfires/wildfires)
   c. Dams
   d. Ice jams
   e. Thunderstorms
   f. Drought
   g. Extreme Temps
   h. Tornadoes
   i. High winds
   j. Hurricanes
   k. Snow and Blizzards
   l. Ice storms
   m. Earthquakes
   n. Landslides

h) Identify/update Potential New Development Areas (page 3 & map)

i) Update status of Mitigation Measures from the 2009 Plan (page 4)

j) Identify/update Critical Facilities (attachment & map)

k) Discuss Public Involvement and Outreach (page 3)
   a. Identify local stakeholders
   b. Schedule first public meeting
   c. Schedule first public meeting

# Meeting Agenda
# Dover Hazard Mitigation Planning Team
# Dover Town House
# July 14, 2015

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## Local Team Meeting #3 (Mitigation Measures)

1) Review and Update Existing Mitigation Measures

2) Current Status of Recommended Mitigation Measures from the 2009 Plan

3) Potential Mitigation Measures for this 2015 Plan Update

4) Prioritize Updated Mitigation Measures (High, Medium, Low)

5) Plan for Final Public Meeting – Identify Stakeholders/Invitees

# 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/Dover/

| | |
|---|---|
| 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 Norfolk 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 Dover 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.

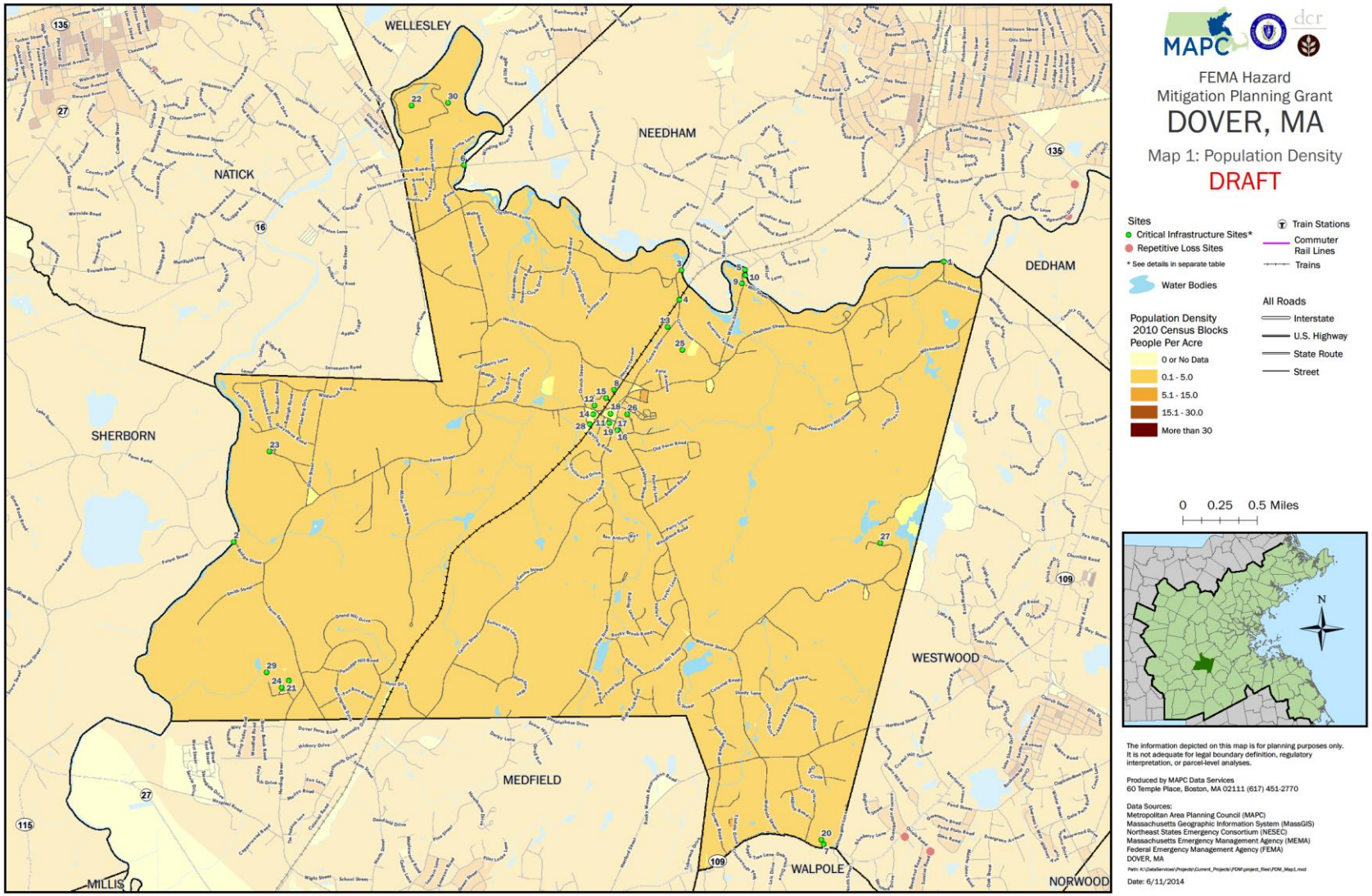
The landslide information shows areas with either a low susceptibility or a moderate susceptibility to landslides based on mapping of geological formations. This mapping is highly general in nature. For more information on how landslide susceptibility was mapped, refer to http://pubs.usgs.gov/pp/p1183/pp1183.html.

