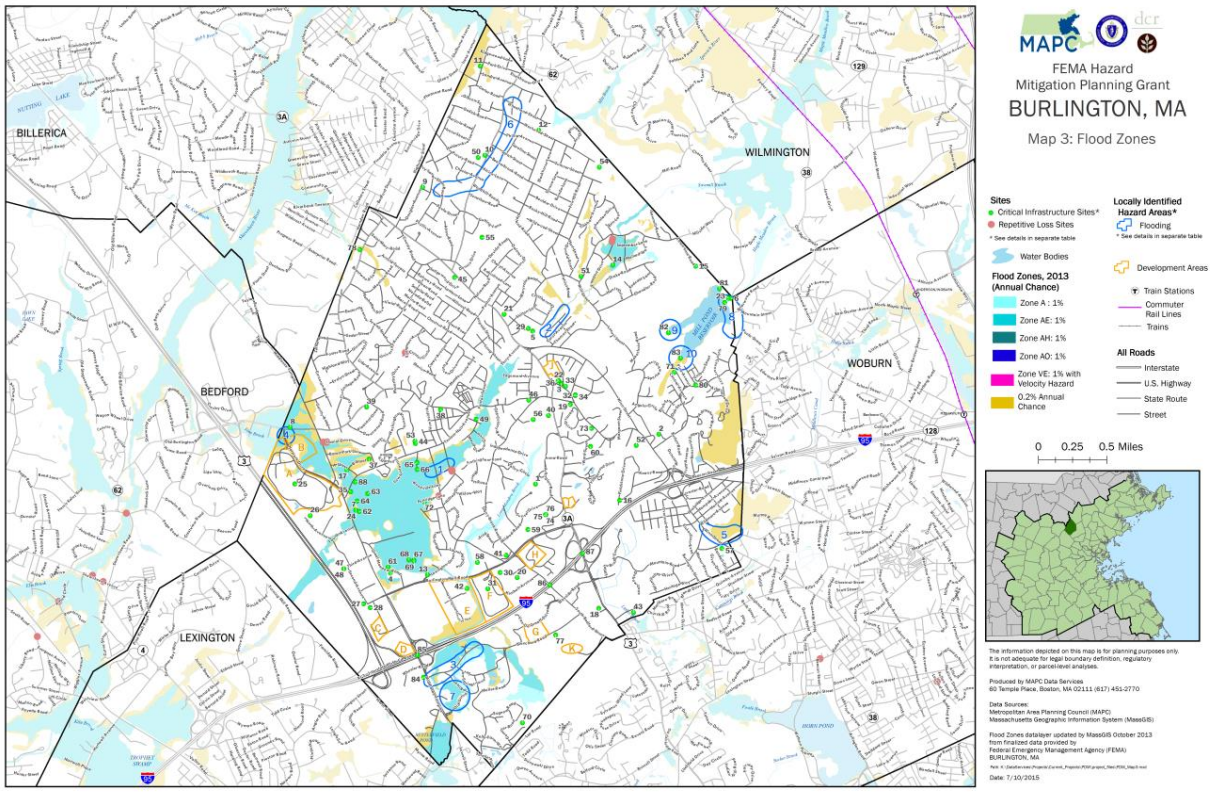
TOWN OF BURLINGTON
HAZARD MITIGATION PLAN
2016 UPDATE



MAPC
METROPOLITAN AREA PLANNING COUNCIL

Final Plan

Adopted by the Town of Burlington
June 13, 2016

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TOWN OF BURLINGTON HAZARD MITIGATION PLAN
2016 UPDATE

ACKNOWLEDGEMENTS AND CREDITS

This plan was prepared for the Town of Burlington 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 Burlington Local Hazard Mitigation Planning Team, composed of staff from a number of different Town Departments. This team met on June 19, 2014, and October 1, 2014 and discussed where the impacts of natural hazards most affect the Town, goals for addressing these impacts, updates to the Town's existing mitigation measures and new or revised hazard mitigation measures that would benefit the Town.

Public participation in this planning process is important for improving awareness of the potential impacts of natural hazards and to build support for the actions the Town takes to mitigate them. The Town's Planning Board hosted one public meeting on November 20, 2014 and the Local Hazard Mitigation Team a second public meeting on September 2, 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 Burlington 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 Burlington Local Hazard Mitigation Planning Team identified 88 Critical Facilities. These are also shown on the map series and listed in Table 20, identifying which facilities are located within the mapped hazard zones.

A HAZUS-MH analysis provided estimates of damages from Hurricanes of category 2 and 4 ($19.45 million to $78.96 million as well as earthquakes of magnitudes 5 and 7 ($520.41 million to $4.93 billion). Flood damage estimates range from $12.14 million to $60.67 million.

Hazard Mitigation Goals

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

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

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

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

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

Hazard Mitigation Strategy

The Burlington Local Hazard Mitigation Planning Team identified a number of mitigation measures that would serve to reduce the Town's vulnerability to natural hazard events. One of the most important of these is the implementation of the Town's new upgraded Capital Improvement Program that includes funds for regular steam cleaning and drainage upgrades over the next ten years. Other actions include efforts to acquire conservation land along Sandy Brook, upgrading fire access roads within the Mill Pond Conservation Area, identifying and retro-fitting public building roofs at risk for collapse due to snow and ice loads and instituting a new public education program on wind hazard mitigation for residents and businesses.

Overall, the hazard mitigation strategy recognizes that mitigating hazards for Burlington 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 Planning Board. 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 Burlington 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 2008 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 or modify or delete them. The Plan Update's hazard mitigation strategy reflects both new measures and measures carried forward from the 2008 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 25, Burlington made some progress on implementing mitigation measures identified in the 2008 Hazard Mitigation Plan. Several projects have been completed, including upgrading the drainage at Sears and Winn Streets, coordinating with Bedford on improvements to Wilson Mill Dam, purchasing a new brush fire fighting

truck in 2013, cleaning the drain pipes at Mill Pond Dam, and elevating the High School practice field and rebuilding wetlands there in 2013.

Other projects were not completed, most notably working to acquire land along Sandy Brook. This will be carried forward in the 2016 plan update.

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

Though not formally done in the 2008 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 Burlington 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).

Massachusetts has taken a regional approach and has encouraged the regional planning agencies to apply for grants to prepare plans for groups of their member communities. The Metropolitan Area Planning Council (MAPC) received a grant from the Federal Emergency Management Agency (FEMA) under the Pre-Disaster Mitigation (PDM) Program, to assist the Town of Burlington to update its local Hazard Mitigation Plans, which was first adopted in 2008 as part of a multijurisdictional plan. The local Hazard Mitigation Plan update produced under this grant are designed to individually meet the requirements of the Disaster Mitigation Act for each community while listing regional concerns and hazards that impact the Town or city creating the plan.

What is a Hazard Mitigation Plan?

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

Previous Federal/State Disasters

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

Table 2 Previous Federal/State Disaster Declarations

DISASTER NAME (DATE OF EVENT)	TYPE OF ASSISTANCE	DECLARED AREAS
Hurricane Bob (August 1991)	FEMA Public Assistance Project Grants	Counties of Barnstable, Bristol, Dukes, Essex, Hampden, Middlesex, Plymouth, Nantucket, Norfolk, Suffolk
	Hazard Mitigation Grant Program	Counties of Barnstable, Bristol, Dukes, Essex, Hampden, Middlesex, Plymouth, Nantucket, Norfolk, Suffolk (16 projects)
No-Name Storm (October 1991)	FEMA Public Assistance Project Grants	Counties of Barnstable, Bristol, Dukes, Essex, Middlesex, Plymouth, Nantucket, Norfolk
	FEMA Individual Household Program	Counties of Barnstable, Bristol, Dukes, Essex, Middlesex, Plymouth, Nantucket, Norfolk
	Hazard Mitigation Grant Program	Counties of Barnstable, Bristol, Dukes, Essex, Middlesex, Plymouth, Nantucket, Norfolk, Suffolk (10 projects)
March Blizzard (March 1993)	FEMA Public Assistance Project Grants	All 14 Counties
January Blizzard (January 1996)	FEMA Public Assistance Project Grants	All 14 Counties
May Windstorm (May 1996)	State Public Assistance Project Grants	Counties of Plymouth, Norfolk, Bristol
October Flood (October 1996)	FEMA Public Assistance Project Grants	Counties of Essex, Middlesex, Norfolk, Plymouth, Suffolk
	FEMA Individual Household Program	Counties of Essex, Middlesex, Norfolk, Plymouth, Suffolk

DISASTER NAME (DATE OF EVENT)	TYPE OF ASSISTANCE	DECLARED AREAS
	Hazard Mitigation Grant Program	Counties of Essex, Middlesex, Norfolk, Plymouth, Suffolk (36 projects)
1997	Community Development Block Grant-HUD	Counties of Essex, Middlesex, Norfolk, Plymouth, Suffolk
June Flood (June 1998)	FEMA Individual Household Program	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester
	Hazard Mitigation Grant Program	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester (19 projects)
(1998)`	Community Development Block Grant-HUD	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester
March Flood (March 2001)	FEMA Individual Household Program	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester
	Hazard Mitigation Grant Program	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester (16 projects)
February Snowstorm (Feb 17-18, 2003)	FEMA Public Assistance Project Grants	All 14 Counties
January Blizzard (January 22-23, 2005)	FEMA Public Assistance Project Grants	All 14 Counties
Hurricane Katrina (August 29, 2005)	FEMA Public Assistance Project Grants	All 14 Counties
May Rainstorm/Flood (May 12-23, 2006)	Hazard Mitigation Grant Program	Statewide
April Nor'easter (April 15-27, 2007)	Hazard Mitigation Grant Program	Statewide
Flooding (March, 2010)	FEMA Public Assistance FEMA Individuals and Households Program SBA Loan	Bristol, Essex, Middlesex, Suffolk, Norfolk, Plymouth, Worcester

DISASTER NAME (DATE OF EVENT)	TYPE OF ASSISTANCE	DECLARED AREAS
	Hazard Mitigation Grant Program	Statewide
Tropical Storm Irene (August 27-28, 2011)	FEMA Public Assistance	Statewide
Hurricane Sandy (October 27-30, 2012)	FEMA Public Assistance	Statewide
Severe snowstorm and Flooding (February 8-09, 2013	FEMA Public Assistance; Hazard Mitigation Grant Program	Statewide
Blizzard of 2015 (January 26-28, 2015)	FEMA Public Assistance; Hazard Mitigation Grant Program	Statewide

Source: database provided by MEMA)

FEMA Funded Mitigation Projects

The Town of Burlington has not received funding from FEMA for mitigation projects under the Hazard Mitigation Grant Program (HMGP).

Community Profile

The Town of Burlington was formed in 1799 and is sited on the watersheds of the Ipswich, Mystic and Shawsheen Rivers. It is now a suburban industrial town at the junction of the Boston-Merrimac corridor but for most of its history it was almost entirely agricultural, selling hops and rye to Boston and supplementing that income with small shoe making shops. Early railroad expansion passed the town by, limiting its early development, and Burlington continued to cure hams for the Boston market and produce milk, fruit and vegetables.

This picture changed drastically, however, as soon as Route 128 was built.
The highway kicked off an enormous expansion, and between 1955 and 1965 Burlington was the fastest growing town in the state. In one five year period, its population tripled as residential and commercial retail development exploded, creating the town's present character.

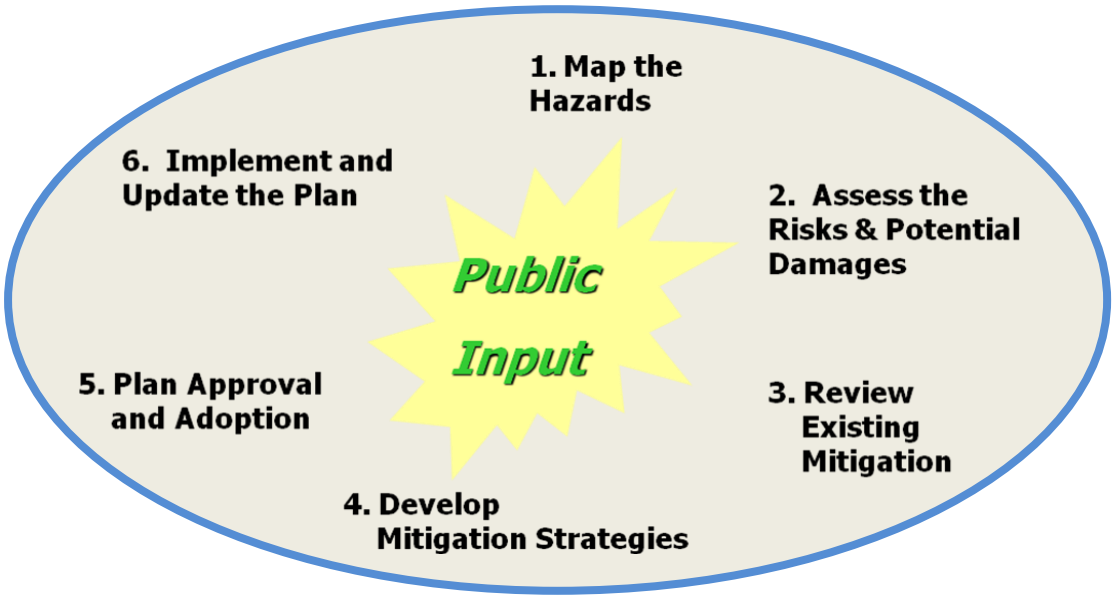
The Town is bordered by Bedford on the west, Billerica on the northwest, Wilmington on the northeast, Woburn on the southeast and south, and Lexington on the south. Burlington has a total area of 11.88 square miles and had a population of 24,498 at the 2010 Census. The Town maintains a website at http://www.burlington.org/

III. PLANNING PROCESS AND PUBLIC PARTICIPATION

MAPC employs a six step planning process based on FEMA's hazard mitigation planning guidance focusing on local needs and priorities but maintaining a regional perspective matched to the scale and nature of natural hazard events. Public participation is a central component of this process, providing critical information about the local occurrence of hazards while also serving as a means to build a base of support for hazard mitigation activities. MAPC supports participation by the general public and other plan stakeholders through Regional and Local Hazard Mitigation Planning Teams, two public meetings hosted by the local Hazard Mitigation Team, posting of the plan to the Town's website, and invitations sent to neighboring communities, Town boards and commissions, the local chamber of commerce, and other local or regional entities to review the plan and provide comment.

Planning Process Summary

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

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

    - Town of Burlington, General Bylaws
    - Town of Burlington, Zoning Bylaw
    - Town of Burlington Open Space Plan, 2011
    - Town of Burlington Capital Improvement Program 2015-2024
    - Massachusetts State Hazard Mitigation Plan,2013
    - FEMA, Local Mitigation Plan Review Guide; October 1, 2011
    - FEMA, Flood Insurance Rate Maps for Middlesex County, MA, 2014
    - 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/
    - USGS, National Water Information System, http://nwis.waterdata.usgs.gov/usa/nwis
    - US Census, 2010

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

- Develop Mitigation Strategies – MAPC works with the local municipal staff to identify new mitigation measures, utilizing information gathered from the hazard identification, vulnerability assessments, and the community's existing mitigation efforts to determine where additional work is necessary to reduce the potential

damages from hazard events. Additional information on the development of hazard mitigation strategies can be found in Chapter VII.

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

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

Local Plan Update Representatives

On February 28, 2014 a letter was sent notifying Burlington of the first meeting regarding the plan update and requesting that the Chief Elected Official designate a minimum of two municipal employees and/or officials to represent the community. The following individuals were appointed to represent Burlington:

Mike Patterson	Assistant Fire Chief
John Sanchez	Department of Public Works Director

The Local Multiple Hazard Community Planning Team

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

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

On June 19, 2014, MAPC and MEMA staff held a meeting with the Local Committee to outline the hazard mitigation planning and updating process at Burlington Town Hall.

On October 1, 2014, MAPC conducted a meeting of the Burlington Local Committee. The meeting was organized by Planning Director Kristin Kassner. The purpose of the

meeting was to review and develop hazard mitigation goals, review the status of mitigation measures identified in the 2008 hazard mitigation plan, identify new potential mitigation measures and to gather information on local hazard mitigation issues and sites or areas related to these. The meeting also covered measures to be carried forward from the previous plan and to prioritize new measures.