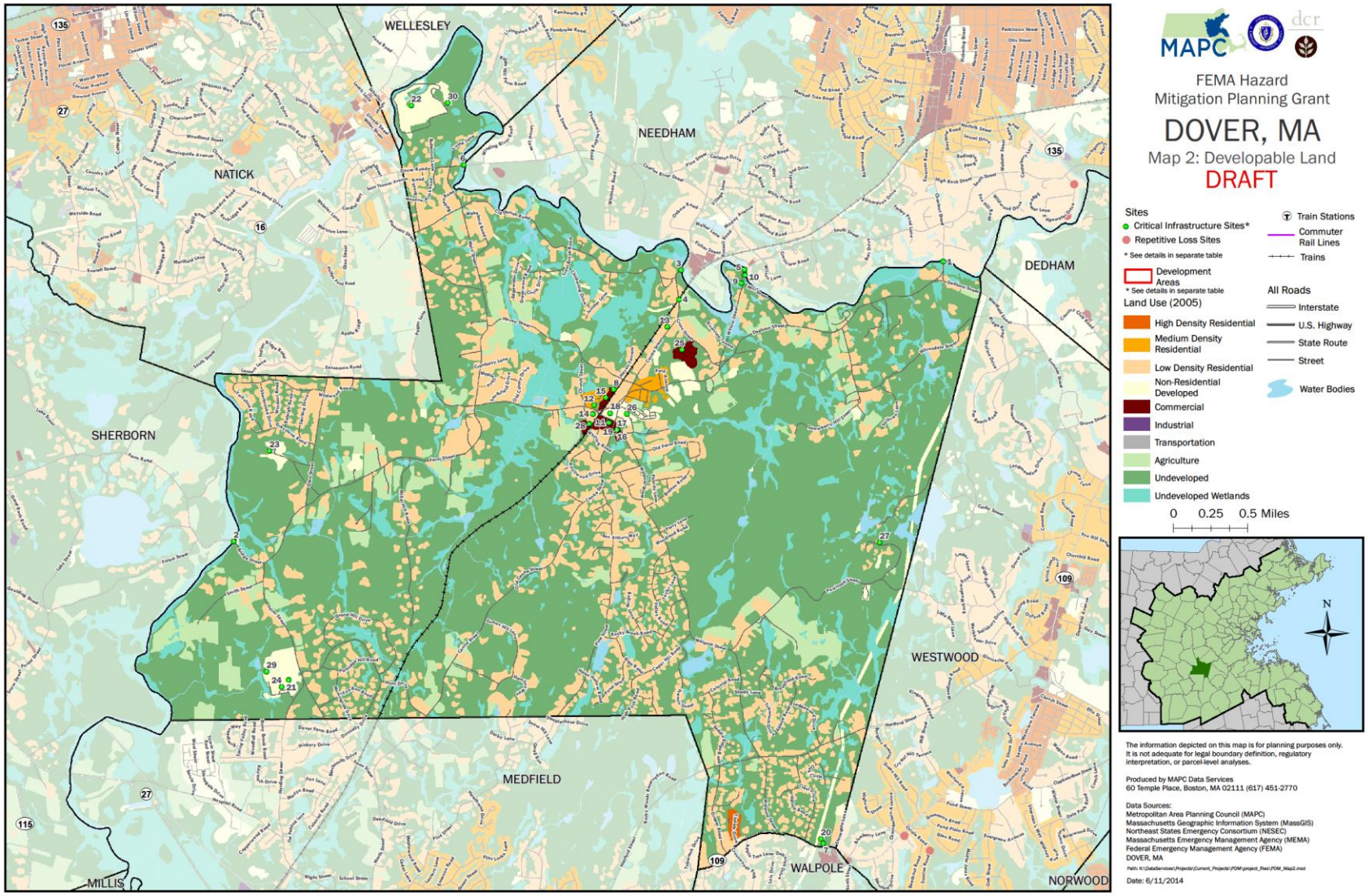
***Map 5: Hurricanes and Tornadoes –*** This map shows a number of different items. The map includes the storm tracks for both hurricanes and tropical storms, if any occurred in this community. This information must be viewed in context. A storm track only shows where the eye of the storm passed through.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


WELLESLEY
NEEDHAM
NATICK
DEDHAM
SHERBORN
WESTWOOD
MEDFIELD
WALPOLE
NORWOOD
MILLIS
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
DOVER, MA
Map 1: Population Density
DRAFT
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)
DOVER, MA
Date: 6/11/2014


WELLESLEY
NEEDHAM
NATICK
DEDHAM
SHERBORN
WESTWOOD
MEDFIELD
WALPOLE
NORWOOD
MILLIS
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
DOVER, MA
Map 2: Developable Land
DRAFT
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
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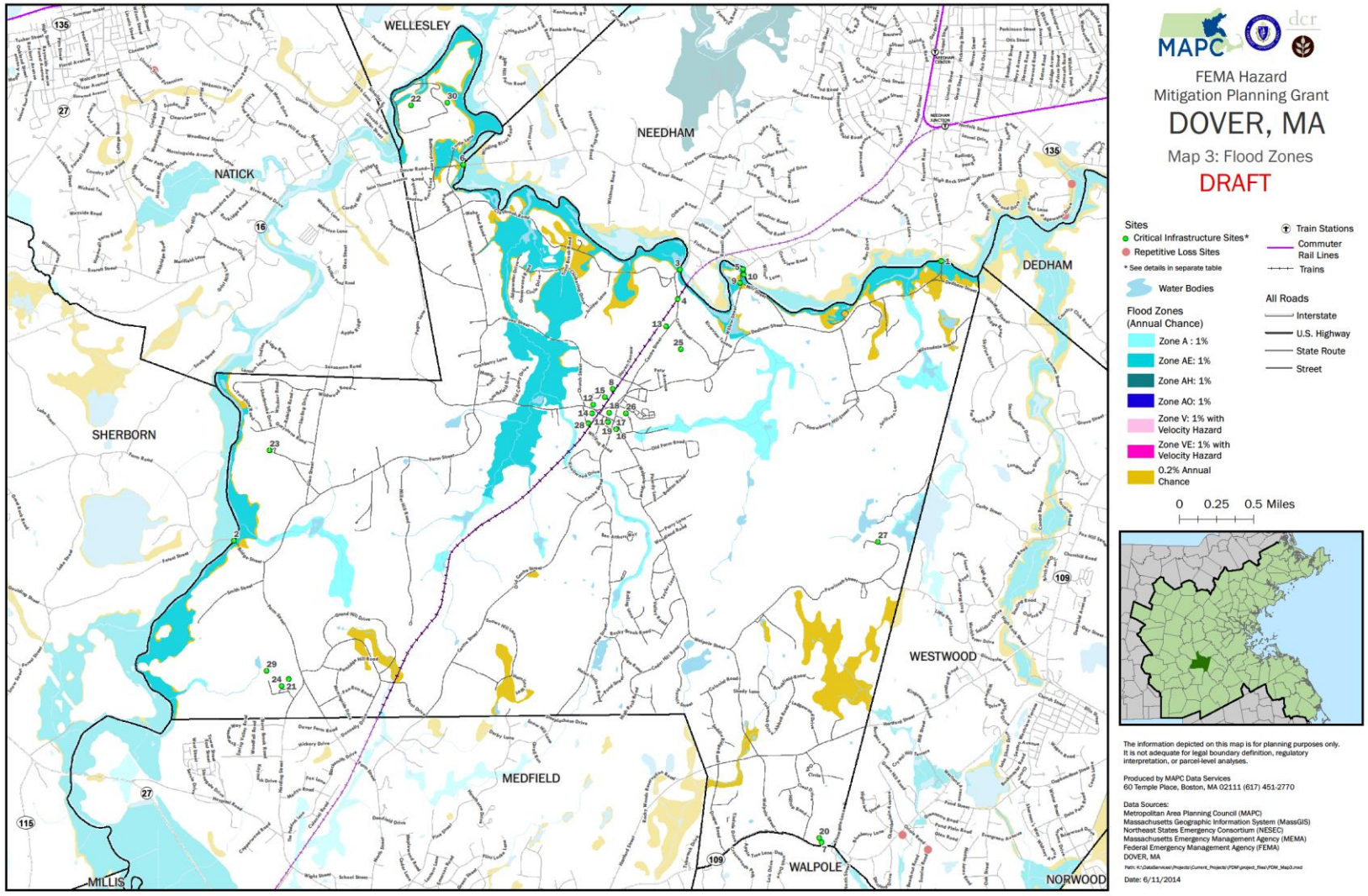
Federal Emergency Management Agency (FEMA)
DOVER, MA
Date: 6/11/2014