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

Table 3
Membership of the Burlington Hazard Mitigation Planning Team

Name	**Representing**
Mike Patterson	Assistant Fire Chief/Emergency Management
Kristin Kassner	Planning Director
Don Benjamin	Senior Planner
Christine Mathis	Health Department
Susan Lumenello	Health Department
John Keeley	Conservation Agent
Steve Yetman	Fire and Emergency Management
Thomas Hayes	DPW and Engineering
Andrew Ungerson	Building Department
Josh Morris	Planning

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 Burlington hazard mitigation planning process during a meeting of the Planning Board, on November 20, 2015 held in the Town Hall Annex. The draft plan update was presented at public and advertised meeting of the Local Hazard Mitigation Team held on September 2, 2015 in Burlington Town Hall Annex. The attendance list for each meeting can be found in Table 4. See public meeting notices in Appendix C.

Table 4
Burlington Public Meetings

Name	**Representing**
November 20, 2014	
Mike Patterson	Assistant Fire Chief/Emergency Management
Kristin Kassner	Planning Director
Don Benjamin	Senior Planner
Christine Mathis	Health Department
Susan Lumenello	Health Department
John Keeley	Conservation Agent
Steve Yetman	Fire and Emergency Management
Thomas Hayes	DPW and Engineering
Andrew Ungerson	Building Department
Approximately 20 members of the public	
Meeting #2 September 2, 2015	
Mike Patterson	Assistant Fire Chief/Emergency Management
Jennifer Gelina	Planning Department
John Peters	Board of Selectmen
Steven Yetman	Fire Department and Emergency Management
Kristine Brown	Recreation Department and Bike Committee
John Keeley	Conservation Agent
John Luther	Building Department
Chris Warren	Burlington Union New
Joanne Kinchla	Council on Aging

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 Bedford
Town of Billerica
Town of Burlington
Town of Wilmington
City of Woburn
Town of Lexington Burlington Chamber of Commerce
Burlington Conservation Commission
Burlington Department Heads
Burlington Union News
Town Meeting Members
Burlington Planning Board

See Appendix C for public meeting notices.

The Town is bordered by Bedford on the west, Billerica on the northwest, Wilmington on the northeast, Woburn on the southeast and south, and Lexington on the south. Burlington has a total area of 11.88 square miles and had a population of 24,498 at the 2010 Census. The Town maintains a website at http://www.burlington.org/

Town Web Site
The draft Burlington Hazard Mitigation Plan 2016 Update was posted on the Town's website following the second public meeting. Members of the public could access the draft document and submit comments or questions to the Town.

No public comments were received on the draft 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 hazard. As updates and a review of the plan are conducted by the Hazard Mitigation Implementation Team, these will be placed on the Town's web site, and any meetings of the Hazard Mitigation Implementation Team will be publicly noticed in accordance with Town and state open meeting laws.

Planning Timeline

June 19, 2014	PDM Process Overview meeting with Local Hazard Mitigation Team, MEMA and MAPC
October 1, 2014	Meeting of the Burlington Local Hazard Mitigation Planning Team
November 20, 2014	First Public Meeting with Burlington Planning Board
September 2, 2015	Second Public Meeting with Hazard Mitigation Planning Team
September 23, 2015	Draft posted on Burlington website for review
October 2, 2015	Draft Plan Update submitted to MEMA
February 9, 2016	Revised Draft Update submitted to MEMA
March 1, 2016	Revised Draft Update submitted to MEMA
April 15, 2016	Approval Pending Adoption issued by FEMA
June 13, 2016	Plan Update Adopted by vote of the Board of Selectmen

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IV. RISK ASSESSMENT

The risk assessment analyzes the potential natural hazards that could occur within the Town of Burlington 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 Burlington'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 Burlington. 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 Burlington 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	**Burlington**	**Massachusetts**	**Burlington**
Flooding	High	High	Serious	Serious
Dam failures	Very Low	Very Low	Extensive	Serious
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-Storms/Blizzard/Snow	High	High	Minor	Minor
Winter-Ice Storms	Medium	Medium	Minor	Minor
Earthquakes	Very Low	Very Low	Serious	Serious
Landslides	Low	Very Low	Minor	Minor
Brush fires	Medium	High	Minor	Minor
Extreme Temperatures	Medium	Medium	Minor	Minor
Drought	Low	Low	Minor	Minor

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

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 Burlington. 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 Burlington have included:

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

Local data for previous flooding occurrences are not collected by the Town of Burlington. The best available local data is for Middlesex County through the National Climatic Data Center (see Table 6). Middlesex County, which includes the Town of Burlington,

experienced 76 flood events from 1996 –2015. No deaths or injuries were reported and the total reported property damage in the county was $40.83 million dollars.

Table 6 Middlesex County Flood Events, 1996-2014

Location	Date	Type	Deaths	Injuries	Property Damage
Totals:			0	0	40.830M
WESTERN MIDDLESEX (ZONE)	01/29/1996	Flood	0	0	0.00K
WESTERN MIDDLESEX (ZONE)	04/17/1996	Flood	0	0	0.00K
WESTERN MIDDLESEX (ZONE)	04/17/1996	Flood	0	0	0.00K
SOUTHEAST PORTIONS	09/18/1996	Flood	0	0	0.00K
WESTERN MIDDLESEX (ZONE)	10/21/1996	Flood	0	0	0.00K
WESTERN MIDDLESEX (ZONE)	10/22/1996	Flood	0	0	0.00K
WESTERN MIDDLESEX (ZONE)	03/10/1998	Flood	0	0	0.00K
WESTERN MIDDLESEX (ZONE)	03/11/1998	Flood	0	0	0.00K
WESTERN MIDDLESEX (ZONE)	05/12/1998	Flood	0	0	0.00K
WESTERN MIDDLESEX (ZONE)	06/14/1998	Flood	0	0	0.00K
WESTERN MIDDLESEX (ZONE)	06/15/1998	Flood	0	0	0.00K
WESTERN MIDDLESEX (ZONE)	06/17/1998	Flood	0	0	0.00K
WESTERN MIDDLESEX (ZONE)	04/22/2000	Flood	0	0	0.00K
WESTERN MIDDLESEX (ZONE)	04/23/2000	Flood	0	0	0.00K
WESTERN MIDDLESEX (ZONE)	04/23/2000	Flood	0	0	0.00K
WESTERN MIDDLESEX (ZONE)	04/23/2000	Flood	0	0	0.00K
WESTERN MIDDLESEX (ZONE)	03/22/2001	Flood	0	0	0.00K
WESTERN MIDDLESEX (ZONE)	03/22/2001	Flood	0	0	0.00K
WESTERN MIDDLESEX (ZONE)	03/22/2001	Flood	0	0	0.00K
WESTERN MIDDLESEX (ZONE)	03/23/2001	Flood	0	0	0.00K
WESTERN MIDDLESEX (ZONE)	03/23/2001	Flood	0	0	0.00K
WESTERN MIDDLESEX (ZONE)	03/31/2001	Flood	0	0	0.00K
WESTERN MIDDLESEX (ZONE)	04/01/2001	Flood	0	0	0.00K
WESTERN MIDDLESEX (ZONE)	04/01/2004	Flood	0	0	0.00K
WESTERN MIDDLESEX (ZONE)	04/01/2004	Flood	0	0	0.00K
WESTERN MIDDLESEX (ZONE)	04/02/2004	Flood	0	0	0.00K
WESTERN MIDDLESEX (ZONE)	04/02/2004	Flood	0	0	0.00K
WESTERN MIDDLESEX (ZONE)	04/02/2004	Flood	0	0	0.00K
WESTERN MIDDLESEX (ZONE)	04/02/2004	Flood	0	0	0.00K
WESTERN MIDDLESEX (ZONE)	04/15/2004	Flood	0	0	0.00K
WESTERN MIDDLESEX (ZONE)	03/29/2005	Flood	0	0	0.00K

Location	Date	Type	Deaths	Injuries	Property Damage
WESTERN MIDDLESEX (ZONE)	10/15/2005	Flood	0	0	100.00K
WESTERN MIDDLESEX (ZONE)	10/15/2005	Flood	0	0	100.00K
SOUTHEAST MIDDLESEX (ZONE)	10/15/2005	Flood	0	0	125.00K
COUNTYWIDE	05/13/2006	Flood	0	0	5.000M
COUNTYWIDE	05/13/2006	Flood	0	0	0.00K
WAKEFIELD	07/11/2006	Flood	0	0	2.00K
CAMBRIDGE	10/28/2006	Flood	0	0	5.00K
SAXONVILLE	04/16/2007	Flood	0	0	25.00K
FRAMINGHAM	02/13/2008	Flood	0	0	0.00K
MEDFORD	05/27/2008	Flood	0	0	3.00K
STONEHAM	06/24/2008	Flood	0	0	10.00K
WESTLANDS	06/29/2008	Flood	0	0	5.00K
EVERETT	08/10/2008	Flood	0	0	15.00K
SUDBURY	08/10/2008	Flood	0	0	40.00K
NORTH WOBURN	09/06/2008	Flood	0	0	15.00K
BILLERICA	12/12/2008	Flood	0	0	20.00K
HOLLISTON	03/14/2010	Flood	0	0	26.430M
FARM HILL	03/29/2010	Flood	0	0	8.810M
FARM HILL	04/01/2010	Flood	0	0	0.00K
WEST NEWTON	08/28/2011	Flood	0	0	5.00K
RIVER PINES	10/14/2011	Flood	0	0	0.00K
NORTH SOMMERVILLE	06/08/2012	Flood	0	0	0.00K
BEAVER BROOK	06/23/2012	Flood	0	0	0.00K
MELROSE	06/23/2012	Flood	0	0	0.00K
TUFTS COLLEGE	06/23/2012	Flood	0	0	0.00K
MALDEN	06/23/2012	Flood	0	0	0.00K
TUFTS COLLEGE	06/23/2012	Flood	0	0	15.00K
NEWTON	07/18/2012	Flood	0	0	5.00K
NORTH WALTHAM	10/29/2012	Flood	0	0	0.00K
RIVER PINES	06/07/2013	Flood	0	0	0.00K
LOWELL	07/01/2013	Flood	0	0	0.00K
RIVER PINES	07/01/2013	Flood	0	0	0.00K
HARWOOD	07/23/2013	Flood	0	0	0.00K
FRAMINGHAM	09/01/2013	Flood	0	0	10.00K
CHELMSFORD CENTER	03/30/2014	Flood	0	0	35.00K
NORTH WALTHAM	03/30/2014	Flood	0	0	0.00K

Location	Date	Type	Deaths	Injuries	Property Damage
GRANITEVILLE	03/30/2014	Flood	0	0	0.00K
CONCORD	07/27/2014	Flood	0	0	0.00K
NORTH LEXINGTON	08/31/2014	Flood	0	0	0.00K
FELCHVILLE	10/22/2014	Flood	0	0	20.00K
NEWTON LOWER FALLS	10/23/2014	Flood	0	0	0.00K
BOXBOROUGH	12/09/2014	Flood	0	0	0.00K
CLEMATIS BROOK	12/09/2014	Flood	0	0	5.00K
SOMERVILLE	12/09/2014	Flood	0	0	30.00K
NONANTUM	12/09/2014	Flood	0	0	0.00K
Totals:			0	0	40.830M

Source: NOAA, National Climatic Data Center

Overview of Town-Wide Flooding

Burlington is located at the headwaters of three watersheds. Much of western Burlington lies within the Shawsheen River watershed. The northeastern part of town lies within the Ipswich River watershed. Finally, southeastern Burlington lies within the Mystic River watershed. Although sites along Burlington's waterways are prone to flooding, much of the land was built upon prior to regulations limiting such actions. When development increased some neighborhoods had no man-made drainage systems and the smaller streams were unable to handle the increased flows. In addition, stream sedimentation is a major contributing factor. Because Burlington relies heavily on groundwater, the town limits the use of salt to protect the aquifer. The trade-off is that they use more sand than most communities do and this sand runs off into the streams. Because the town has no control over the amount of salt used on Route 128 and Route 3, it is imperative that they limit salt use on local roads. (2011 Open Space Plan)

Beaver dams are occasionally a contributing factor in flooding. The town sometimes contracts out for beaver removal when roadways or public property is endangered. The town has also installed drains through beaver dams ("beaver deceivers") to reduce the impact of the dams.

Significant portions of Burlington are located in 100-year flood hazard areas, denoted as "Zone A" on the Federal Emergency Management Agency's FIRM Flood Zones Map. Zone A relates to those parcels located in the 100-year flood plain that have a 1-in-100 chance in any given year of flooding. Specific areas in Town that fall into this category, and have the most flooding potential, include areas adjacent to Sawmill Brook from the Wilmington town line to Lucaya Circle and most areas along the entirety of Longmeadow Brook, Sandy Brook, and Vine Brook. (2011 Open Space Plan)

Long Meadow Brook is critical to flooding. There are quite a few homes built in the floodplain. A few years ago the town investigated the possibility of creating additional

flood storage capacity near the High School but a study found that this would not be feasible. Most wetland areas are important for flood control but there are no major acquisitions planned for flood control purposes. Most wetlands are privately owned.

For the past twenty-five years, the Conservation Department has had a stream cleaning program. This program helps to alleviate flooding of residents' homes and helps to maintain wildlife habitats. The program consists of removing obstructions such as fallen trees, logs, storm debris buildup, overhanging brush, trash, lawn clippings, sediment buildup, mud and illegally dumped objects.

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 numbers correspond to the numbers on Map 8, "Local Hazard Areas."

1. Sandy Brook: A small residential area where flooding continues to impact approximately four homes and sometimes forces the road to be closed to one land; town staff did not consider Sandy Brook Road to be a major access road, rather more of a short

cut road for the southwestern part of town. No mitigation conducted since noted in 2008. This is seen as a medium priority by the NHM team.

2. Thomas, Carol and Susan Streets: the stream causing flooding has been cleaned twice since 2008 and floods much less frequently due to the reduced use of sand for winter road traction.

3. Wheeler Road- Beaver Deceivers were installed in 2010 by National Development and need to be maintained. Wheeler Road will be rebuilt in 2015 with stream cleaning and drainage system upgrade.

4. Middlesex Turnpike/Bedford Street: this area still experiences flooding but the 2011 Middlesex Turnpike Extension did add flood storage capacity for the neighborhood.

5. Wyman Street: The old town well culvert was replaced and the stream impacting this neighborhood has been cleaned twice in the last 5 years.

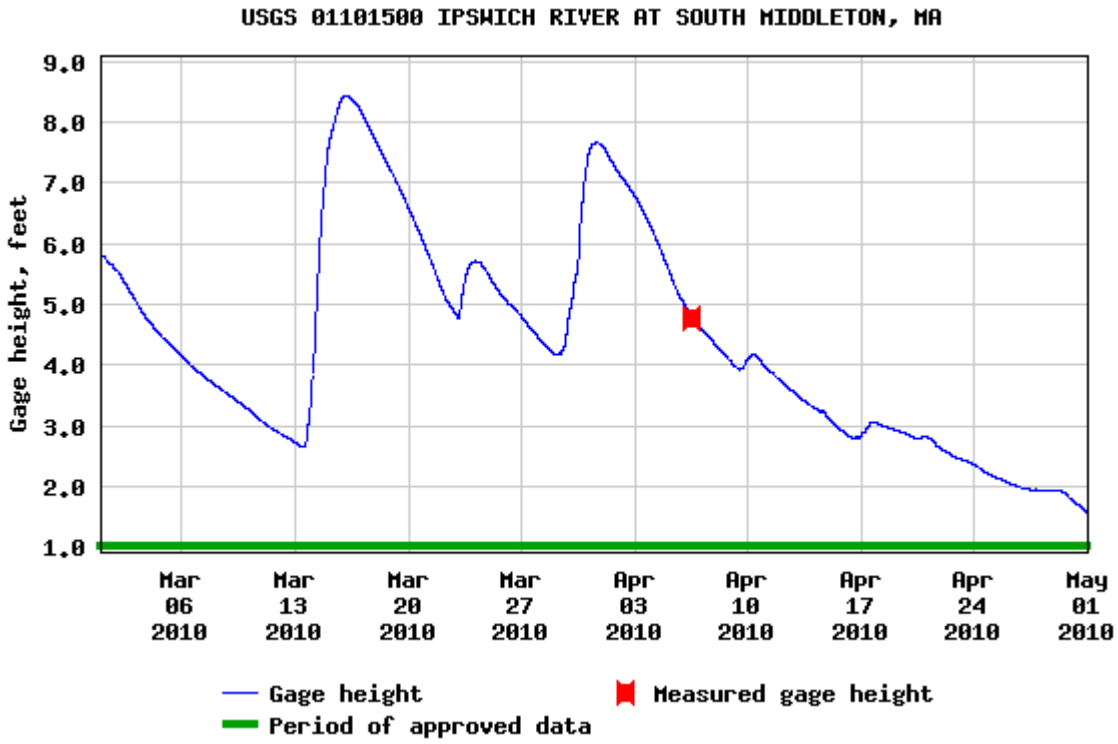
6. Stewart Street at Wilmington Street: No mitigation action taken since 2008. This was a low priority area in 2008 with 1-2 houses impacted on a very infrequent basis. Stream cleaning under the Capital Improvement Program will address the problem going forward.

7. 13 Old Concord Road: H Mart commercial site built 15 years ago; floods only during very high precipitation events.

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

One indication of the extent of flooding is the gage height at the nearest USGS streamflow gauging station, which is on the Ipswich River in South Middleton. The USGS gage height, shown in Figure 4, exceeded 8 feet on March 16, 2010 and exceeded 7 feet on March 31, 2010. Normal gage height in March is about 4 feet.

Figure 1- Ipswich River Gage Heights, March-April 2010



Source, US Geological Service, National Water Information System

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 eight repetitive loss structures in Burlington, an increase of three over the 2008 plan. All of the properties are single family residences.
Table 7 summarizes the number and type of repetitive loss structures located within Burlington and the number of losses and total claims associated with them.

Table 7- Summary of Repetitive Losses and Claims

	Single Family Residential	Other Residential	Non-Residential	Total
Number of Properties	**8**	**0**	**0**	**8**
Number of Losses	**18**	**0**	**0**	**18**
Total Claims	**$120,332.78**		**0**	$120,332.78

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

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

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.

Mill Pond Reservoir supplies part of Burlington's drinking water. Mill Pond Dam and the North and South Dikes impound the Mill Pond Reservoir, which is a 53- acre body of water. The town built the main dam and the two dikes in 1973. The Office of Dam Safety classified the main dam and south dike as High Hazard Potential, Large Dams while the North Dike was classified as Significant Hazard Potential, Large Dam. Failure of the main dam or dikes would cause loss of life and extensive property damage.

If the Mill Pond Dam burst, there would be a greater threat to the Town of Wilmington than there would be for Burlington. The 2014 Emergency Action Plan for the Mill Pond Dam includes notification of the Wilmington Fire Department in the event of an emergency. Once that notification has been made, the Town of Wilmington is responsible for notifying residents. Any necessary evacuations are also the responsibility of the Town of Wilmington. The plan includes a "Resident Evacuation/Notification Table which lists 17 residences on Main Street, 6 on Butters Row, 6 on Factory Street, one business on Eames Street, and 27 residences on Chestnut Street.

Based on the record of previous occurrences dam failure in Burlington 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 Burlington. Information on wind related hazards can be found on Map 5 in Appendix B

Hurricanes and Tropical Storms

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

Since 1900, 39 tropical storms have impacted New England (NESEC). Massachusetts has experienced approximately 32 tropical storms, nine Category 1 hurricanes, five Category 2 hurricanes and one Category 3 hurricane. A hurricane or storm track is the line that delineates the path of the eye of a hurricane or tropical storm. There have been two recorded storm tracks through Burlington, a tropical storm in 1908 and a Category Two hurricane in 1869. However, Burlington 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) Hurricane Sandy caused high winds, brought down trees and caused power outages lasting 3-4 days to approximately 200 homes in the Eugene/Muller and Luther Streets neighborhood. Other areas that lost power for the same period included homes on Lantern and Ledgewood Streets, Skelton Road and Wilmington Road.

The hazard mapping indicates that the 100 year wind speed in Burlington 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. 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 Burlington. Potential hurricane damages to Burlington have been estimated using HAZUS-MH. Total building related damages are estimated at $19.45 million for a Category 2 hurricane and $78.96 million for a Category 4 hurricane. Other potential impacts are detailed in Table 21.

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

Tornados

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

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

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

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

Source: Massachusetts State Hazard Mitigation Plan, 2013

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

The most recent tornado events in Massachusetts were in Springfield in 2011 and in Revere in 2014. The Springfield tornado caused significant damage and resulted in 4 deaths in June of 2011. The Revere tornado touched down at in Chelsea just south of Route 16 and moved north into Revere's business district along Broadway and ended near the intersection of Routes 1 and 60. The path was approximately two miles long and 3/8 mile wide, with wind speeds up to 120 miles per hour. Approximately 65 homes had substantial damages and 13 homes and businesses were uninhabitable.

Although there have been no recorded tornados within the limits of the Town of Burlington, since 1956 there have been 17 tornadoes in surrounding Middlesex County recorded by the Tornado History Project. Two tornados were F3, three were F2 and twelve were F1.These 10 tornadoes resulted in a total of one fatality and six injuries and up to $7.7 million in damages, as summarized in Table 9. The town did not suffer any direct tornado impacts/events during the update period. Middlesex County did experience 4 tornado warnings in 2014.

Table 9 - Tornado Records for Middlesex County

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

Source: The Tornado History Project

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

Although tornadoes are a potential Town-wide hazard in Burlington, tornado impacts are relatively localized compared to severe storms and hurricanes. Damages from any tornado in Burlington would greatly depend on the track of the tornado. Generally the portions of the Town near Routes 128, 3 and 3A, are more densely developed and would likely be subject to more damage in the event of a tornado.

Based on the record of previous occurrences since 1950, Tornado events in Burlington are a Medium frequency event as defined by the 2013 Massachusetts State Hazard Mitigation Plan. This hazard may occur from once in 5 years to once in 50 years, or a 2% to 20% chance per year.

Nor'easters

A northeast coastal storm, known as a nor'easter, is typically a large counter-clockwise wind circulation around a low-pressure center. Featuring strong northeasterly winds blowing in from the ocean over coastal areas, nor'easters are relatively common in the winter months in New England occurring one to two times a year. The storm radius of a nor'easter can be as much as 1,000 miles and these storms feature sustained winds of 10 to 40 mph with gusts of up to 70 mph. These storms are accompanied by heavy rains or snows, depending on temperatures.

Previous occurrences of Nor'easters include the following:

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

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

Burlington 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.

The entire Town of Burlington 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 Burlington 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 Local Hazard Mitigation Team reported that two homes near the intersection of Rita and Ward Streets were damaged by falling trees in high winds during a microburst that occurred in 2010. In August, 2013, another thunderstorm with very high wind gusts downed trees in several neighborhoods throughout Burlington and caused power losses town-wide.

The Town does not keep records of thunderstorms, but estimates that at least ten to twelve occur each year.

The best available data on previous occurrences of thunderstorms in Burlington is for Middlesex County through the National Climatic Data Center (NCDC). Between 1995 and April 30, 2015 NCDC records show 251 thunderstorm events in Middlesex County (Table 10). These storms resulted in a total of $2.7 million in property damages. There were 10 injuries and no deaths reported.

Table 10 Middlesex County Thunderstorm Wind Events, 1995-2015

LOCATION	BEGIN_DATE	EVENT_TYPE	MAGNITUDE	DEATHS	INJURIES	DAMAGE
MIDDLESEX CO.	04/04/1995	Thunderstorm Wind	58 kts.	0	0	0.00K
MIDDLESEX CO.	07/15/1995	Thunderstorm Wind	0 kts.	0	0	0.00K
MIDDLESEX CO.	07/15/1995	Thunderstorm Wind	0 kts.	0	0	0.00K
MIDDLESEX CO.	09/14/1995	Thunderstorm Wind	0 kts.	0	2	0.00K
MIDDLESEX CO.	09/14/1995	Thunderstorm Wind	0 kts.	0	0	0.00K
MIDDLESEX CO.	10/28/1995	Thunderstorm Wind	0 kts.	0	0	0.00K

LOCATION	BEGIN_DATE	EVENT_TYPE	MAGNITUDE	DEATHS	INJURIES	DAMAGE
MIDDLESEX CO.	10/28/1995	Thunderstorm Wind	0 kts.	0	0	0.00K
MIDDLESEX CO.	10/28/1995	Thunderstorm Wind	0 kts.	0	0	0.00K
MIDDLESEX CO.	07/08/1996	Thunderstorm Wind	50 kts.	0	0	0.00K
MIDDLESEX CO.	07/08/1996	Thunderstorm Wind	50 kts.	0	0	0.00K
MIDDLESEX CO.	02/22/1997	Thunderstorm Wind	52 kts.	0	0	0.00K
MIDDLESEX CO.	02/22/1997	Thunderstorm Wind	50 kts.	0	0	0.00K
MIDDLESEX CO.	07/09/1997	Thunderstorm Wind	50 kts.	0	0	1.00K
MIDDLESEX CO.	05/29/1998	Thunderstorm Wind	50 kts.	0	0	0.00K
MIDDLESEX CO.	05/29/1998	Thunderstorm Wind	50 kts.	0	0	0.00K
MIDDLESEX CO.	05/31/1998	Thunderstorm Wind	60 kts.	0	0	0.00K
MIDDLESEX CO.	05/31/1998	Thunderstorm Wind	60 kts.	0	1	10.00K
MIDDLESEX CO.	05/31/1998	Thunderstorm Wind	50 kts.	0	0	0.00K
MIDDLESEX CO.	05/31/1998	Thunderstorm Wind	50 kts.	0	0	0.00K
MIDDLESEX CO.	05/31/1998	Thunderstorm Wind	70 kts.	0	0	0.00K
MIDDLESEX CO.	05/31/1998	Thunderstorm Wind	50 kts.	0	0	0.00K
MIDDLESEX CO.	07/23/1998	Thunderstorm Wind	50 kts.	0	0	0.00K
MIDDLESEX CO.	09/15/1998	Thunderstorm Wind	50 kts.	0	0	0.00K
MIDDLESEX CO.	07/06/1999	Thunderstorm Wind	56 kts.	0	0	0.00K
MIDDLESEX CO.	07/06/1999	Thunderstorm Wind	65 kts.	0	0	0.00K
MIDDLESEX CO.	07/06/1999	Thunderstorm Wind	60 kts.	0	0	0.00K
MIDDLESEX CO.	07/23/1999	Thunderstorm Wind	50 kts.	0	0	0.00K
MIDDLESEX CO.	07/24/1999	Thunderstorm Wind	50 kts.	0	0	0.00K
MIDDLESEX CO.	07/25/1999	Thunderstorm Wind	50 kts.	0	0	0.00K
MIDDLESEX CO.	08/05/1999	Thunderstorm Wind	50 kts.	0	0	0.00K
MIDDLESEX CO.	06/02/2000	Thunderstorm Wind	50 kts. E	0	0	0.00K
MIDDLESEX CO.	06/02/2000	Thunderstorm Wind	50 kts. E	0	0	0.00K
MIDDLESEX CO.	06/27/2000	Thunderstorm Wind	50 kts. E	0	0	0.00K
MIDDLESEX CO.	05/12/2001	Thunderstorm Wind	50 kts. E	0	0	0.00K
MIDDLESEX CO.	05/12/2001	Thunderstorm Wind	50 kts. E	0	0	0.00K
MIDDLESEX CO.	06/17/2001	Thunderstorm Wind	60 kts. E	0	0	0.00K
MIDDLESEX CO.	06/20/2001	Thunderstorm Wind	50 kts. E	0	0	0.00K
MIDDLESEX CO.	06/30/2001	Thunderstorm Wind	50 kts. E	0	0	0.00K
MIDDLESEX CO.	06/30/2001	Thunderstorm Wind	50 kts. E	0	0	0.00K
MIDDLESEX CO.	06/30/2001	Thunderstorm Wind	50 kts. E	0	0	0.00K
MIDDLESEX CO.	06/30/2001	Thunderstorm Wind	50 kts. E	0	0	0.00K
MIDDLESEX CO.	07/01/2001	Thunderstorm Wind	50 kts. E	0	0	0.00K
MIDDLESEX CO.	07/01/2001	Thunderstorm Wind	50 kts. E	0	0	0.00K
MIDDLESEX CO.	07/10/2001	Thunderstorm Wind	50 kts. E	0	0	0.00K
MIDDLESEX CO.	08/10/2001	Thunderstorm Wind	50 kts. E	0	0	0.00K
MIDDLESEX CO.	08/10/2001	Thunderstorm Wind	50 kts. E	0	0	0.00K
MIDDLESEX CO.	08/10/2001	Thunderstorm Wind	50 kts. E	0	0	0.00K

LOCATION	BEGIN_DATE	EVENT_TYPE	MAGNITUDE	DEATHS	INJURIES	DAMAGE
MIDDLESEX CO.	04/19/2002	Thunderstorm Wind	52 kts. E	0	0	5.00K
MIDDLESEX CO.	05/31/2002	Thunderstorm Wind	50 kts. E	0	0	2.00K
MIDDLESEX CO.	06/27/2002	Thunderstorm Wind	50 kts. E	0	0	5.00K
MIDDLESEX CO.	06/27/2002	Thunderstorm Wind	50 kts. E	0	0	5.00K
MIDDLESEX CO.	07/15/2002	Thunderstorm Wind	50 kts. E	0	0	2.00K
MIDDLESEX CO.	07/23/2002	Thunderstorm Wind	50 kts. E	0	0	5.00K
MIDDLESEX CO.	07/23/2002	Thunderstorm Wind	65 kts. E	0	0	35.00K
MIDDLESEX CO.	08/02/2002	Thunderstorm Wind	50 kts. E	0	0	2.00K
MIDDLESEX CO.	08/02/2002	Thunderstorm Wind	50 kts. E	0	0	2.00K
MIDDLESEX CO.	08/13/2003	Thunderstorm Wind	50 kts. EG	0	0	25.00K
MIDDLESEX CO.	08/22/2003	Thunderstorm Wind	50 kts. EG	0	0	5.00K
MIDDLESEX CO.	08/22/2003	Thunderstorm Wind	50 kts. EG	0	0	10.00K
MIDDLESEX CO.	08/22/2003	Thunderstorm Wind	50 kts. EG	0	0	5.00K
MIDDLESEX CO.	08/22/2003	Thunderstorm Wind	50 kts. EG	0	0	10.00K
MIDDLESEX CO.	07/08/2004	Thunderstorm Wind	50 kts. EG	0	0	10.00K
MIDDLESEX CO.	08/20/2004	Thunderstorm Wind	50 kts. EG	0	0	10.00K
MIDDLESEX CO.	08/20/2004	Thunderstorm Wind	50 kts. EG	0	0	10.00K
MIDDLESEX CO.	08/20/2004	Thunderstorm Wind	50 kts. EG	0	0	15.00K
MIDDLESEX CO.	08/20/2004	Thunderstorm Wind	50 kts. EG	0	0	75.00K
MIDDLESEX CO.	08/21/2004	Thunderstorm Wind	50 kts. EG	0	0	15.00K
MIDDLESEX CO.	06/29/2005	Thunderstorm Wind	50 kts. EG	0	0	10.00K
MIDDLESEX CO.	07/27/2005	Thunderstorm Wind	50 kts. EG	0	0	5.00K
MIDDLESEX CO.	07/27/2005	Thunderstorm Wind	50 kts. EG	0	0	5.00K
MIDDLESEX CO.	08/05/2005	Thunderstorm Wind	50 kts. EG	0	4	15.00K
MIDDLESEX CO.	08/05/2005	Thunderstorm Wind	50 kts. EG	0	0	15.00K
MIDDLESEX CO.	08/05/2005	Thunderstorm Wind	50 kts. EG	0	0	5.00K
MIDDLESEX CO.	08/14/2005	Thunderstorm Wind	50 kts. EG	0	0	5.00K
MIDDLESEX CO.	08/14/2005	Thunderstorm Wind	50 kts. EG	0	0	5.00K
MIDDLESEX CO.	08/14/2005	Thunderstorm Wind	50 kts. EG	0	0	5.00K
MIDDLESEX CO.	04/01/2006	Thunderstorm Wind	50 kts. EG	0	0	8.00K
MIDDLESEX CO.	05/21/2006	Thunderstorm Wind	61 kts. EG	0	0	75.00K
MIDDLESEX CO.	05/21/2006	Thunderstorm Wind	61 kts. EG	0	0	20.00K
MIDDLESEX CO.	06/23/2006	Thunderstorm Wind	50 kts. EG	0	0	30.00K
MIDDLESEX CO.	07/11/2006	Thunderstorm Wind	50 kts. EG	0	0	10.00K
MIDDLESEX CO.	07/11/2006	Thunderstorm Wind	50 kts. EG	0	0	10.00K
MIDDLESEX CO.	07/11/2006	Thunderstorm Wind	50 kts. EG	0	0	10.00K
MIDDLESEX CO.	07/21/2006	Thunderstorm Wind	50 kts. EG	0	0	35.00K
MIDDLESEX CO.	07/21/2006	Thunderstorm Wind	50 kts. EG	0	0	10.00K
MIDDLESEX CO.	07/21/2006	Thunderstorm Wind	50 kts. EG	0	0	10.00K
MIDDLESEX CO.	07/21/2006	Thunderstorm Wind	50 kts. EG	0	0	35.00K
MIDDLESEX CO.	07/28/2006	Thunderstorm Wind	50 kts. EG	0	0	15.00K