WELLESLEY
NEEDHAM
NATICK
DEDHAM
SHERBORN
WESTWOOD
MEDFIELD
WALPOLE
NORWOOD
MILLIS
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
DOVER, MA
Map 3: Flood Zones
DRAFT
Sites
Critical Infrastructure Sites*
Repetitive Loss Sites
* See details in separate table
Water Bodies
Flood Zones
(Annual Chance)
Zone A : 1%
Zone AE: 1%
Zone AH: 1%
Zone AO: 1%
Zone V: 1% with
Velocity Hazard
Zone VE: 1% with
Velocity Hazard
0.2% Annual
Chance
Train Stations
Commuter
Rail Lines
Trains
All Roads
Interstate
U.S. Highway
State Route
Street
0 0.25 0.5 Miles
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interpretation, or parcel-level analyses.
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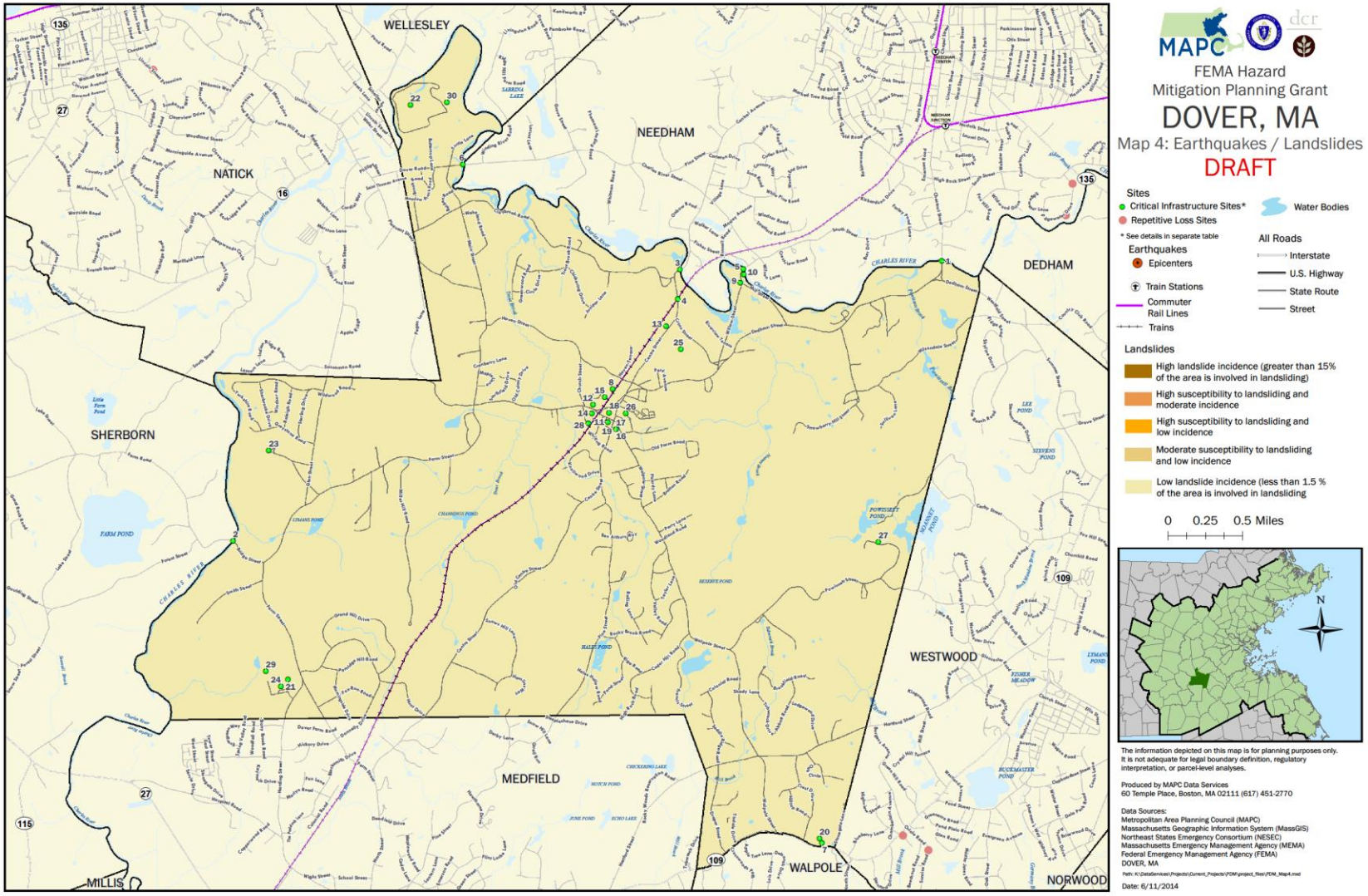
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
DOVER, MA
Date: 6/11/2014


WELLESLEY
NEEDHAM
NATICK
DEDHAM
SHERBORN
WESTWOOD
MEDFIELD
WALPOLE
NORWOOD
MILLIS
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
DOVER, MA
Map 4: Earthquakes / Landslides
DRAFT
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
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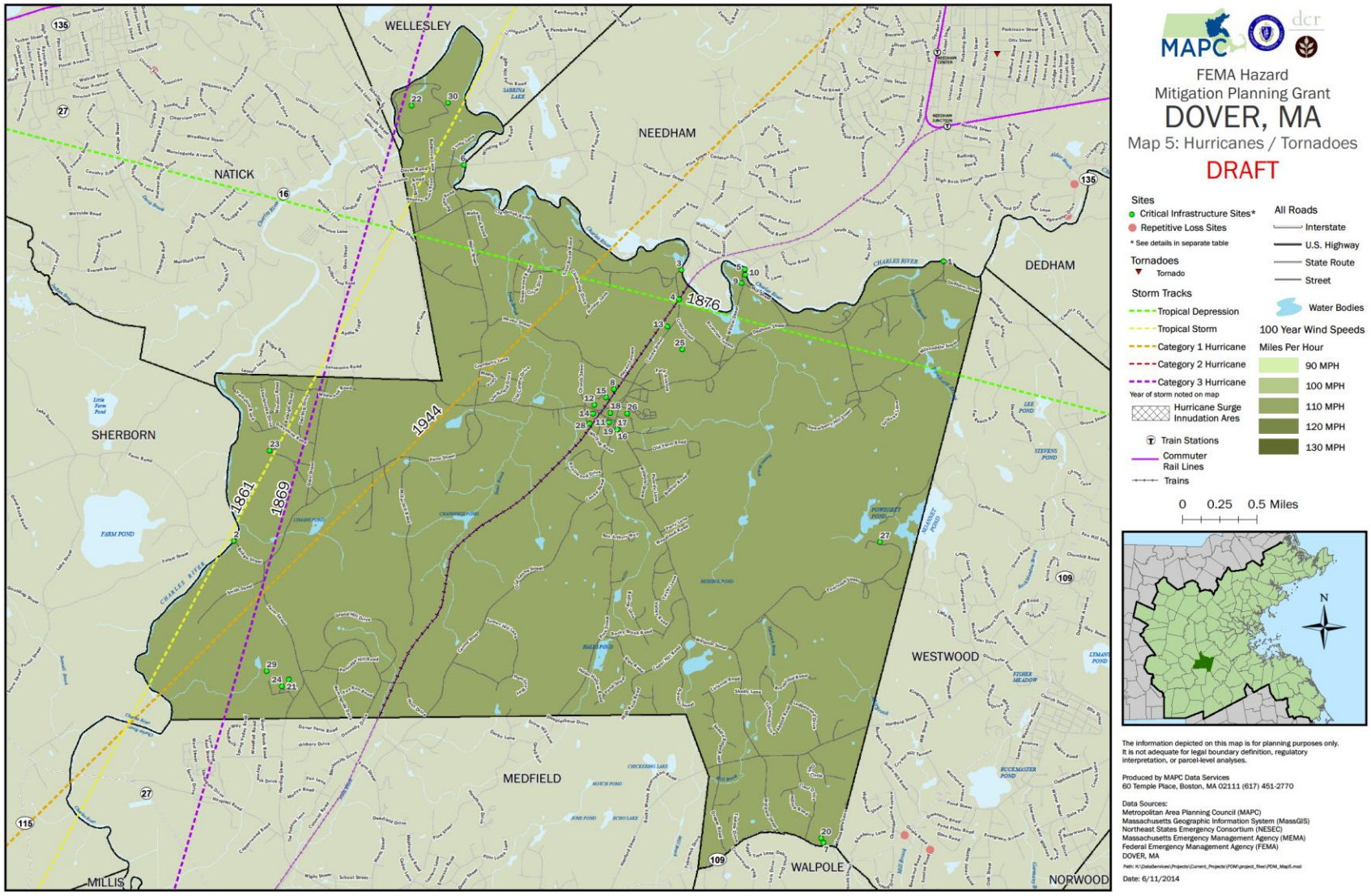
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
DOVER, MA
Date: 6/11/2014