LOCATION	BEGIN_DATE	EVENT_TYPE	MAGNITUDE	DEATHS	INJURIES	DAMAGE
MIDDLESEX CO.	07/28/2006	Thunderstorm Wind	50 kts. EG	0	0	10.00K
MIDDLESEX CO.	07/28/2006	Thunderstorm Wind	50 kts. EG	0	0	10.00K
MIDDLESEX CO.	07/28/2006	Thunderstorm Wind	50 kts. EG	0	0	10.00K
MIDDLESEX CO.	08/02/2006	Thunderstorm Wind	50 kts. EG	0	0	15.00K
MIDDLESEX CO.	05/16/2007	Thunderstorm Wind	50 kts. EG	0	0	0.00K
MIDDLESEX CO.	06/27/2007	Thunderstorm Wind	50 kts. EG	0	0	0.00K
MIDDLESEX CO.	07/06/2007	Thunderstorm Wind	50 kts. EG	0	0	0.00K
MIDDLESEX CO.	07/09/2007	Thunderstorm Wind	50 kts. EG	0	0	0.00K
MIDDLESEX CO.	07/09/2007	Thunderstorm Wind	50 kts. EG	0	0	0.00K
MIDDLESEX CO.	07/15/2007	Thunderstorm Wind	50 kts. EG	0	0	0.00K
MIDDLESEX CO.	07/15/2007	Thunderstorm Wind	50 kts. EG	0	0	0.00K
MIDDLESEX CO.	07/15/2007	Thunderstorm Wind	50 kts. EG	0	0	0.00K
MIDDLESEX CO.	07/15/2007	Thunderstorm Wind	50 kts. EG	0	0	0.00K
MIDDLESEX CO.	07/28/2007	Thunderstorm Wind	50 kts. EG	0	0	0.00K
MIDDLESEX CO.	07/28/2007	Thunderstorm Wind	50 kts. EG	0	0	0.00K
MIDDLESEX CO.	07/28/2007	Thunderstorm Wind	50 kts. EG	0	0	0.00K
MIDDLESEX CO.	07/28/2007	Thunderstorm Wind	50 kts. EG	0	0	0.00K
MIDDLESEX CO.	07/29/2007	Thunderstorm Wind	50 kts. EG	0	0	0.00K
MIDDLESEX CO.	08/17/2007	Thunderstorm Wind	50 kts. EG	0	0	0.00K
MIDDLESEX CO.	08/17/2007	Thunderstorm Wind	50 kts. EG	0	0	0.00K
MIDDLESEX CO.	09/08/2007	Thunderstorm Wind	50 kts. EG	0	0	25.00K
MIDDLESEX CO.	05/27/2008	Thunderstorm Wind	50 kts. EG	0	0	1.00K
MIDDLESEX CO.	05/27/2008	Thunderstorm Wind	50 kts. EG	0	0	8.00K
MIDDLESEX CO.	05/27/2008	Thunderstorm Wind	50 kts. EG	0	0	0.50K
MIDDLESEX CO.	05/27/2008	Thunderstorm Wind	50 kts. EG	0	0	1.00K
MIDDLESEX CO.	05/27/2008	Thunderstorm Wind	50 kts. EG	0	0	1.00K
MIDDLESEX CO.	06/10/2008	Thunderstorm Wind	50 kts. EG	0	0	20.00K
MIDDLESEX CO.	06/10/2008	Thunderstorm Wind	50 kts. EG	0	0	13.00K
MIDDLESEX CO.	06/10/2008	Thunderstorm Wind	50 kts. EG	0	0	5.00K
MIDDLESEX CO.	06/23/2008	Thunderstorm Wind	50 kts. EG	0	0	5.00K
MIDDLESEX CO.	06/23/2008	Thunderstorm Wind	50 kts. EG	0	0	4.00K
MIDDLESEX CO.	06/24/2008	Thunderstorm Wind	50 kts. EG	0	0	5.00K
MIDDLESEX CO.	06/24/2008	Thunderstorm Wind	50 kts. EG	0	0	5.00K
MIDDLESEX CO.	06/24/2008	Thunderstorm Wind	50 kts. EG	0	1	0.00K
MIDDLESEX CO.	06/24/2008	Thunderstorm Wind	50 kts. EG	0	0	5.00K
MIDDLESEX CO.	06/24/2008	Thunderstorm Wind	50 kts. EG	0	0	1.00K
MIDDLESEX CO.	06/24/2008	Thunderstorm Wind	50 kts. EG	0	0	3.00K
MIDDLESEX CO.	06/24/2008	Thunderstorm Wind	50 kts. EG	0	0	1.00K
MIDDLESEX CO.	06/27/2008	Thunderstorm Wind	50 kts. EG	0	0	5.00K
MIDDLESEX CO.	06/27/2008	Thunderstorm Wind	50 kts. EG	0	0	3.00K
MIDDLESEX CO.	06/29/2008	Thunderstorm Wind	50 kts. EG	0	0	10.00K

LOCATION	BEGIN_DATE	EVENT_TYPE	MAGNITUDE	DEATHS	INJURIES	DAMAGE
MIDDLESEX CO.	06/29/2008	Thunderstorm Wind	50 kts. EG	0	0	5.00K
MIDDLESEX CO.	06/29/2008	Thunderstorm Wind	50 kts. EG	0	0	0.00K
MIDDLESEX CO.	07/01/2008	Thunderstorm Wind	50 kts. EG	0	0	20.00K
MIDDLESEX CO.	07/01/2008	Thunderstorm Wind	55 kts. MG	0	0	0.00K
MIDDLESEX CO.	07/01/2008	Thunderstorm Wind	50 kts. EG	0	0	10.00K
MIDDLESEX CO.	07/01/2008	Thunderstorm Wind	50 kts. EG	0	0	5.00K
MIDDLESEX CO.	07/01/2008	Thunderstorm Wind	50 kts. EG	0	0	5.00K
MIDDLESEX CO.	07/02/2008	Thunderstorm Wind	50 kts. EG	0	0	1.00K
MIDDLESEX CO.	07/02/2008	Thunderstorm Wind	50 kts. EG	0	0	1.00K
MIDDLESEX CO.	07/02/2008	Thunderstorm Wind	50 kts. EG	0	0	5.00K
MIDDLESEX CO.	07/02/2008	Thunderstorm Wind	50 kts. EG	0	0	5.00K
MIDDLESEX CO.	07/03/2008	Thunderstorm Wind	50 kts. EG	0	0	15.00K
MIDDLESEX CO.	07/03/2008	Thunderstorm Wind	50 kts. EG	0	0	3.00K
MIDDLESEX CO.	07/03/2008	Thunderstorm Wind	50 kts. EG	0	0	3.00K
MIDDLESEX CO.	07/19/2008	Thunderstorm Wind	50 kts. EG	0	0	6.00K
MIDDLESEX CO.	07/19/2008	Thunderstorm Wind	50 kts. EG	0	0	8.00K
MIDDLESEX CO.	07/19/2008	Thunderstorm Wind	50 kts. EG	0	0	2.00K
MIDDLESEX CO.	07/20/2008	Thunderstorm Wind	50 kts. EG	0	0	5.00K
MIDDLESEX CO.	07/27/2008	Thunderstorm Wind	50 kts. EG	0	0	5.00K
MIDDLESEX CO.	08/03/2008	Thunderstorm Wind	50 kts. EG	0	0	5.00K
MIDDLESEX CO.	08/07/2008	Thunderstorm Wind	50 kts. EG	0	0	5.00K
MIDDLESEX CO.	08/07/2008	Thunderstorm Wind	50 kts. EG	0	0	5.00K
MIDDLESEX CO.	09/09/2008	Thunderstorm Wind	50 kts. EG	0	0	8.00K
MIDDLESEX CO.	09/09/2008	Thunderstorm Wind	50 kts. EG	0	0	4.00K
MIDDLESEX CO.	05/09/2009	Thunderstorm Wind	50 kts. EG	0	0	2.00K
MIDDLESEX CO.	05/24/2009	Thunderstorm Wind	50 kts. EG	0	0	15.00K
MIDDLESEX CO.	07/07/2009	Thunderstorm Wind	50 kts. EG	0	0	1.00K
MIDDLESEX CO.	07/08/2009	Thunderstorm Wind	50 kts. EG	0	0	20.00K
MIDDLESEX CO.	07/26/2009	Thunderstorm Wind	50 kts. EG	0	0	1.00K
MIDDLESEX CO.	07/26/2009	Thunderstorm Wind	50 kts. EG	0	0	15.00K
MIDDLESEX CO.	07/31/2009	Thunderstorm Wind	50 kts. EG	0	0	30.00K
MIDDLESEX CO.	07/31/2009	Thunderstorm Wind	50 kts. EG	0	0	15.00K
MIDDLESEX CO.	07/31/2009	Thunderstorm Wind	50 kts. EG	0	0	10.00K
MIDDLESEX CO.	07/31/2009	Thunderstorm Wind	50 kts. EG	0	0	3.00K
MIDDLESEX CO.	07/31/2009	Thunderstorm Wind	50 kts. EG	0	0	15.00K
MIDDLESEX CO.	07/31/2009	Thunderstorm Wind	50 kts. EG	0	0	5.00K
MIDDLESEX CO.	05/04/2010	Thunderstorm Wind	50 kts. EG	0	0	30.00K
MIDDLESEX CO.	05/04/2010	Thunderstorm Wind	50 kts. EG	0	0	7.00K
MIDDLESEX CO.	06/01/2010	Thunderstorm Wind	50 kts. EG	0	0	5.00K
MIDDLESEX CO.	06/03/2010	Thunderstorm Wind	50 kts. EG	0	0	20.00K
MIDDLESEX CO.	06/03/2010	Thunderstorm Wind	50 kts. EG	0	0	1.00K

LOCATION	BEGIN_DATE	EVENT_TYPE	MAGNITUDE	DEATHS	INJURIES	DAMAGE
MIDDLESEX CO.	06/05/2010	Thunderstorm Wind	50 kts. EG	0	0	40.00K
MIDDLESEX CO.	06/06/2010	Thunderstorm Wind	50 kts. EG	0	1	25.00K
MIDDLESEX CO.	06/06/2010	Thunderstorm Wind	50 kts. EG	0	0	3.00K
MIDDLESEX CO.	06/06/2010	Thunderstorm Wind	50 kts. EG	0	0	20.00K
MIDDLESEX CO.	06/06/2010	Thunderstorm Wind	50 kts. EG	0	0	50.00K
MIDDLESEX CO.	06/06/2010	Thunderstorm Wind	50 kts. EG	0	0	30.00K
MIDDLESEX CO.	06/06/2010	Thunderstorm Wind	50 kts. EG	0	0	10.00K
MIDDLESEX CO.	06/06/2010	Thunderstorm Wind	50 kts. EG	0	0	100.00K
MIDDLESEX CO.	06/06/2010	Thunderstorm Wind	50 kts. EG	0	0	25.00K
MIDDLESEX CO.	06/06/2010	Thunderstorm Wind	50 kts. EG	0	0	1.00K
MIDDLESEX CO.	06/06/2010	Thunderstorm Wind	50 kts. EG	0	0	30.00K
MIDDLESEX CO.	06/06/2010	Thunderstorm Wind	50 kts. EG	0	0	1.00K
MIDDLESEX CO.	06/24/2010	Thunderstorm Wind	50 kts. EG	0	0	10.00K
MIDDLESEX CO.	06/24/2010	Thunderstorm Wind	50 kts. EG	0	0	2.00K
MIDDLESEX CO.	06/24/2010	Thunderstorm Wind	50 kts. EG	0	0	2.00K
MIDDLESEX CO.	06/24/2010	Thunderstorm Wind	50 kts. EG	0	0	15.00K
MIDDLESEX CO.	06/24/2010	Thunderstorm Wind	50 kts. EG	0	0	3.00K
MIDDLESEX CO.	06/24/2010	Thunderstorm Wind	50 kts. EG	0	0	30.00K
MIDDLESEX CO.	06/24/2010	Thunderstorm Wind	50 kts. EG	0	0	1.00K
MIDDLESEX CO.	06/24/2010	Thunderstorm Wind	50 kts. EG	0	0	15.00K
MIDDLESEX CO.	06/24/2010	Thunderstorm Wind	50 kts. EG	0	0	1.00K
MIDDLESEX CO.	06/24/2010	Thunderstorm Wind	50 kts. EG	0	0	15.00K
MIDDLESEX CO.	07/12/2010	Thunderstorm Wind	50 kts. EG	0	0	25.00K
MIDDLESEX CO.	07/12/2010	Thunderstorm Wind	50 kts. EG	0	0	50.00K
MIDDLESEX CO.	07/19/2010	Thunderstorm Wind	50 kts. EG	0	0	25.00K
MIDDLESEX CO.	06/01/2011	Thunderstorm Wind	50 kts. EG	0	0	5.00K
MIDDLESEX CO.	06/01/2011	Thunderstorm Wind	50 kts. EG	0	0	3.00K
MIDDLESEX CO.	06/09/2011	Thunderstorm Wind	50 kts. EG	0	0	15.00K
MIDDLESEX CO.	06/09/2011	Thunderstorm Wind	50 kts. EG	0	0	15.00K
MIDDLESEX CO.	08/02/2011	Thunderstorm Wind	50 kts. EG	0	0	1.00K
MIDDLESEX CO.	08/19/2011	Thunderstorm Wind	50 kts. EG	0	0	3.00K
MIDDLESEX CO.	08/19/2011	Thunderstorm Wind	50 kts. EG	0	0	5.00K
MIDDLESEX CO.	08/19/2011	Thunderstorm Wind	50 kts. EG	0	0	15.00K
MIDDLESEX CO.	08/19/2011	Thunderstorm Wind	50 kts. EG	0	0	5.00K
MIDDLESEX CO.	08/19/2011	Thunderstorm Wind	50 kts. EG	0	0	0.00K
MIDDLESEX CO.	08/19/2011	Thunderstorm Wind	50 kts. EG	0	0	5.00K
MIDDLESEX CO.	06/08/2012	Thunderstorm Wind	50 kts. EG	0	0	25.00K
MIDDLESEX CO.	06/23/2012	Thunderstorm Wind	45 kts. EG	0	0	5.00K
MIDDLESEX CO.	07/04/2012	Thunderstorm Wind	50 kts. EG	0	0	10.00K
MIDDLESEX CO.	07/18/2012	Thunderstorm Wind	50 kts. EG	0	0	15.00K
MIDDLESEX CO.	07/18/2012	Thunderstorm Wind	70 kts. EG	0	0	350.00K

LOCATION	BEGIN_DATE	EVENT_TYPE	MAGNITUDE	DEATHS	INJURIES	DAMAGE
MIDDLESEX CO.	09/07/2012	Thunderstorm Wind	50 kts. EG	0	0	10.00K
MIDDLESEX CO.	09/08/2012	Thunderstorm Wind	40 kts. EG	0	0	3.00K
MIDDLESEX CO.	06/17/2013	Thunderstorm Wind	50 kts. EG	0	0	25.00K
MIDDLESEX CO.	06/17/2013	Thunderstorm Wind	50 kts. EG	0	0	20.00K
MIDDLESEX CO.	06/17/2013	Thunderstorm Wind	45 kts. EG	0	0	3.00K
MIDDLESEX CO.	06/18/2013	Thunderstorm Wind	45 kts. EG	0	0	10.00K
MIDDLESEX CO.	06/24/2013	Thunderstorm Wind	45 kts. EG	0	0	3.00K
MIDDLESEX CO.	07/23/2013	Thunderstorm Wind	50 kts. EG	0	0	20.00K
MIDDLESEX CO.	07/29/2013	Thunderstorm Wind	50 kts. EG	0	0	5.00K
MIDDLESEX CO.	07/29/2013	Thunderstorm Wind	50 kts. EG	0	0	5.00K
MIDDLESEX CO.	07/03/2014	Thunderstorm Wind	50 kts. EG	0	0	50.00K
MIDDLESEX CO.	07/03/2014	Thunderstorm Wind	50 kts. EG	0	0	75.00K
MIDDLESEX CO.	07/07/2014	Thunderstorm Wind	40 kts. EG	0	0	5.00K
MIDDLESEX CO.	07/07/2014	Thunderstorm Wind	50 kts. EG	0	0	15.00K
MIDDLESEX CO.	07/07/2014	Thunderstorm Wind	50 kts. EG	0	0	5.00K
MIDDLESEX CO.	07/07/2014	Thunderstorm Wind	50 kts. EG	0	0	5.00K
MIDDLESEX CO.	07/07/2014	Thunderstorm Wind	87 kts. EG	0	0	100.00K
MIDDLESEX CO.	07/07/2014	Thunderstorm Wind	50 kts. EG	0	0	5.00K
MIDDLESEX CO.	07/07/2014	Thunderstorm Wind	50 kts. EG	0	0	15.00K
MIDDLESEX CO.	07/07/2014	Thunderstorm Wind	50 kts. EG	0	0	25.00K
MIDDLESEX CO.	07/07/2014	Thunderstorm Wind	50 kts. EG	0	0	15.00K
MIDDLESEX CO.	07/07/2014	Thunderstorm Wind	50 kts. EG	0	0	5.00K
MIDDLESEX CO.	07/07/2014	Thunderstorm Wind	50 kts. EG	0	0	25.00K
MIDDLESEX CO.	07/07/2014	Thunderstorm Wind	50 kts. EG	0	0	5.00K
MIDDLESEX CO.	07/07/2014	Thunderstorm Wind	50 kts. EG	0	0	5.00K
MIDDLESEX CO.	07/15/2014	Thunderstorm Wind	50 kts. EG	0	0	25.00K
MIDDLESEX CO.	07/28/2014	Thunderstorm Wind	50 kts. EG	0	0	50.00K
MIDDLESEX CO.	09/06/2014	Thunderstorm Wind	50 kts. EG	0	1	10.00K
MIDDLESEX CO.	09/06/2014	Thunderstorm Wind	50 kts. EG	0	0	5.00K
MIDDLESEX CO.	09/06/2014	Thunderstorm Wind	50 kts. EG	0	0	5.00K
MIDDLESEX CO.	09/06/2014	Thunderstorm Wind	50 kts. EG	0	0	5.00K
MIDDLESEX CO.	09/06/2014	Thunderstorm Wind	50 kts. EG	0	0	3.00K
MIDDLESEX CO.	09/06/2014	Thunderstorm Wind	50 kts. EG	0	0	10.00K
MIDDLESEX CO.	09/06/2014	Thunderstorm Wind	50 kts. EG	0	0	3.00K
MIDDLESEX CO.	09/06/2014	Thunderstorm Wind	50 kts. EG	0	0	2.00K
MIDDLESEX CO.	09/06/2014	Thunderstorm Wind	50 kts. EG	0	0	15.00K
MIDDLESEX CO.	09/06/2014	Thunderstorm Wind	50 kts. EG	0	0	5.00K
MIDDLESEX CO.	09/06/2014	Thunderstorm Wind	50 kts. EG	0	0	1.00K
MIDDLESEX CO.	09/06/2014	Thunderstorm Wind	50 kts. EG	0	0	10.00K
MIDDLESEX CO.	09/06/2014	Thunderstorm Wind	50 kts. EG	0	0	10.00K
Totals				**0**	**10**	**2.719M**

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

Severe thunderstorms are a Town-wide hazard for Burlington. 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 Burlington 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 increases with temperatures below 20 degrees.

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

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

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

Source: 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 Burlington blizzards and severe winter storms have occurred in the following years:

Table 11- Severe Winter Storm Records for Massachusetts

Blizzard of 1978	February 1978
Blizzard	March 1993
Blizzard	January 1996
Severe Snow Storm	March 2001
Severe Snow Storm	December 2003
Severe Snow Storm	January 2004
Severe Snow Storm	January 2005
Severe Snow Storm	April, 2007
Severe Snow Storm	December 2010
Severe Snow Storm	January 2011
Blizzard of 2013	February 2013
Blizzard of 2015	January 2015

Source: National Oceanic and Atmospheric Administration

The average annual snowfall for all of Burlington is 48 - 72 inches (see Map 6 in Appendix B).

The Town of Burlington does not keep local records of winter storms. However, the Local Hazard Mitigation Team noted that during the winter of 2012-2013, Burlington experienced several heavy snow events that led to fire hydrants becoming inaccessible, and roof collapse from heavy snow on approximately twelve flat-roofed homes and five to eight commercial buildings with flat roofs. Ice dams in gutters also caused residential damage on an undetermined number of homes.

Data for Middlesex County, which includes Burlington, is the best available data to help understand previous occurrences and impacts of heavy snow events. According to the National Climate Data Center (NCDC) records, from 1995 to 2015, Middlesex County

experienced 151 heavy snowfall events, resulting in no deaths, no injuries, and $4.415 million dollars in property damage. See Table 12 for heavy snow events and impacts in Middlesex County.

Table 12 - Heavy Snow events and Impacts in Middlesex County 1996 –2014

Date	Type	Deaths	Injuries	Property Damage
01/02/1996	Heavy Snow	0	0	0.00K
01/02/1996	Heavy Snow	0	0	0.00K
01/07/1996	Heavy Snow	0	0	1.400M
01/07/1996	Heavy Snow	0	0	1.500M
01/10/1996	Heavy Snow	0	0	0.00K
01/12/1996	Heavy Snow	0	0	0.00K
02/02/1996	Heavy Snow	0	0	0.00K
02/16/1996	Heavy Snow	0	0	0.00K
02/16/1996	Heavy Snow	0	0	0.00K
03/02/1996	Heavy Snow	0	0	0.00K
03/02/1996	Heavy Snow	0	0	0.00K
03/07/1996	Heavy Snow	0	0	0.00K
03/07/1996	Heavy Snow	0	0	0.00K
04/07/1996	Heavy Snow	0	0	0.00K
04/07/1996	Heavy Snow	0	0	0.00K
04/09/1996	Heavy Snow	0	0	0.00K
04/09/1996	Heavy Snow	0	0	0.00K
12/06/1996	Heavy Snow	0	0	0.00K
12/06/1996	Heavy Snow	0	0	0.00K
12/07/1996	Heavy Snow	0	0	1.360M
03/31/1997	Heavy Snow	0	0	0.00K
03/31/1997	Heavy Snow	0	0	0.00K
04/01/1997	Heavy Snow	0	0	0.00K
04/01/1997	Heavy Snow	0	0	0.00K
11/14/1997	Heavy Snow	0	0	0.00K
12/23/1997	Heavy Snow	0	0	0.00K
12/23/1997	Heavy Snow	0	0	0.00K
01/15/1998	Heavy Snow	0	0	0.00K

Date	Type	Deaths	Injuries	Property Damage
01/15/1998	Heavy Snow	0	0	0.00K
01/23/1998	Heavy Snow	0	0	0.00K
01/14/1999	Heavy Snow	0	0	0.00K
01/14/1999	Heavy Snow	0	0	0.00K
02/25/1999	Heavy Snow	0	0	0.00K
02/25/1999	Heavy Snow	0	0	0.00K
03/06/1999	Heavy Snow	0	0	0.00K
03/06/1999	Heavy Snow	0	0	0.00K
03/15/1999	Heavy Snow	0	0	0.00K
03/15/1999	Heavy Snow	0	0	0.00K
01/13/2000	Heavy Snow	0	0	0.00K
01/13/2000	Heavy Snow	0	0	0.00K
01/25/2000	Heavy Snow	0	0	0.00K
01/25/2000	Heavy Snow	0	0	0.00K
02/18/2000	Heavy Snow	0	0	0.00K
02/18/2000	Heavy Snow	0	0	0.00K
12/30/2000	Heavy Snow	0	0	0.00K
01/20/2001	Heavy Snow	0	0	0.00K
01/20/2001	Heavy Snow	0	0	0.00K
02/05/2001	Heavy Snow	0	0	0.00K
02/05/2001	Heavy Snow	0	0	0.00K
03/05/2001	Heavy Snow	0	0	0.00K
03/05/2001	Heavy Snow	0	0	0.00K
03/09/2001	Heavy Snow	0	0	0.00K
03/09/2001	Heavy Snow	0	0	0.00K
03/30/2001	Heavy Snow	0	0	0.00K
12/08/2001	Heavy Snow	0	0	0.00K
12/08/2001	Heavy Snow	0	0	0.00K
03/20/2002	Heavy Snow	0	0	0.00K
03/16/2004	Heavy Snow	0	0	0.00K
03/16/2004	Heavy Snow	0	0	0.00K
02/24/2005	Heavy Snow	0	0	0.00K

Date	Type	Deaths	Injuries	Property Damage
12/13/2007	Heavy Snow	0	0	0.00K
12/13/2007	Heavy Snow	0	0	0.00K
12/16/2007	Heavy Snow	0	0	0.00K
12/16/2007	Heavy Snow	0	0	0.00K
12/19/2007	Heavy Snow	0	0	0.00K
12/19/2007	Heavy Snow	0	0	0.00K
01/14/2008	Heavy Snow	0	0	28.00K
01/14/2008	Heavy Snow	0	0	20.00K
01/14/2008	Heavy Snow	0	0	20.00K
02/22/2008	Heavy Snow	0	0	0.00K
02/22/2008	Heavy Snow	0	0	0.00K
02/22/2008	Heavy Snow	0	0	0.00K
03/01/2008	Heavy Snow	0	0	0.00K
12/19/2008	Heavy Snow	0	0	0.00K
12/19/2008	Heavy Snow	0	0	0.00K
12/19/2008	Heavy Snow	0	0	0.00K
12/20/2008	Heavy Snow	0	0	0.00K
12/20/2008	Heavy Snow	0	0	8.00K
12/21/2008	Heavy Snow	0	0	0.00K
12/31/2008	Heavy Snow	0	0	0.00K
12/31/2008	Heavy Snow	0	0	0.00K
01/10/2009	Heavy Snow	0	0	0.00K
01/11/2009	Heavy Snow	0	0	0.00K
01/18/2009	Heavy Snow	0	0	0.00K
01/18/2009	Heavy Snow	0	0	0.00K
01/18/2009	Heavy Snow	0	0	0.00K
03/01/2009	Heavy Snow	0	0	0.00K
03/01/2009	Heavy Snow	0	0	0.00K
03/02/2009	Heavy Snow	0	0	0.00K
12/09/2009	Heavy Snow	0	0	15.00K
12/09/2009	Heavy Snow	0	0	0.50K
12/19/2009	Heavy Snow	0	0	0.00K

Date	Type	Deaths	Injuries	Property Damage
12/20/2009	Heavy Snow	0	0	0.00K
01/18/2010	Heavy Snow	0	0	0.00K
02/16/2010	Heavy Snow	0	0	0.00K
02/16/2010	Heavy Snow	0	0	0.00K
02/16/2010	Heavy Snow	0	0	15.00K
02/23/2010	Heavy Snow	0	0	8.00K
01/12/2011	Heavy Snow	0	0	0.00K
01/12/2011	Heavy Snow	0	0	0.00K
01/26/2011	Heavy Snow	0	0	0.00K
01/26/2011	Heavy Snow	0	0	0.00K
01/26/2011	Heavy Snow	0	0	0.00K
10/29/2011	Heavy Snow	0	0	0.00K
10/29/2011	Heavy Snow	0	0	30.00K
12/29/2012	Heavy Snow	0	0	0.00K
12/29/2012	Heavy Snow	0	0	0.00K
12/29/2012	Heavy Snow	0	0	0.00K
02/08/2013	Heavy Snow	0	0	0.00K
02/08/2013	Heavy Snow	0	0	0.00K
02/08/2013	Heavy Snow	0	0	0.00K
02/23/2013	Heavy Snow	0	0	0.00K
03/07/2013	Heavy Snow	0	0	0.00K
03/07/2013	Heavy Snow	0	0	0.00K
03/07/2013	Heavy Snow	0	0	0.00K
03/18/2013	Heavy Snow	0	0	0.00K
03/18/2013	Heavy Snow	0	0	0.00K
03/18/2013	Heavy Snow	0	0	0.00K
12/14/2013	Heavy Snow	0	0	0.00K
12/14/2013	Heavy Snow	0	0	0.00K
12/14/2013	Heavy Snow	0	0	0.00K
12/17/2013	Heavy Snow	0	0	0.00K
12/17/2013	Heavy Snow	0	0	0.00K
12/17/2013	Heavy Snow	0	0	0.00K

Date	Type	Deaths	Injuries	Property Damage
01/02/2014	Heavy Snow	0	0	0.00K
01/02/2014	Heavy Snow	0	0	0.00K
01/02/2014	Heavy Snow	0	0	0.00K
01/18/2014	Heavy Snow	0	0	0.00K
02/05/2014	Heavy Snow	0	0	0.00K
02/05/2014	Heavy Snow	0	0	0.00K
02/05/2014	Heavy Snow	0	0	0.00K
02/13/2014	Heavy Snow	0	0	0.00K
02/13/2014	Heavy Snow	0	0	0.00K
02/13/2014	Heavy Snow	0	0	0.00K
02/18/2014	Heavy Snow	0	0	0.00K
02/18/2014	Heavy Snow	0	0	0.00K
11/26/2014	Heavy Snow	0	0	10.00K
01/24/2015	Heavy Snow	0	0	0.00K
01/24/2015	Heavy Snow	0	0	0.00K
01/24/2015	Heavy Snow	0	0	0.00K
01/26/2015	Heavy Snow	0	0	0.00K
01/26/2015	Heavy Snow	0	0	0.00K
02/02/2015	Heavy Snow	0	0	0.00K
02/02/2015	Heavy Snow	0	0	0.00K
02/02/2015	Heavy Snow	0	0	0.00K
02/08/2015	Heavy Snow	0	0	0.00K
02/08/2015	Heavy Snow	0	0	0.00K
02/08/2015	Heavy Snow	0	0	0.00K
02/14/2015	Heavy Snow	0	0	0.00K
02/14/2015	Heavy Snow	0	0	0.00K
02/14/2015	Heavy Snow	0	0	0.00K
Total		0	0	4.415M

Source: NOAA, National Climatic Data Center

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

Ice Storms

The ice storm category covers a range of different weather phenomena that collectively involve rain or snow being converted to ice in the lower atmosphere leading to potentially hazardous conditions on the ground. Hail size typically refers to the diameter of the hailstones. Warnings and reports may report hail size through comparisons with real-world objects that correspond to certain diameters:

Description	Diameter (inches)
Pea	0.25
Marble or Mothball	0.50
Penny or Dime	0.75
Nickel	0.88
Quarter	1.00
Half Dollar	1.25
Walnut or Ping Pong Ball	1.50
Golf ball	1.75
Hen's Egg	2.00
Tennis Ball	2.50
Baseball	2.75
Tea Cup	3.00
Grapefruit	4.00
Softball	4.50

While ice pellets and sleet are examples of these, the greatest hazard is created by freezing rain conditions, which is rain that freezes on contact with hard surfaces leading to a layer of ice on roads, walkways, trees, and other surfaces. The conditions created by freezing rain can make driving particularly dangerous and emergency response more difficult. The weight of ice on tree branches can also lead to falling branches damaging electric lines.

Town-specific data for previous ice storm occurrences are not collected by the Town of Burlington. The Hazard Mitigation Team related that Burlington experienced heavy icing during the 2011 Halloween Storm. Trees falling on power lines caused loss of power in about 20% of the town for 3-4 days.

The best available local data is for Middlesex County through the National Climatic Data Center (see Table 13). Middlesex County, which includes the Town of Burlington, experienced four ice storm events from 1995 –2015. No deaths or injuries were reported and the total reported property damage in the county was $6.155 million dollars.

Table 13- Middlesex County Ice Storm Events, 1995-2015

Location	Date	Type	Deaths	Injuries	Damage
Totals:			0	0	6.155M
WESTERN MIDDLESEX (ZONE)	01/09/1998	Ice Storm	0	0	5.00K
WESTERN MIDDLESEX (ZONE)	11/16/2002	Ice Storm	0	0	150.00K
NORTHWEST MIDDLESEX COUNTY (ZO...	12/11/2008	Ice Storm	0	0	3.000M
WESTERN MIDDLESEX (ZONE)	12/11/2008	Ice Storm	0	0	3.000M
Totals:			0	0	6.155M

Source: NOAA, National Climatic Data Center

Ice storms are considered to be medium frequency events based on past occurrences, as defined by the Massachusetts State Hazard Mitigation Plan, 2013. This hazard occurs once in 5 years to once in 50 years, with 2% to 20% chance of occurring each year.

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

Winter storms are considered to be high frequency events based on past occurrences, as defined by the Massachusetts State Hazard Mitigation Plan, 2013. This hazard occurs more than once in years, with a greater than percent chance of occurring each year.

Geologic Hazards

Geologic hazards include earthquakes and landslides. Although new construction under the most recent building codes generally will be built to seismic standards, there are still many structures which pre-date the most recent building code. Information on geologic hazards in Burlington 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 Ann. More recently, a pair of damaging earthquakes occurred near Ossipee, NH in 1940, and a 4.0 earthquake centered in Hollis, Maine in October 2012 was felt in the Boston area. Historical records of some of the more significant earthquakes in the region are shown in Table 14.