WELLESLEY
NEEDHAM
NATICK
DEDHAM
SHERBORN
WESTWOOD
MEDFIELD
WALPOLE
NORWOOD
MILLIS
1876
1944
1861
1869
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
DOVER, MA
Map 5: Hurricanes / Tornadoes
DRAFT
Sites
Critical Infrastructure Sites*
Repetitive Loss Sites
* See details in separate table
Tornadoes
Tornado
Storm Tracks
Tropical Depression
Tropical Storm
Category 1 Hurricane
Category 2 Hurricane
Category 3 Hurricane
Year of storm noted on map
Hurricane Surge Innudation Ares
Train Stations
Commuter Rail Lines
Trains
All Roads
Interstate
U.S. Highway
State Route
Street
Water Bodies
100 Year Wind Speeds
Miles Per Hour
90 MPH
100 MPH
110 MPH
120 MPH
130 MPH
0 0.25 0.5 Miles
N
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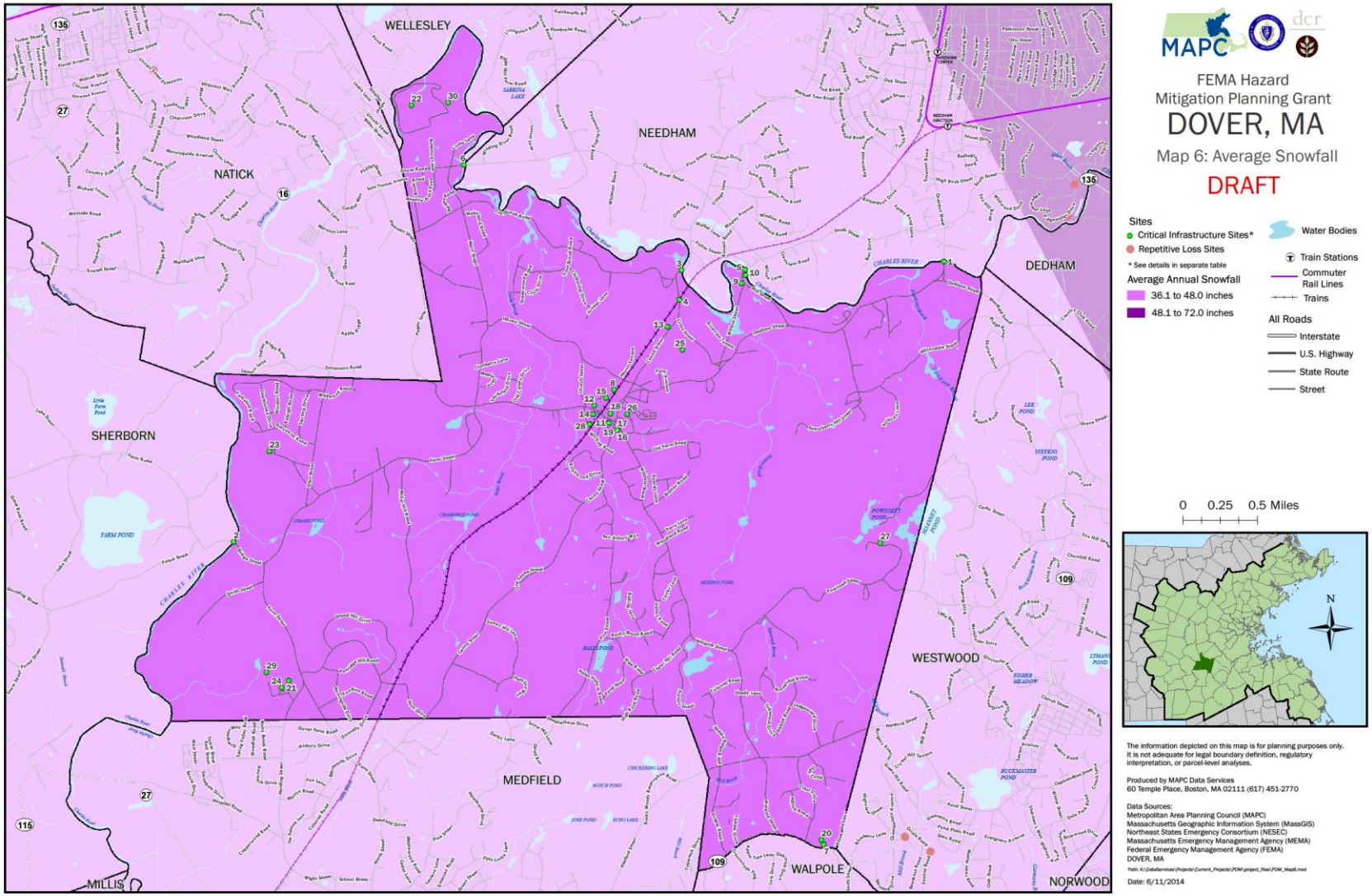
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
DOVER, MA
Date: 6/11/2014