Table 14- 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. Burlington 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 Burlington. The Local Hazard Mitigation Team reported feeling earth tremors from the October 16, 2012 4.0 magnitude earthquake centered in Maine. On August 23, 2011 team members experience earth tremors and swaying buildings as a result of a magnitude

7 earthquake in Pennsylvania. No injuries or damages were reported for either earthquake.

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

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

Earthquakes are a potential Town-wide hazard in Burlington. The Town has many older buildings that pre-date current building code which could be vulnerable in the event of a severe earthquake. Potential earthquake damages to Burlington have been estimated using HAZUS-MH. Total building related damages are estimated at $520.41 million for a 5.0 magnitude earthquake and $4.92 billion for a 7.0 magnitude earthquake. Other potential impacts are detailed in Table 22.

According to the Boston College Weston Observatory, in most parts of New England, there is a one in ten chance that a potentially damaging earthquake will occur in a 50 year time period. The Massachusetts State Hazard Mitigation Plan classifies earthquakes as "very low" frequency events that occur less frequently than once in 100 years, or a less than 1% per year.

Landslides

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

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

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

Estimated Volume	**Expected Landslide Velocity**		
($m^{3)}$	Fast moving landslide (Rock fall)	Rapid moving landslide (Debris flow)	Slow moving landslide (Slide)
<0.001	Slight intensity		
<0.5	Medium intensity		
>0.5	High intensity		
<500	High intensity	Slight intensity	
500-10,000	High intensity	Medium intensity	Slight intensity
10,000 – 50,000	Very high intensity	High intensity	Medium intensity
>500,000		Very high intensity	High intensity
>>500,000			Very high intensity

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

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

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

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

Fire Related Hazards

A brush fire is an uncontrolled fire occurring in a forested or grassland area. In the Boston Metro region these fires rarely grow to the size of a wildfire as seen more typically in the western U.S. As their name implies, these fires typically burn no more than the underbrush of a forested area. Wildfire season can begin in March and usually ends in late November. The majority of wildfires typically occur in April and May, when most vegetation is void of any appreciable moisture, making them highly flammable. Once "green-up" takes place in late May to early June, the fire danger usually is reduced somewhat.

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

The Fire Department responds to approximately 30 brush fires annually. Most of these were less than one acre in size and did not cause any structural damage. There have never been any deaths associated with brush fires. Most brush fires are caused by careless disposal of cigarettes and by weather conditions such as lack of rainfall, winds and lightning.

The following areas of Town were identified as having the highest potential for brush fires based on past occurrences and their potential for the accumulation of dried vegetation growth. The numbers correspond to the numbers on Map 8, “Hazard Areas”.

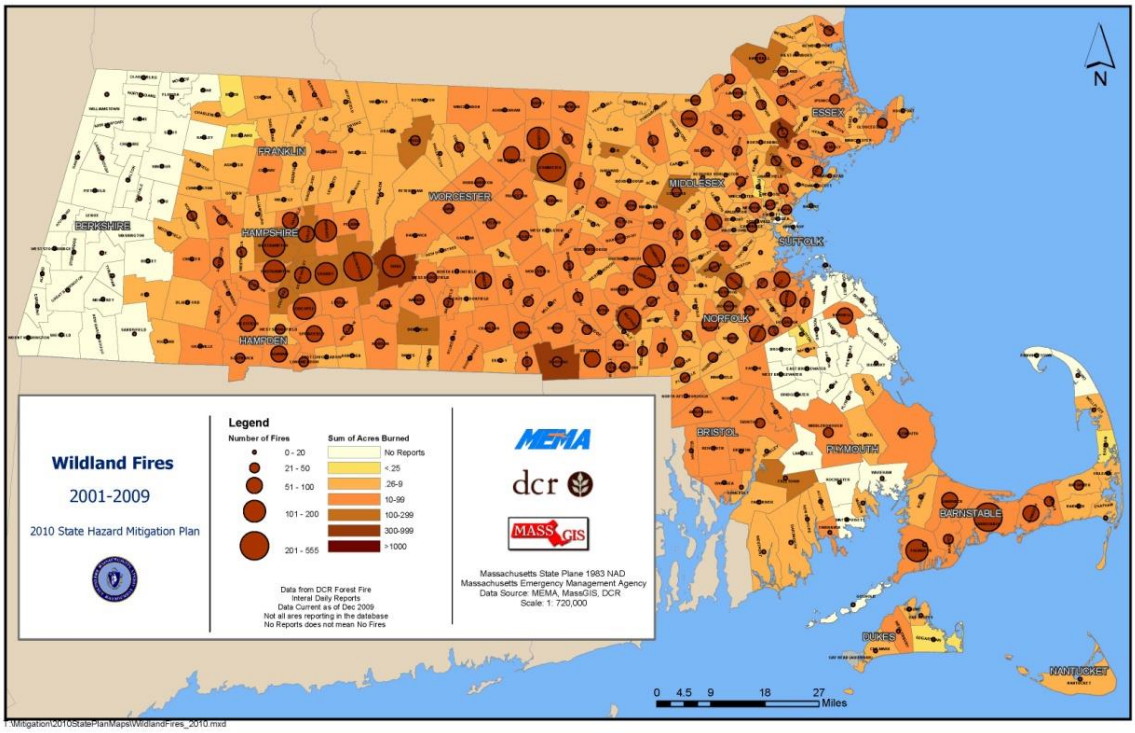
11. **Land Locked Parcel**- listed in 2008
City of Boston/Northeastern/Thorstenson Property: this area was developed into two developments, one completed 32-unit townhouse development (2011) and the Holly Glen project being constructed in 2014.

12. **Overlook Recreation Area on Winnmere Hill**- listed in 2008

13. **Mill Pond Reservoir**- listed in 2008

14. **Sawmill Brook Conservation Brook**- listed in 2008

Figure 2 Massachusetts Wildfires 2001-2009



Source: Massachusetts State Hazard Mitigation Plan

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

Based on past occurrences and the Massachusetts Hazard Mitigation Plan 2013, brushfires are of High frequency, events that occur more frequently than once in 5 years (Greater than 20% per year)

Extreme Temperatures

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

Burlington has four well-defined seasons. The seasons have several defining factors, with temperature one of the most significant. Extreme temperatures can be defined as those, which are far outside of the normal seasonal ranges for Massachusetts. The average temperatures for Massachusetts are: winter (Dec-Feb) Average = 31.8°F and summer (Jun-Aug) Average = 71°F. Extreme temperatures are a Town-wide hazard.

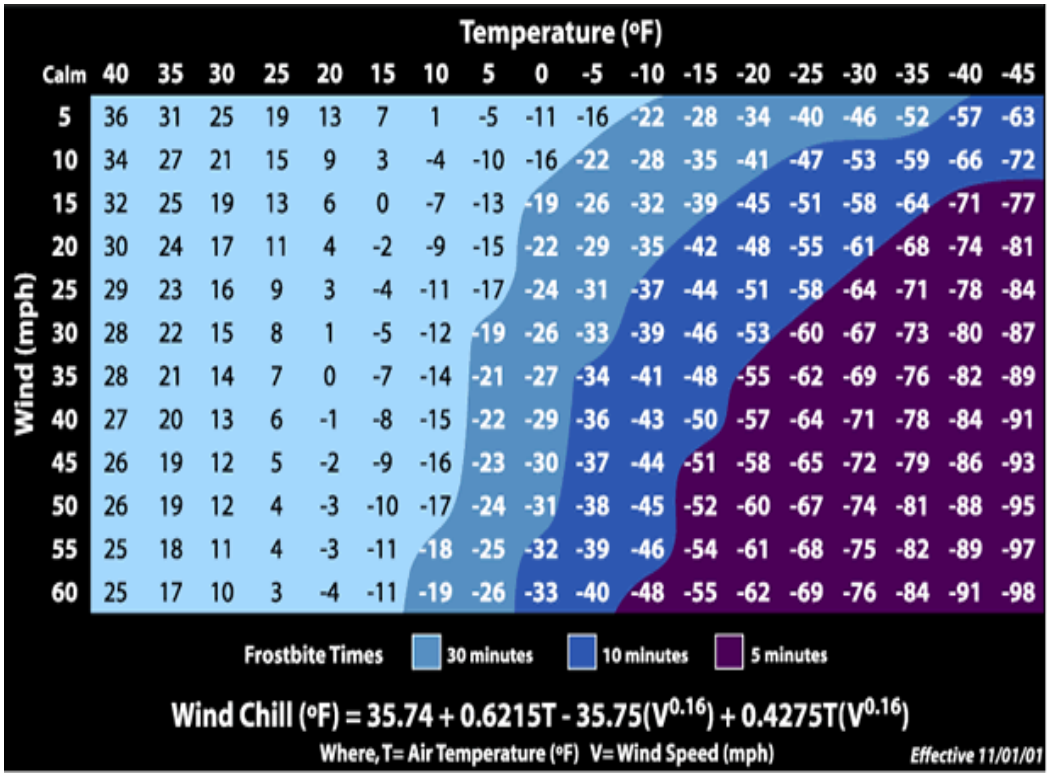
Extreme Cold

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

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

Extreme cold is a dangerous situation that can result in health emergencies for susceptible people, such as those without shelter or who are stranded or who live in homes that are poorly insulated or without heat.

Figure 3 - Wind Chill Temperature Index and Frostbite Risk



The Town of Burlington does not collect data for previous occurrences of extreme cold. The best available local data are for Middlesex County, 1995- 2015, through the National Climatic Data Center (NCDC). There are three extreme cold events on record which caused no deaths and no injuries, property damage (see Table 15).

Table 15 – Middlesex County Extreme Cold and Wind Chill Occurrences

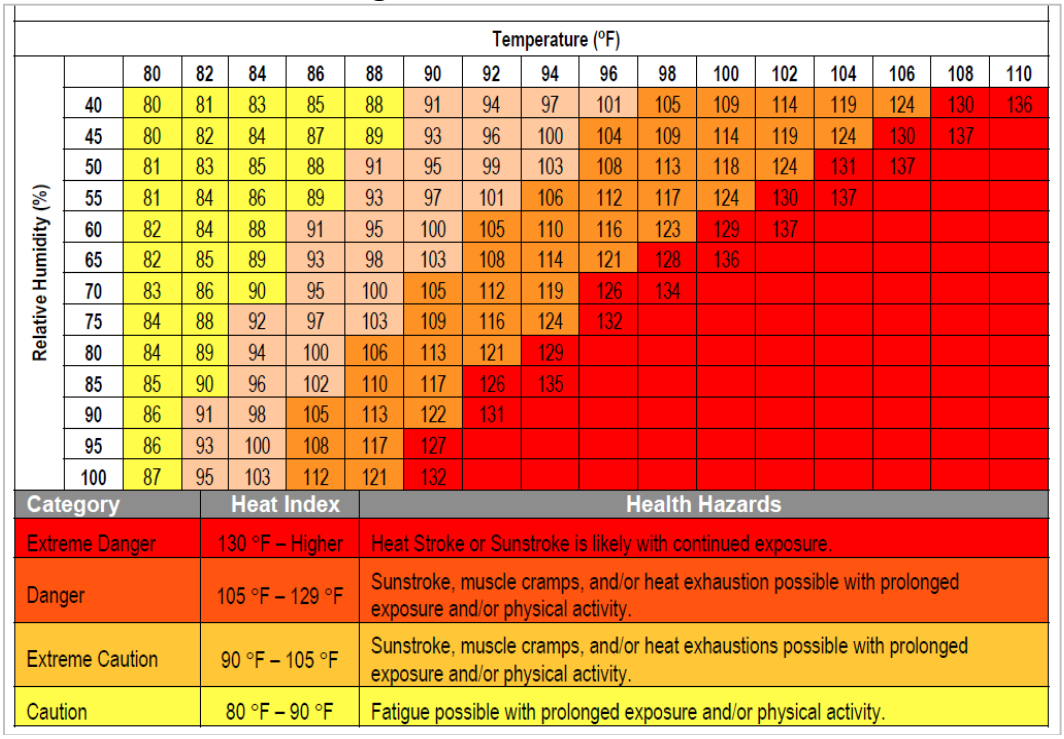
Date	Location	Type	Deaths	Injuries	Property Damage
2/15/2015	Western Middlesex	Extreme Cold/wind Chill	0	0	0
2/16/2015	Northwest Middlesex	Extreme Cold/wind Chill	0	0	0
2/16/2015	Southeast Middlesex	Extreme Cold/wind Chill	0	0	0

Source: NOAA, National Climatic Data Center

Extreme Heat

While a heat wave for Massachusetts is defined as three or more consecutive days above 90°F, another measure used for identifying extreme heat events is through a Heat Advisory from the NWS. These advisories are issued when the heat index (Figure 4) is forecast to exceed 100 degree Fahrenheit (F) for 2 or more hours; an excessive heat advisory is issued if forecast predicts the temperature to rise above105 degree F.

Figure 4- 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 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 Burlington does not collect data on excessive heat occurrences. The best available local data are for Middlesex County, through the National Climatic Data Center. From 1999 - 2015, there has been a total of one excessive heat event, with no reported deaths, no injuries, and no property damage resulting from excessive heat (see Table 16).

Extreme temperature events are projected to be medium frequency events based on past occurrences, as defined by the Massachusetts State Hazard Mitigation Plan, 2013. Both extreme cold and hot weather events occur between once in five years to once in 50 years, or a 2 percent to 20 percent chance of occurring each year.

Table 16 – Middlesex County Extreme Heat Occurrences 1999-2015

DATE	EVENT_TYPE	DEATHS	INJURIES	DAMAGE
7/6/2010	Excessive Heat	0	0	0

Source: NOAA, National Climatic Data Center

Drought

Drought is a temporary irregularity in precipitation and differs from aridity since the latter is restricted to low rainfall regions and is a permanent feature of climate. Drought is a period characterized by long durations of below normal precipitation. Drought conditions occur in virtually all climatic zones yet its characteristics vary significantly from one region to another, since it is relative to the normal precipitation in that region. Drought can affect agriculture, water supply, aquatic ecology, wildlife, and plant life.

In Massachusetts, droughts are caused by the prevalence of dry northern continental air and a decrease in coastal- and tropical-cyclone activity. During the 1960's, a cool drought occurred because dry air from the north caused lower temperatures in the spring and summer of 1962-65. The northerly winds drove frontal systems to sea along the Southeast Coast and prevented the Northeastern States from receiving moisture (U.S. Geological Survey). This is considered the drought of record in Massachusetts.

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

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

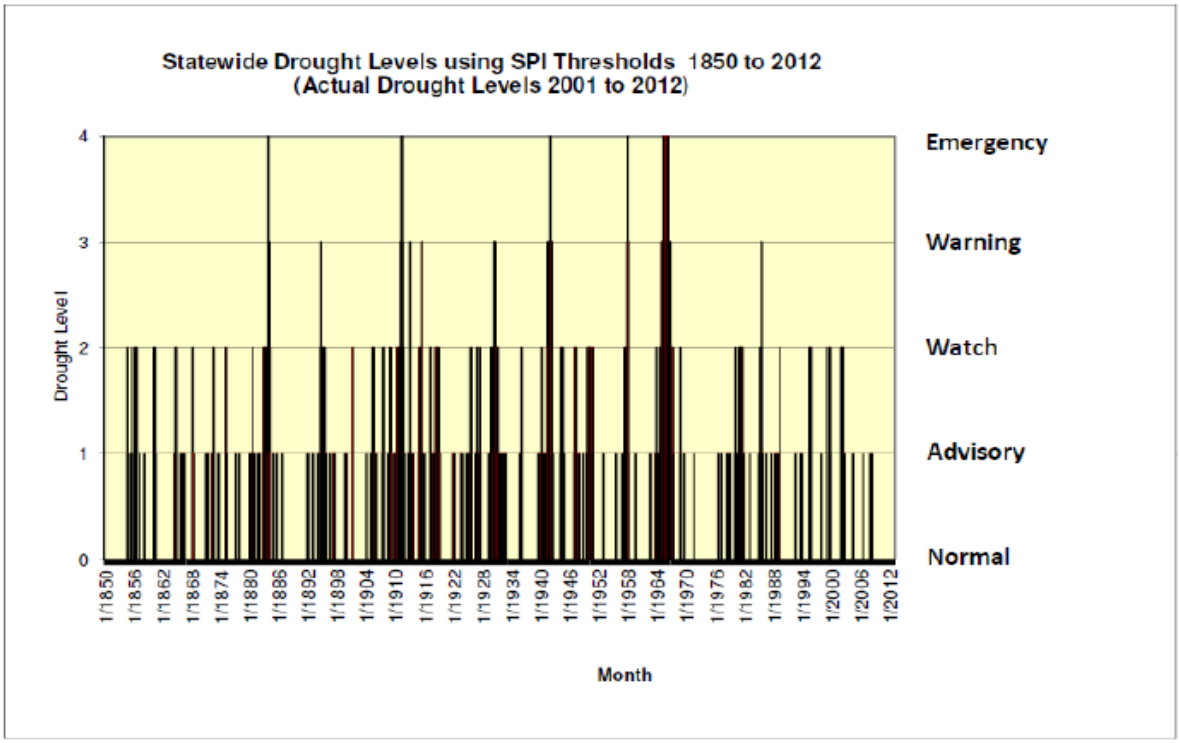
Determinations regarding the end of a drought or reduction of the drought level focus on two key drought indicators: precipitation and groundwater levels. These two factors have the greatest long-term impact on stream flow, water supply, reservoir levels, soil moisture and potential for forest fires.

Previous Occurrences

Burlington 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 5 depicts the incidents of drought levels' occurrence in Massachusetts from 1850 to 2012 using the Standardized Precipitation Index (SPI) parameter alone. On a monthly basis, the state would have been in a Drought Watch to Emergency condition 11 percent of the time between 1850 and 2012. Table 17 summarizes the chronology of major droughts since the 1920's.

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



(Source: Mass. State Drought Management Plan 2013)

Drought Emergency

Drought emergencies have been reached infrequently, with 5 events occurring in the period between 1850 and 2012: in 1883, 1911, 1941, 1957, and 1965-1966. The 1965-1966 drought period is viewed as the most severe drought to have occurred in modern times in Massachusetts because of its long duration. On a monthly basis over the 162-year period of record, there is a one percent chance of being in a drought Emergency.

Drought Warning

Drought Warning levels not associated with drought Emergencies have occurred 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 17 - 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.

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.

Impacts of Climate Change

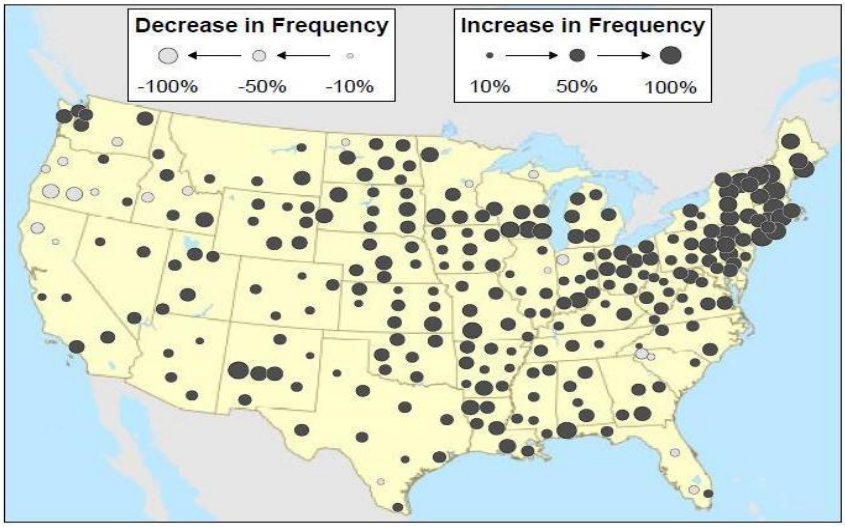
Many of the natural hazards that Burlington has historically experienced are likely to be exacerbated by climate change in future years. This is particularly true for flooding

caused by extreme precipitation and extreme heat. These are described in more detail below.

Climate Change Impacts: Extreme Precipitation

Burlington's average annual precipitation is 42 inches. While total annual precipitation has not changed significantly, according to the 2012 report *When It Rains It Pours – Global Warming and the Increase in Extreme Precipitation from 1948 to 2011* intense rainstorms and snowstorms have become more frequent and more severe over the last half century in the northeastern United States**.** Extreme downpours are now happening 30 percent more often nationwide than in 1948 (see Figure 6). In other words, large rain or snow storms that happened once every 12 months, on average, in the middle of the 20th century, now happen every nine months.

Figure 6- Changes in Frequency of *Extreme Downpours, 1948 – 2011*



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

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

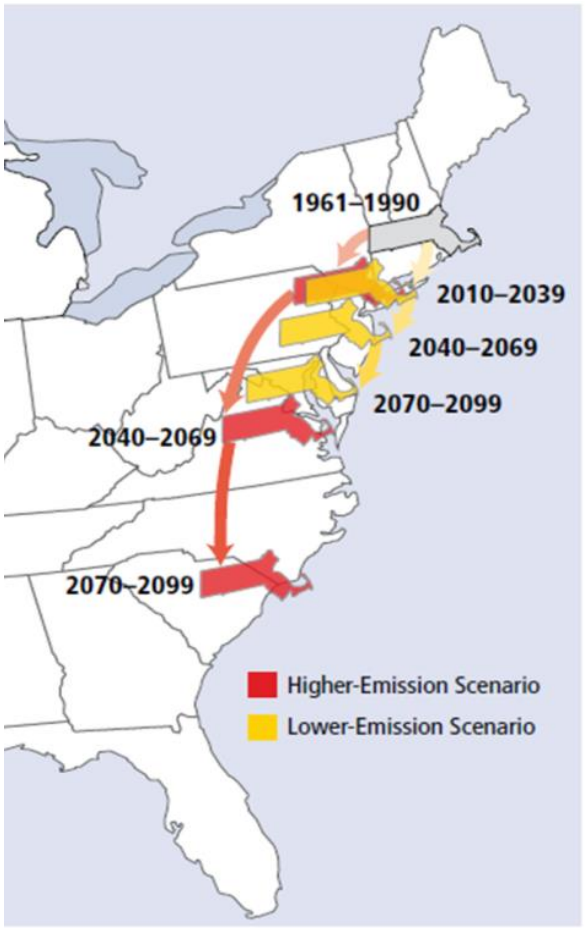
At the other extreme, changes in precipitation patterns and the projected future rising temperatures due to climate change (discussed below) will likely increase the frequency of short-term (one- to three-month) droughts and decrease stream flow during the summer.

Climate Change Impacts: Extreme Heat

Recent temperature trends suggest greater potential impacts to come due to climate change. In the report "Confronting Climate Change in the U.S. Northeast," (2007), the

Union of Concerned Scientists presented temperature projections to 2099 based on two scenarios, one with lower carbon dioxide emissions, and the other with high emissions.

Figure 7 – Mass. Extreme Heat Scenarios



Source: Union of Concerned Scientists

Between 1961 and 1990, Boston experienced an average of 11 days per year over 90°F. That could triple to 30 days per year by 2095 under the low emissions scenario, and increase to 60 days per year under the high emissions scenario. Days over 100°F could increase from the current average of one day per year to 6 days with low emissions or 24 days with high emissions By 2099, Massachusetts could have a climate similar to Maryland's under the low emissions scenario, and similar to the Carolinas' with high emissions (Figure 12). Furthermore, the number of days with poor air quality could quadruple in Boston by the end of the 21st century under higher emissions scenario, or increase by half under the lower emissions scenario. These extreme temperature trends could have significant impacts on public health, particularly for those individuals with asthma and other respiratory system conditions, which typically affect the young and the old more severely.

Land Use and Development Trends

Existing Land Use

The most recent land use statistics available from the state are from aerial photography done in 2005. Table 18 shows the acreage and percentage of land in 20 categories. If the four residential categories are aggregated, residential uses make up 46.92% of the area of the Town (3,561.37 acres). Commercial and industrial uses combined make up 14.01% of the Town, or 1,063.59 acres.

Table 18- 2005 Land Use

Land Use Type	Acres	Percent
Cropland	71.70	0.94%
Pasture	0.00	0.00
Forest	1740.86	22.94%
Non Forested Wetland	165.17	2.18%
Mining	43.77	0.58%
Open Land	255.80	3.37%
Participation Recreation	128.63	1.69%
Spectator Recreation	0.00	0.00
Water Recreation	0.00	0.00
Multifamily Residential	109.50	1.44%
High Density Residential	20.46	0.27%
Medium Density Residential	3240.18	42.69%
Low Density Residential	191.23	2.52%
Commercial	480.40	6.33%
Industrial	583.19	7.68%
Urban Open	249.94	3.29%
Transportation	246.04	3.24%
Waste Disposal	0.00	0.00
Water	62.33	0.82%
Woody Perennial	0.00	0.00
Totals	7,589.22	100.00%

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

Burlington is commonly known as a shopping and entertainment destination, with the Burlington Mall and surrounding stores drawing visitors from beyond the Town's

borders. Yet its prime location at the junction of Route 128 and 3, and its large office and industrial parks, also make Burlington one of the
principal economic centers of the region. As mentioned, approximately 37,000 workers commute daily to their jobs in Burlington. The Town has a diverse mix of occupations that generally pay 20% more than the regional average. The largest employment sectors are information technology, health care, retail, manufacturing and wholesale trade. Below is a list of the top employers, most of which are clustered in the southern section of Burlington along Routes 128 and 3. More specifically, they are located within one-half mile of either side of Route 128 and one-half mile to the east of Route 3.

Figure 6
Major Employers in Burlington*

Company	Address	# of Employees
Lahey Clinic	41 and 31 Mall Road 63 South Avenue	3500
Oracle/Sun Microsystems	10 Van de Graaff Drive and Network Drive	2550
Siemens-Nixdorf	200 Wheeler Road 24 New England Executive Park	1500
Town of Burlington	Various locations	800
Avid	Network Drive	700
Raytheon	7 Van de Graff Drive	600
Burlington Mall	Corner of Middlesex Turnpike & Burlington Mall Road	550
Nuance	Wall Street and Wayside Road	500
FAA	12 & 16 New England Executive Park	385
Lightbridge	30 Corporate Drive	300

**Includes only companies with 300 or more employees*
Planning Department data

(2011 Burlington Open Space and Recreation Plan)

Historic, Cultural, and Natural Resource Areas

The most significant conservation areas in Burlington include Sawmill Brook, Little Brood, Mill Pond and Vine Brook. In addition there other important natural resource areas including the Landlocked Forest/ Parcel, and the Mary Cummings Park/City of Boston Parcel. The Landlocked Forest/Parcel is a 270-arce parcel located southwest of Route 3 and is the largest remaining natural resource area in Burlington. It includes a number of wetlands, provides excellent wildlife habitat and has hiking trails that connect with trails in Lexington and Bedford. The Mary Cummings Park of 140-acres, also known as the City of Boston Parcel, is located along the Town's southern boundary with Woburn. It was bequeathed to Boston by Mary Cummings in 1929 under the condition that the land would be kept as "a public pleasure ground."

Other well-known natural resource, cultural and historic areas include:

- Mill Pond Reservoir
- Town Common
- Hens and Chicken Tavern/John Wynn House
- Isaiah Reed House
- Major General John Walker House
- Burlington Public Library
- Marian Tavern and Grandview Farm
- Burlington Historical Museum
- Old Burying Ground
- Woburn Second Parish Meeting House
- The West School
- Francis Wyman House
- Several pre-historic archaeological sites.

(2011 Burlington Open Space and Recreation Plan)

Development Trends

Burlington was once a quiet, agricultural community prior to the 1950's as it did not have railroad connections and did not experience significant development until the construction of Routes 3 and 128. This transformed the Town into what is now a largely built out, busy commercial suburb. Building out has greatly increased problems with stormwater runoff and flooding as about 10% much of the Town consists of low lying, wetland areas and water bodies. Consisting largely of single family homes along with commercial and industrial space, Burlington has amended its zoning over the last several years to include a wider variety of housing types.
(2011 Burlington Open Space and Recreation Plan)

Development trends throughout the metropolitan region are tracked by MAPC's Development Database, which provides an inventory of new development over the last decade. The database tracks both completed developments and those currently under construction. The database includes eighteen developments in the Town of Burlington since 2008, of which ten are completed and eight were under construction or planned for beyond 2015.

The database also includes several attributes of the new development, including site acreage, housing units, and commercial space. The developments in Burlington include a total of 854 housing units, 4,470,300 square feet of commercial space, and are sited on a total of 394 acres (see Table 20).

In order to characterize any change in the Town's vulnerability associated with new developments, a GIS mapping analysis was conducted which overlaid the development sites with the FEMA Flood Insurance Rate Map. The analysis shows that portions of three of the developments, Sun Campus, Greenleaf Way and New England Executive Park, are located within a flood zone.

Potential Future Development

MAPC consulted with Town planning staff to determine areas that may be developed in the future, based on the Town's comprehensive planning efforts and current trends and projects. These areas are described below.

A. **Sun Campus: Network Drive at Northwest Park (Planned Development District** Zoning): 135,000 SF of 180,000 SF has been built out. Former vacant parcel will be built out with new Nordblooms- not yet started

B. **Greenleaf Way- part of Northwest Park PDD- assisted living and daycare facilities** Primrose School Daycare, 180 kids, built in 2013; includes Stonebridge at Burlington assisted living: 135 units, built in 2012

C. **53 and 63 South Avenue (Keurig)-** 600,00 SF, two phase project approved in 2010, part of South Avenue PDD project, approved in 2010

D. **90 Middlesex Turnpike**- 38,000 SF retail mall; redevelopment of former car dealership-built

E. **New England Executive Park**-National Development owns; redevelopment of former office park into 190 room hotel, 330,000 SF of retail/office/ two parking garages- built

F. **Lahey Hospital**- adding a cancer clinic and new emergency room, permitted but not built

G. **682 VanderGraff Drive-** Oracle (green field development): 49 acres, 125,00O SF office and 762 parking spaces in 4 level parking garage- permitted

H. **Burlington Woods Office Park, Building 4-** 100,000 SF office, under construction

I. **Mercedes of Burlington**- 5.3 acres, 50,000 SF building, under construction

J. **Former Building 19 site**- 6 acres, probable mixed use, not yet permitted

K. **George Costas Research**- Federal Homeland Security site, research buildings, 70,000 SF, permitted

Table 19- Relationship of Potential Development to Hazard Areas

Parcel	Flood Zone	Landslide Risk
A. Sun Campus	2.13% in AE: 1% Annual Chance of Flooding, with BFE , and 0.56% in AE: Regulatory Floodway , and 5.98% in X: 0.2% Annual Chance of Flooding	Low incidence
B. Greenleaf Way	28.07% in AE: 1% Annual Chance of Flooding, with BFE , and 9.23% in AE: Regulatory Floodway , and 43.76% in X: 0.2% Annual Chance of Flooding	Low incidence
C. 53 and 63 South Avenue	No	Low incidence
D. 90 Middlesex Turnpike	No	Low incidence
E. New England Executive Park:	0.32% in AE: 1%	Low incidence

	Annual Chance of Flooding, with BFE , and 3.99% in AE: Regulatory Floodway , and 21.65% in X: 0.2% Annual Chance of Flooding	
F. Lahey Hospital	No	Low incidence
G. 682 Vander Graff Drive	No	Low incidence
H. Burlington Woods Office Park	No	Low incidence
I. Mercedes of Burlington	No	Low incidence
J. Former Building 19 site	No	Low incidence
K. George Costas Research	No	Low incidence

Table 20- Summary of Burlington Developments 2008-2015

DEVELOPMENTS COMPLETED 2008-2015	Acres	HOUSING UNITS	COMMERCIAL (SQ FEET)	PROJECT TYPE
Middlesex Marketplace	12.31	0	38600	
Arborpoint - Seven Springs	70	444	0	Housing
Palomar - Network Drive at Northwest Park	4	0	180000	Office/R&D
5 Wall Street	17.67	0	170000	Office
Wayside Commons 2 Wayside Road, formerly Raytheon	16	0	190200	lifestyle center (retail and restaurant)
8 Van de Graaff Drive - Oracle	23.9	0	420000	Office
Burlington Mall Expansion	2	0	246000	retail/ restaurant
The Village at Burlington Commons - 141 Cambridge Street	0.5	8	0	Housing
Lahey Clinic Expansion	0	0	331000	Hospital
Hillview-129 Cambridge Street	0.5	7	0	Housing
SUBTOTAL	146.88	459	1575800	
UNDER CONSTRUCTION/PLANNED				
NorthWest Park Redevelopment; Middlesex Turnpike and Second Avenue	127	300	1500000	office, retail, hotel
78 Blanchard Rd	4.4	0	120000	Office
Winn Street Commons 265 Winn Street	0.8	12	0	Housing: One more Townhouse to build
36 Muller Rd Planned Development District	15	83	150000	Housing
400 Wheeler Rd	24	0	250000	office and retail
South Avenue PDD	16	0	545000	R&D/ Restaurant
NEEP Renovations and Expansion	60	0	329500	
Total	394.08	854	4470300	

Critical Infrastructure in Hazard Areas

Critical infrastructure includes facilities that are important for disaster response and evacuation (such as emergency operations centers, fire stations, water pump stations, etc.) and facilities where additional assistance might be needed during an emergency (such as nursing homes, elderly housing, day care centers, etc.). There are facilities identified in Burlington. These are listed in Table 21 and are shown on the maps in Appendix B.