WELLESLEY
NEEDHAM
NATICK
DEDHAM
SHERBORN
WESTWOOD
MEDFIELD
WALPOLE
NORWOOD
MILLIS
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
DOVER, MA
Map 6: Average Snowfall
DRAFT
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
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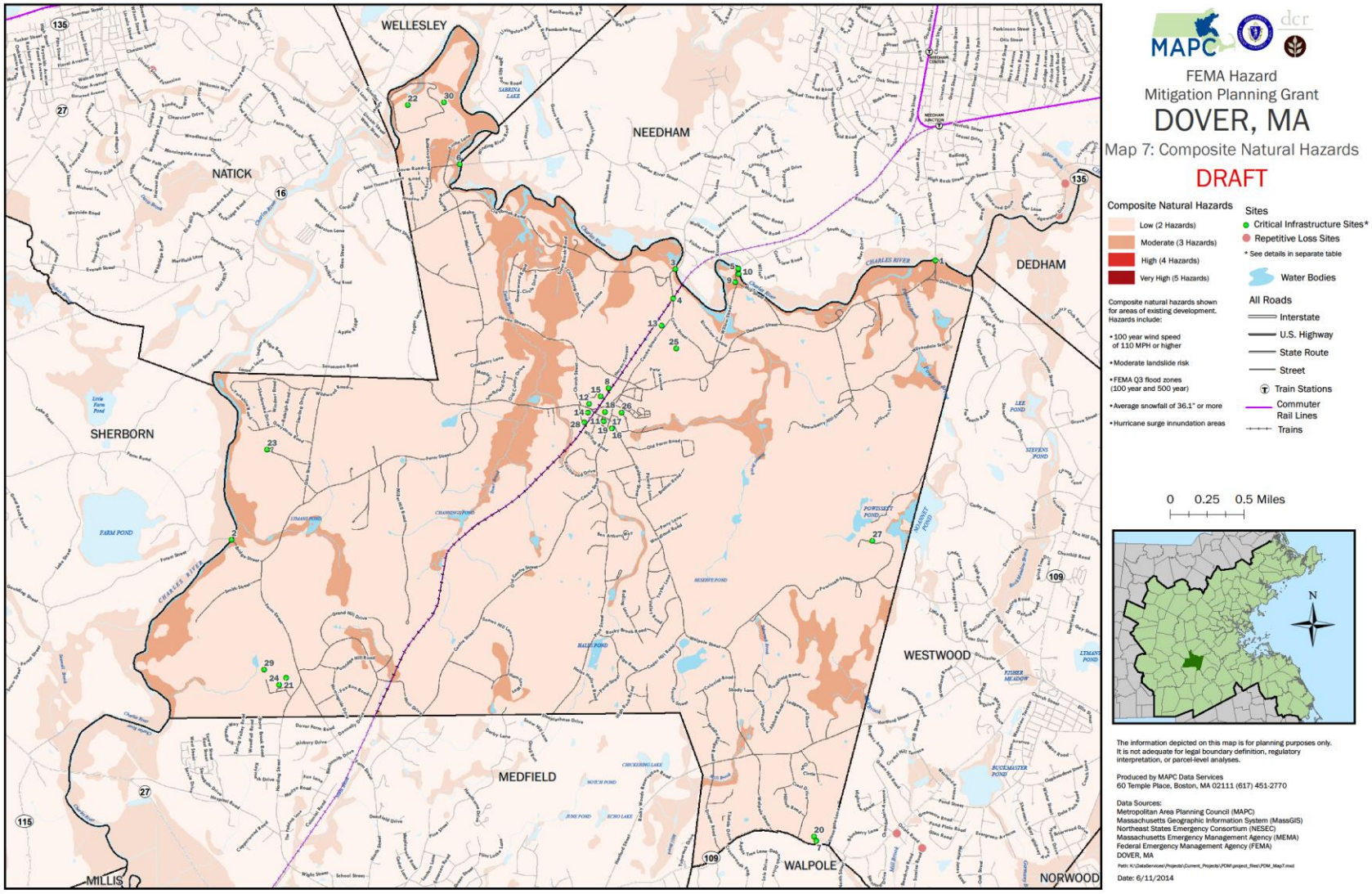
DOVER, MA
Date: 6/11/2014


WELLESLEY
NEEDHAM
NATICK
DEDHAM
SHERBORN
WESTWOOD
MEDFIELD
WALPOLE
MILLIS
NORWOOD
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
DOVER, MA
Map 7: Composite Natural Hazards
DRAFT
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
N
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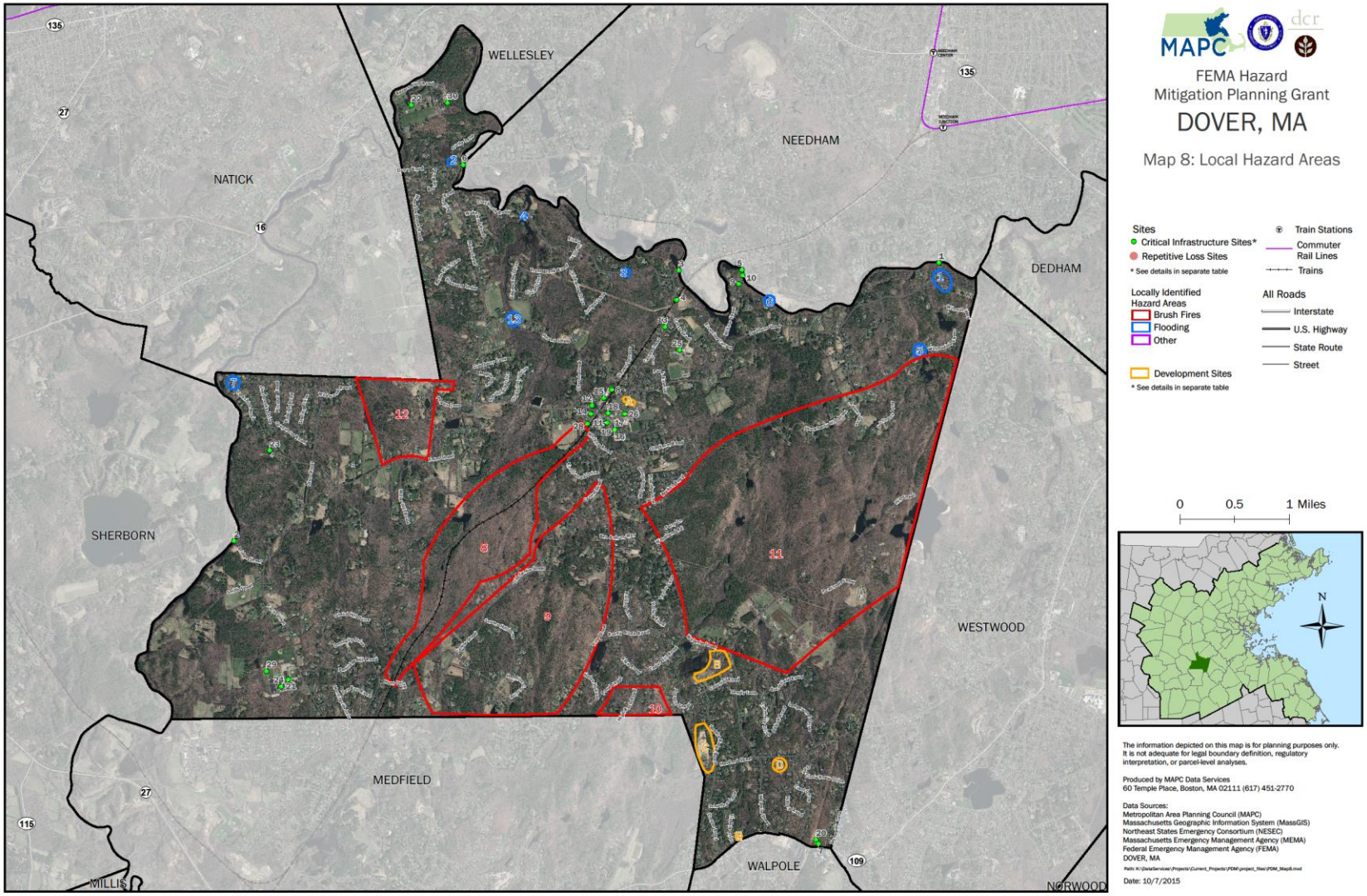
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
DOVER, MA
Date: 6/11/2014


WELLESLEY
NEEDHAM
NATICK
DEDHAM
SHERBORN
WESTWOOD
MEDFIELD
WALPOLE
MILLIS
NORWOOD
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
DOVER, 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
Other
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
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Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
DOVER, MA
Date: 10/7/2015

# APPENDIX C
# DOCUMENTATION OF PUBLIC MEETINGS

# HAZARD MITIGATION PLAN PUBLIC MEETING

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



The Dover Hazard Mitigation Plan is being updated to help the town reducing 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 Dover Hazard Mitigation Plan at a public meeting:

**Date:** **Thursday, June 24, 2014**
**Time:** **6:30 PM**
**Location:** **Dover Town House**
**5 Springdale Avenue, Dover, MA 02030**

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

MAPC
METROPOLITAN AREA PLANNING COUNCIL

TOWN OF DOVER
BOARD OF SELECTMEN
5 SPRINGDALE AVENUE
P.O. BOX 250
DOVER, MASSACHUSETTS 02030

James P. Dawley, Jr., Chairman
Robyn Hunter, Clerk
Candace McCann

Telephone: 508-785-0032 x 221
Fax: 508-785-2341
www.doverma.org

**AGENDA**
**BOARD OF SELECTMEN MEETING**
**Thursday, June 25, 2015**

| | |
|---|---|
| 6:30 PM | Ford Spalding re Minuteman Regional Vocational School |
| 6:45 PM | Metropolitan Area Planning Council re: Pre-Hazard Mitigation Plan |
| 6:55 PM | Appointments |
| 7:05 PM | Declare Surplus Item |
| 7:10 PM | Other Business:<br>Special Licenses |
| 7:15 PM | Approve June 9, 2015 Meeting Minutes |
| 7:20 PM | Citizens' Comments |
| 7:25 PM | Adjournment |

# HAZARD MITIGATION PLAN PUBLIC MEETING

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



The Dover Hazard Mitigation Plan is being updated to help the town reducing its vulnerability to natural hazard events such as flooding, hurricanes and blizzards. Dover's neighboring towns are being notified and invited to attend a public meeting.

**Date:** **Thursday, August 13, 2014**
**Time:** **6:30 PM**
**Location:** **Dover Town House**
**5 Springdale Avenue, Dover, MA 02030**

The draft plan will be online by Aug. 13 at www.mapc.org/doverhazardmit

Comments and questions may be submitted at this meeting or in writing to Paul Dell'Aquila at the MetroWest Regional Collaborative, by email to PDellAquila@mapc.org. Comments should be submitted by August 28, 2015.

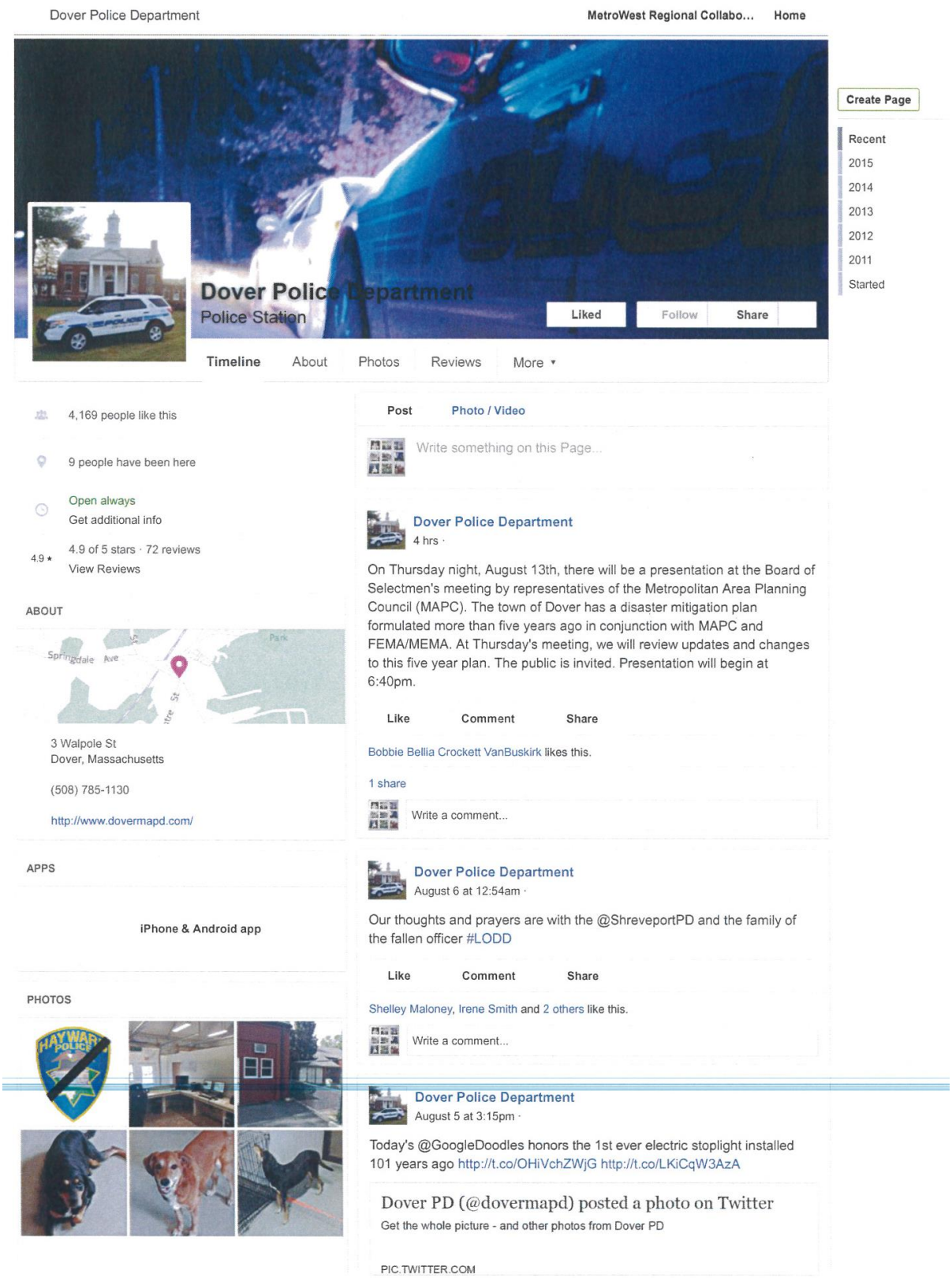
TOWN OF DOVER
BOARD OF SELECTMEN
5 SPRINGDALE AVENUE
P.O. BOX 250
DOVER, MASSACHUSETTS 02030