Explanation of Columns in Table 21

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

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

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

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

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

Column 6: 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 7.Brush Fires- Areas determined by Local Hazard Mitigation Team to be at risk for brush fires.

Table 21
Critical Facilities and Relationship to Hazard Areas

ID	NAME	TYPE	Landslides	FEMA\ Flood Zone	Locally Identified Area of Flooding	Average Annual Snow Fall-inches	Brush Fires
48-004	Department of Public Works Highway Barn	Municipal Office	Low incidence	No	No	H 48.1 - 72.0	0
48-005	State Highway Department Salt Barn	Municipal Office	Low incidence	No	No	H 48.1 - 72.0	0
48-006	Mill Pond Water Treatment Plant	Water Treatment Facility	Low incidence	No	Mill Pond Dam	H 48.1 - 72.0	0
48-007	Vine Brook Water Plant	Water Treatment Facility	Low incidence	X: 0.2% Annual Chance of Flooding	No	H 48.1 - 72.0	0
48-008	Bedford Street Sewer Pump Station	Sewer Pumping Station	Low incidence	AE: 1% Annual Chance of Flooding; with BFE	No	H 48.1 - 72.0	0
48-009	29 Douglas Avenue Sewer Pump Station	Sewer Pumping Station	Low incidence	No	No	H 48.1 - 72.0	0
48-010	Wilmington Road Sewer Pump Station	Sewer Pumping Station	Low incidence	No	No	H 48.1 - 72.0	0
48-011	Brookside Sewer Pump Station	Sewer Pumping Station	Low incidence	No	No	H 48.1 - 72.0	0
48-012	Westwood Street Sewer Pump Station	Sewer Pumping Station	Low incidence	No	No	H 48.1 - 72.0	0
48-013	Lexington Street Sewer Pump Station	Sewer Pumping Station	Low incidence	AE: 1% Annual Chance of Flooding; with BFE	No	H 48.1 - 72.0	0

Table 21
Critical Facilities and Relationship to Hazard Areas

ID	NAME	TYPE	Landslides	FEMA\ Flood Zone	Locally Identified Area of Flooding	Average Annual Snow Fall-inches	Brush Fires
48-014	Lucya Road Sewer Pump Station	Sewer Pumping Station	Low incidence	AE: 1% Annual Chance of Flooding; with BFE	No	H 48.1 - 72.0	0
48-015	Town Line Road Sewer Pump Station	Sewer Pumping Station	Low incidence	No	No	H 48.1 - 72.0	0
48-016	Keans Road Sewer Pump Station	Sewer Pumping Station	Low incidence	No	No	H 48.1 - 72.0	0
48-017	Tom Irwin, Inc	Hazardous Materials	Low incidence	X: 0.2% Annual Chance of Flooding	No	H 48.1 - 72.0	0
48-018	Herb Chambers	Hazardous Materials	Low incidence	No	No	H 48.1 - 72.0	0
48-019	Verizon	Hazardous Materials	Low incidence	No	No	H 48.1 - 72.0	0
48-020	Verizon	Hazardous Materials	Low incidence	No	No	H 48.1 - 72.0	0
48-021	Pool & Patio Inc	Hazardous Materials	Low incidence	No	No	H 48.1 - 72.0	0
48-022	Burlington Fire Department	Hazardous Materials	Low incidence	No	No	H 48.1 - 72.0	0
48-023	Mill Pond Water Treatment Plant	Hazardous Materials	Low incidence	No	Mill Pond Dam	H 48.1 - 72.0	0
48-024	Vine Brook Water Plant	Hazardous Materials	Low incidence	X: 0.2% Annual Chance of Flooding	No	H 48.1 - 72.0	0
48-025	Sun Microsystems	Hazardous Materials	Low incidence	No	No	H 48.1 - 72.0	0
48-026	AEA Inc	Hazardous Materials	Low incidence	No	No	H 48.1 - 72.0	0
48-027	M/A COM	Hazardous	Low incidence	No	No	H 48.1 - 72.0	0

Table 21
Critical Facilities and Relationship to Hazard Areas

ID	NAME	TYPE	Landslides	FEMA\ Flood Zone	Locally Identified Area of Flooding	Average Annual Snow Fall-inches	Brush Fires
		Materials					
48-028	M/A COM	Hazardous Materials	Low incidence	No	No	H 48.1 - 72.0	0
48-029	B&T Construction	Hazardous Materials	Low incidence	No	No	H 48.1 - 72.0	0
48-030	Lahey Clinic	Hospital	Low incidence	No	No	H 48.1 - 72.0	0
48-031	Lahey Clinic	Hazardous Materials	Low incidence	No	No	H 48.1 - 72.0	0
48-032	Police Department	Emergency Operations Center	Low incidence	No	No	H 48.1 - 72.0	0
48-033	Burlington Town Hall	Municipal Office	Low incidence	No	No	H 48.1 - 72.0	0
48-034	Burlington Police Department	Police Station	Low incidence	No	No	H 48.1 - 72.0	0
48-035	Burlington Fire Station #2	Fire Station	Low incidence	X: 0.2% Annual Chance of Flooding	No	H 48.1 - 72.0	0
48-036	Burlington Fire Department Head Quarters	Fire Station	Low incidence	No	No	H 48.1 - 72.0	0
48-037	Burlington Day Care Center	Child Care	Low incidence	X: 0.2% Annual Chance of Flooding	No	H 48.1 - 72.0	0
48-038	Fraser, Carol Day Care	Child Care	Low incidence	No	No	H 48.1 - 72.0	0
48-039	Johnson, Kathleen A. Day Care	Child Care	Low incidence	No	No	H 48.1 - 72.0	0
48-040	Kinder Care Learning Center	Child Care	Low incidence	No	No	H 48.1 - 72.0	0

Table 21
Critical Facilities and Relationship to Hazard Areas

ID	NAME	TYPE	Landslides	FEMA\ Flood Zone	Locally Identified Area of Flooding	Average Annual Snow Fall-inches	Brush Fires
48-041	Knowledge Beginnings	Child Care	Low incidence	No	No	H 48.1 - 72.0	0
48-042	Little Executive Center	Child Care	Low incidence	No	No	H 48.1 - 72.0	0
48-043	Mulberry Child Care and Preschool	Child Care	Low incidence	No	No	H 48.1 - 72.0	0
48-044	North Suburban Family YMCA	Child Care	Low incidence	No	No	H 48.1 - 72.0	0
48-045	Presbyterian Nursery School	Child Care	Low incidence	No	No	H 48.1 - 72.0	0
48-046	Temple Nursery School	Child Care	Low incidence	No	No	H 48.1 - 72.0	0
48-047	Tender Learning Centre	Child Care	Low incidence	No	No	H 48.1 - 72.0	0
48-048	Tender Learning Centre Kids Club	Child Care	Low incidence	No	No	H 48.1 - 72.0	0
48-049	The Children's Circle, Inc.	Child Care	Low incidence	No	No	H 48.1 - 72.0	0
48-050	World Of Learning, Inc.	Child Care	Low incidence	No	No	H 48.1 - 72.0	0
48-051	Abramo, Catherine J. Day Care	Child Care	Low incidence	No	No	H 48.1 - 72.0	0
48-052	Memorial Elementary School	School	Low incidence	No	No	H 48.1 - 72.0	0
48-053	Francis Wyman Elementary	School	Low incidence	No	No	H 48.1 - 72.0	0

Table 21
Critical Facilities and Relationship to Hazard Areas

ID	NAME	TYPE	Landslides	FEMA\ Flood Zone	Locally Identified Area of Flooding	Average Annual Snow Fall-inches	Brush Fires
	School						
48-054	Fox Hill Elementary School	School	Low incidence	No	No	H 48.1 - 72.0	0
48-055	Pine Glen Elementary School	School	Low incidence	No	No	H 48.1 - 72.0	0
48-056	Mount Hope Christian School	School	Low incidence	No	No	H 48.1 - 72.0	0
48-057	Open Bible Academy	School	Low incidence	No	No	H 48.1 - 72.0	0
48-058	Atria Longmeadow Place	Assisted Living	Low incidence	No	No	H 48.1 - 72.0	0
48-059	Sunrise of Burlington	Assisted Living	Low incidence	No	No	H 48.1 - 72.0	0
48-060	Burlington Housing Authority	Elderly Housing	Low incidence	No	No	H 48.1 - 72.0	0
48-061	Main Water Pump Station	Water Pumping Station	Low incidence	AE: 1% Annual Chance of Flooding; with BFE	No	H 48.1 - 72.0	0
48-062	Water Pump Station #3	Water Pumping Station	Low incidence	AE: 1% Annual Chance of Flooding; with BFE	No	H 48.1 - 72.0	0
48-063	Water Pump Station #5	Water Pumping Station	Low incidence	AE: 1% Annual Chance of Flooding; with BFE	No	H 48.1 - 72.0	0
48-064	Water Pump Station #4	Water Pumping	Low incidence	AE: 1% Annual Chance of Flooding; with BFE	No	H 48.1 - 72.0	0

Table 21
Critical Facilities and Relationship to Hazard Areas

ID	NAME	TYPE	Landslides	FEMA\ Flood Zone	Locally Identified Area of Flooding	Average Annual Snow Fall-inches	Brush Fires
		Station					
48-065	Terrace Hall Ave Water Pump Station #1	Water Pumping Station	Low incidence	AE: 1% Annual Chance of Flooding; with BFE	No	H 48.1 - 72.0	0
48-066	Terrace Hall Ave Water Pump Station #2	Water Pumping Station	Low incidence	AE: 1% Annual Chance of Flooding; with BFE	No	H 48.1 - 72.0	0
48-067	Water Pump Station #11	Water Pumping Station	Low incidence	AE: 1% Annual Chance of Flooding; with BFE	No	H 48.1 - 72.0	0
48-068	Water Pump Station # 10	Water Pumping Station	Low incidence	AE: Regulatory Floodway	No	H 48.1 - 72.0	0
48-069	Water Pump Station #7	Water Pumping Station	Low incidence	AE: 1% Annual Chance of Flooding; with BFE	No	H 48.1 - 72.0	0
48-070	Belmont Road Sewer Pump Station	Sewer Pumping Station	Low incidence	No	No	H 48.1 - 72.0	0
48-071	Grandview Avenue Sewer Pump Station	Sewer Pumping Station	Low incidence	No	No	H 48.1 - 72.0	0
48-072	Partridge Lane Sewer Pump Station	Sewer Pumping Station	Low incidence	AE: 1% Annual Chance of Flooding; with BFE	No	H 48.1 - 72.0	0
48-073	Center Street Water Tank	Water Storage Tank	Low incidence	No	No	H 48.1 - 72.0	0
48-074	Greenleaf Mountain Water Tank	Water Storage Tank	Low incidence	No	No	H 48.1 - 72.0	0

Table 21
Critical Facilities and Relationship to Hazard Areas

ID	NAME	TYPE	Landslides	FEMA\ Flood Zone	Locally Identified Area of Flooding	Average Annual Snow Fall-inches	Brush Fires
48-075	Fire Communication Antenna	Communication Tower	Low incidence	No	No	H 48.1 - 72.0	0
48-076	Police Communication Antenna	Communication Tower	Low incidence	No	No	H 48.1 - 72.0	0
48-077	Blanchard Road Water Tank	Water Storage Tank	Low incidence	No	No	H 48.1 - 72.0	0
48-078	Francis Wyman Road Sewer Pump Station	Sewer Pumping Station	Low incidence	No	No	H 48.1 - 72.0	0
48-079	Main Dam	Dam	Low incidence	No	Mill Pond Dam	H 48.1 - 72.0	0
48-080	WellesleyAvenue Water Pump Station	Water Pumping Station	Low incidence	No	No	H 48.1 - 72.0	0
48-081	Robin Lea Water Pump Station	Water Pumping Station	Low incidence	No	No	H 48.1 - 72.0	0
48-082	North Dike	Dam	Low incidence	No	North Dike Mill Pond	H 48.1 - 72.0	0
48-083	South Dike	Dam	Low incidence	X: 0.2% Annual Chance of Flooding	South Dike Mill Pond	H 48.1 - 72.0	0
48-084	NStar Sub Station	Power Substation	Low incidence	No	No	H 48.1 - 72.0	0
48-085	Rte 128@Middlesex Turnpike Bridge	Bridge	Low incidence	No	No	H 48.1 - 72.0	0
48-086	Rte 128@Cambridge Street Bridge	Bridge	Low incidence	No	No	H 48.1 - 72.0	0

Table 21
Critical Facilities and Relationship to Hazard Areas

ID	NAME	TYPE	Landslides	FEMA\ Flood Zone	Locally Identified Area of Flooding	Average Annual Snow Fall-inches	Brush Fires
48-087	Rte 128@Winn Street Bridge	Bridge	Low incidence	No	No	H 48.1 - 72.0	0
48-088	Main Sewer Pump Station	Sewer Pumping Station	Low incidence	AE: Regulatory Floodway	No	H 48.1 - 72.0	0

Vulnerability Assessment

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

Introduction to HAZUS-MH

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

> "HAZUS-MH is a nationally applicable standardized methodology and software program that contains models for estimating potential losses from earthquakes, floods, and hurricane winds. HAZUS-MH was developed by the Federal Emergency Management Agency (FEMA) under contract with the National Institute of Building Sciences (NIBS). Loss estimates produced by HAZUS-MH are based on current scientific and engineering knowledge of the effects of hurricane winds, floods and earthquakes. Estimating losses is essential to decision-making at all levels of government, providing a basis for developing and evaluating mitigation plans and policies as well as emergency preparedness, response and recovery planning.
>
> HAZUS-MH uses state-of-the-art geographic information system (GIS) software to map and display hazard data and the results of damage and economic loss estimates for buildings and infrastructure. It also allows users to estimate the impacts of hurricane winds, floods and earthquakes on populations."

There are three modules included with the HAZUS-MH software: hurricane wind, flooding, and earthquakes. There are also three levels at which HAZUS-MH can be run. Level 1 uses national baseline data and is the quickest way to begin the risk assessment process. The analysis that follows was completed using Level 1 data. Level 1 relies upon default data on building types, utilities, transportation, etc. from national databases as well as census data. While the databases include a wealth of information on the Town of Burlington, 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 22 - Estimated Damages from Hurricanes

	1% Chance	0.2% Chance
Building Characteristics		
Estimated total number of buildings	7,810	
Estimated total building replacement value (2010$)	$ 4,213	
Millions of dollars		
Building Damages		
# of buildings sustaining minor damage	183	1,141
# of buildings sustaining moderate damage	19	219
# of buildings sustaining severe damage	0	7
# of buildings destroyed	0	3
Population Needs		
# of households displaced	3	52
# of people seeking public shelter	0	10
Debris		
Building debris generated (tons)	4,391	14,621
Tree debris generated (tons)	1,179	3,414
# of truckloads to clear building debris	36	197
Value of Damages (Thousands of dollars)		
Total property damage (buildings and content)	$19,450.57	$78,962.79
Total losses due to business interruption	$573.42	$5,878.19

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-23
Estimated Damages from Earthquakes

	Magnitude 5.0	**Magnitude 7.0**
Building Characteristics		
Estimated total number of buildings	7,810	
Estimated total building replacement value (2010 $) Millions of dollars	$4,213	
Building Damages		
# of buildings sustaining slight damage	2,208	115
# of buildings sustaining moderate damage	972	1,176
# of buildings sustaining extensive damage	183	2,168
# of buildings completely damaged	32	4,345
Population Needs		
# of households displaced	242	6,091
# of people seeking public shelter	120	3,089
Debris		
Building debris generated (million tons)	0.09	1.04
# of truckloads to clear debris (@ 25 tons/truck)	3,400	41,680
Value of Damages (Millions of dollars)		
Total property damage	$520.41	$4,932.54
Total losses due to business interruption	$74.66	$646.46

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 Burlington. The riverine module is not a reliable indicator of flooding in densely developed urban areas such as Burlington, where urban drainage systems contribute to flooding even when structures are not within a mapped flood zone In lieu of using HAZUS, MAPC developed a methodology to provide an approximation of flood damages in areas of the Town where structures have been affected in the past.

We estimated the acreage in these areas as 218.54 acres. Burlington is 7,590.4 acres, so the 218.54 acres of impacted areas comprise 2.88 % of Burlington's land area. The number of structures in each flood area was estimated by assuming that if 2.88 % of the land area is affected by flooding, then 2.03 % of the total buildings are also affected. According to HAZUS there are 7,810 structures in Burlington, which HAZUS estimates have an average replacement value