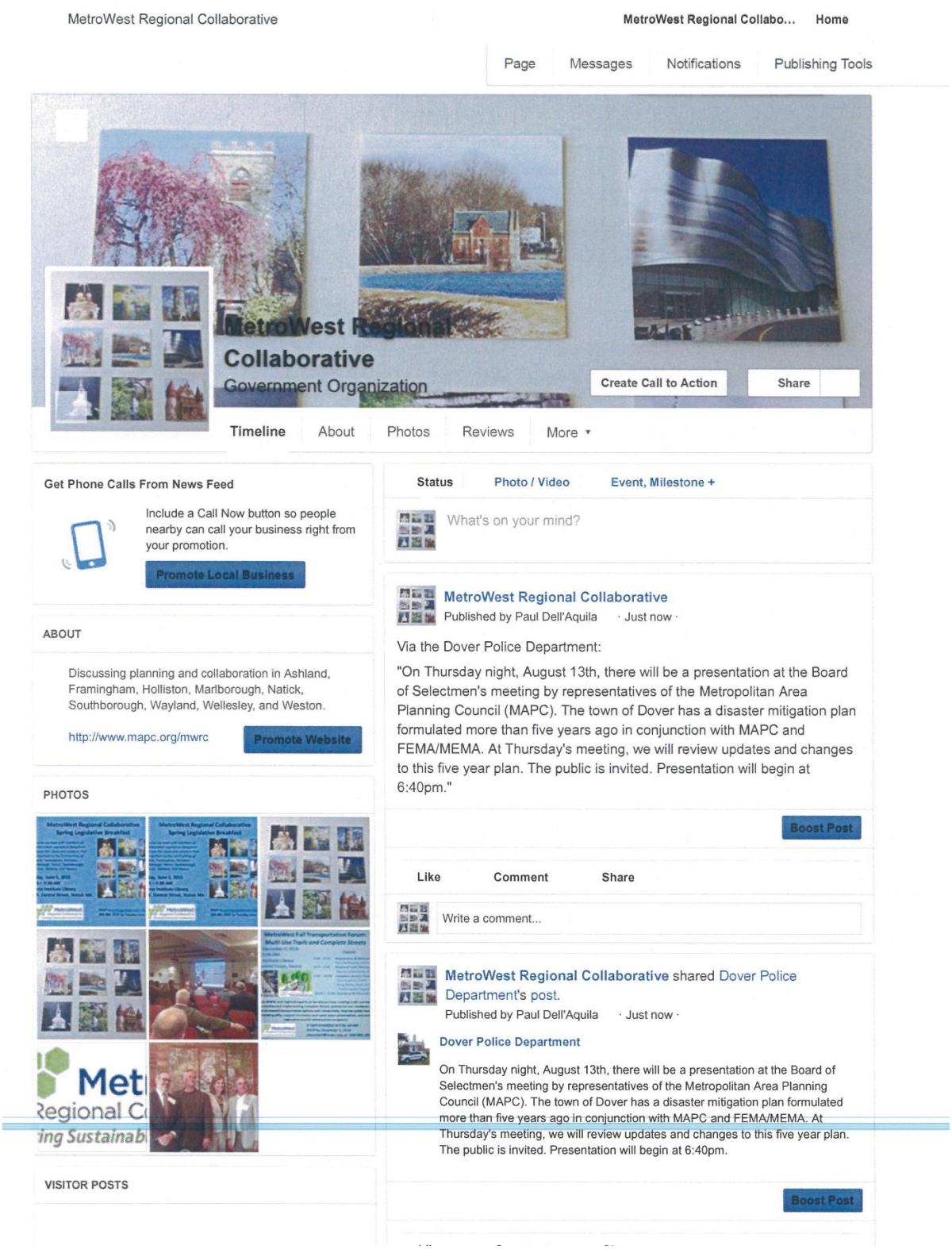
James P. Dawley, Jr., Chairman
Robyn Hunter, Clerk
Candace McCann

Telephone: 508-785-0032 x 221
Fax: 508-785-2341
www.doverma.org

**AGENDA**
**BOARD OF SELECTMEN MEETING**
**Thursday, August 13, 2015**

| | |
|---|---|
| 6:30 PM | Appointment of Police Officer |
| 6:35 PM | Metropolitan Area Planning Council re: Pre-Hazard Mitigation Plan Update |
| 6:45 PM | Springdale Study Committee Update |
| 6:55 PM | Update on the Minuteman Regional Vocational Technical School |
| 7:05 PM | Audit Engagement Letter |
| 7:10 PM | Appointments |
| 7:15 PM | Other Business:<br>Norfolk Hunt Club Annual Gathering<br>Reserve Fund Transfer – Building Maintenance<br>Special Licenses |
| 7:20 PM | Approve July 23, 2015 Meeting Minutes |
| 7:25 PM | Citizens' Comments |
| 7:30 PM | Executive Session |
| 7:45 PM | Adjournment |


Dover Police Department
MetroWest Regional Collabo...
Home
Create Page
Recent
2015
2014
2013
2012
2011
Started
Dover Police Department
Police Station
Liked
Follow
Share
Timeline
About
Photos
Reviews
More
4,169 people like this
9 people have been here
Open always
Get additional info
4.9 ★
4.9 of 5 stars · 72 reviews
View Reviews
ABOUT
3 Walpole St
Dover, Massachusetts
(508) 785-1130
http://www.dovermapd.com/
APPS
iPhone & Android app
PHOTOS
Post
Photo / Video
Write something on this Page...
Dover Police Department
4 hrs ·
On Thursday night, August 13th, there will be a presentation at the Board of Selectmen's meeting by representatives of the Metropolitan Area Planning Council (MAPC). The town of Dover has a disaster mitigation plan formulated more than five years ago in conjunction with MAPC and FEMA/MEMA. At Thursday's meeting, we will review updates and changes to this five year plan. The public is invited. Presentation will begin at 6:40pm.
Like
Comment
Share
Bobbie Bellia Crockett VanBuskirk likes this.
1 share
Write a comment...
Dover Police Department
August 6 at 12:54am ·
Our thoughts and prayers are with the @ShreveportPD and the family of the fallen officer #LODD
Like
Comment
Share
Shelley Maloney, Irene Smith and 2 others like this.
Write a comment...
Dover Police Department
August 5 at 3:15pm ·
Today's @GoogleDoodles honors the 1st ever electric stoplight installed 101 years ago http://t.co/OHiVchZWjG http://t.co/LKiCqW3AzA
Dover PD (@dovermapd) posted a photo on Twitter
Get the whole picture - and other photos from Dover PD
PIC.TWITTER.COM


MetroWest Regional Collaborative
MetroWest Regional Collabo...
Home
Page
Messages
Notifications
Publishing Tools
MetroWest Regional Collaborative
Government Organization
Create Call to Action
Share
Timeline
About
Photos
Reviews
More
Get Phone Calls From News Feed
Include a Call Now button so people nearby can call your business right from your promotion.
Promote Local Business
ABOUT
Discussing planning and collaboration in Ashland, Framingham, Holliston, Marlborough, Natick, Southborough, Wayland, Wellesley, and Weston.
http://www.mapc.org/mwrc
Promote Website
PHOTOS
VISITOR POSTS
Status
Photo / Video
Event, Milestone +
What's on your mind?
MetroWest Regional Collaborative
Published by Paul Dell'Aquila · Just now ·
Via the Dover Police Department:
"On Thursday night, August 13th, there will be a presentation at the Board of Selectmen's meeting by representatives of the Metropolitan Area Planning Council (MAPC). The town of Dover has a disaster mitigation plan formulated more than five years ago in conjunction with MAPC and FEMA/MEMA. At Thursday's meeting, we will review updates and changes to this five year plan. The public is invited. Presentation will begin at 6:40pm."
Boost Post
Like
Comment
Share
Write a comment...
MetroWest Regional Collaborative shared Dover Police Department's post.
Published by Paul Dell'Aquila · Just now ·
Dover Police Department
On Thursday night, August 13th, there will be a presentation at the Board of Selectmen's meeting by representatives of the Metropolitan Area Planning Council (MAPC). The town of Dover has a disaster mitigation plan formulated more than five years ago in conjunction with MAPC and FEMA/MEMA. At Thursday's meeting, we will review updates and changes to this five year plan. The public is invited. Presentation will begin at 6:40pm.
Boost Post

MAPC
METROPOLITAN AREA PLANNING COUNCIL

METROPOLITAN AREA PLANNING COUNCIL

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SEARCH

## MetroWest Regional Collaborative (MWRC)

### About MWRC

The MetroWest Regional Collaborative (MWRC) serves the MetroWest region of Eastern Massachusetts, from I-95 to I-495 along the Route 9 corridor.

We facilitate inter-local collaborative planning and problem solving to enhance the quality of life and economic competitiveness of the MetroWest region.

MWRC serves as a think tank and advocate for locally initiated regional solutions to policy and planning challenges shared by MetroWest communities.

MWRC remains committed to addressing the issues that transcend our municipal borders by promoting inter-municipal cooperation and guiding regional growth and change. MWRC continues to focus on issues such as land use, transportation, municipal governance, mitigation of development impacts, and coordination of municipal services.

### Upcoming Events

**Dover Hazard Mitigation Plan 2015 Update:**
**Public Meeting #2**
(part of Board of Selectmen Meeting)
Thursday, August 13, 2015 at 6:30PM
Dover Town House
5 Springdale Avenue, Dover, MA 02030

**TOWN OF DOVER HAZARD MITIGATION PLAN**
**2016 UPDATE**

TO: Town Clerk, Town of Medfield
RE: Notification of Public Meeting on the Dover Hazard Mitigation Plan

The Town of Dover and the Metropolitan Area Planning Council are working on an update of the *Dover Hazard Mitigation Plan*, a plan intended to reduce the Town's vulnerability to natural hazard events such as flooding, hurricanes, and winter storms. The plan update will identify a set of hazard mitigation measures, including structural improvements, regulatory changes, and educational and outreach efforts related to natural hazards in the Town.

As part of the planning process, Dover's neighboring communities are being notified of a public meeting on the draft plan. The meeting will be held as follows:

Thursday, August 13, 6:30 PM
Board of Selectmen's Meeting Room
Dover Town House
5 Springdale Avenue, Dover, MA 02030

A flyer announcing the meeting is also attached.
The draft plan will be posted online by the date of the meeting at
www.mapc.org/doverhazardmit

Comments and questions may be submitted at this meeting or in writing to Paul Dell'Auila at the MetroWest Regional Collaborative, by email to PDellAquila@mapc.org. Comments should be submitted by August 28, 2015.

Thank you,

**Martin Pillsbury**
Environmental Planning Director
Metropolitan Area Planning Council
60 Temple Place, Boston, MA 02111
**617-933-0747**
mpillsbury@mapc.org
www.mapc.org

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Notification was also sent to the towns of Framingham, Natick, Sherborn, and Westwood

**Dell'Aquila, Paul**

**From:** Peter McGowan <pamcgowan@dovermapd.com>
**Sent:** Friday, September 04, 2015 10:02 AM
**To:** Dell'Aquila, Paul
**Subject:** Fwd: Reference Hazard Mitigation Plan

Paul

Received this today

Chief McGowan.

Sent from my iPhone

Begin forwarded message:

**From:** Greer Pugatch <selectmen@doverma.org>
**Date:** September 4, 2015 at 9:46:29 AM EDT
**To:** Peter McGowan <pamcgowan@dovermapd.com>
**Cc:** <selectmen@doverma.org>
**Subject: FW: Reference Hazard Mitigation Plan**

**From:** Matthew Schmid [mailto:mfsdover@gmail.com]
**Sent:** Friday, August 28, 2015 1:13 PM
**To:** Greer Pugatch
**Subject:** Reference Hazard Mitigation Plan

Dear Selectwomen and Selectman of Dover

I would like to respond to the request for public commentary whose deadline is today. The intention of my comments and suggestions is to promote discussion amongst the powers that be, and to aid in drawing up a final plan.

**TOWN OF DOVER HAZARD MITIGATION PLAN**
**2016 UPDATE**

Before launching into the subject, I wish to *thank all of the participants* who have spent many hours already on determining the best way to deal with natural hazards in the town and prepare a comprehensive method to deal with the various calamities.

Also, I only became aware of the plan draft, its history and the proposed timeline. Hopefully, given the eight months or more that hearings have been held and the plan discussed in public the following comments and suggestions will have been voiced and deliberated.

I will try to be succinct, happy to elaborate in a reply: (the list is random)

- If the plan is limited to "Natural Hazards", is there a separate plan to deal with the Unnatural disasters such as plane crashes, drone accidents?
- Other than one reference, I noticed no discussion or plan to deal with a Gas Line Rupture, let alone monitoring of the line independent of the owners' method. Note, also, that the gas line is not even outlined on the earthquake map
- The focus of the Plan is on Flood control primarily, but would another consideration be on damage from hazards affecting a larger geographical area of the town, with a correspondingly larger population? Flood areas, after all can be defined, and emergency plans more readily promulgated.
- Fire and Wind, even Snow and Ice appear to be greater dangers due to their unpredictability. The damage from those sources is exponentially greater than it was, say, 65 years ago, when the population was a third of the present, the forested areas were few and far between, and the number and stress on the poles far less
- The elderly population, about 20% of the residents, is growing, and communication is currently sporadic at best. In an emergency protective agencies could be overwhelmed with requests for assistance. The plan mentions the need to educate and involve the public in the process, yet there is no definitive method going forward. (As an aside, I heard an interview of a citizen in a central Mass. town, Monroe I think, who jumped into action where town fathers failed, and created an adhoc network to deal with a crisis due to tornadoes some years back). At a minimum, each resident should have an easy to follow "Go to" guide in the event of a calamity with specific names and phone/email contacts in Dover. Neighborhood, i.e.citizen watch "Captains" and their teams of volunteers could be encouraged and trained to aid the professionals.
- Related to the above is a review of "go to" facilities. Case in point is the Caryl Com Center where the town is embarking on an major rehab. Why not add the requirement of expanded shower and bed facilities? Given that the plumbing and the space currently exists, simple modification could be made to the plans before the demo begins, which would avoid expensive modifications in the future.

Just a few thoughts; thanks for listening

Respectfully,
Matthew Schmid
27 Pine St.

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# APPENDIX D
# DOCUMENTATION OF PLAN ADOPTION

TOWN OF DOVER
BOARD OF SELECTMEN
5 SPRINGDALE AVENUE
P.O. BOX 250
DOVER, MASSACHUSETTS 02030

Robyn Hunter, Chairman
Candace McCann, Clerk
Douglass C. Lawrence

Telephone: 508-785-0032 x 221
Fax: 508-785-2341
www.doverma.org

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

A RESOLUTION ADOPTING THE
*TOWN OF DOVER HAZARD MITIGATION PLAN 2016 UPDATE*

WHEREAS, the Town of Dover established a Committee to prepare the *Town of Dover Hazard Mitigation Plan 2016 Update*; and

WHEREAS, the *Town of Dover Hazard Mitigation Plan 2016 Update* contains several potential future projects to mitigate potential impacts from natural hazards in the Town of Dover, and

WHEREAS, duly-noticed public meetings were held by the Planning Board on June 25, 2015, and the Board of Selectmen on August 13, 2015,

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

NOW, THEREFORE BE IT RESOLVED that the Town of Dover BOARD OF SELECTMEN adopts the *Town of Dover Hazard Mitigation Plan 2016 Update*, in accordance with M.G.L. 40 §4 or the charter and bylaws of the Town of Dover.

ADOPTED AND SIGNED this Date: 7-14-16

Robyn Hunter, Chairman, Dover Board of Selectmen

Candace McCann, Clerk

Douglass C. Lawrence

ATTEST: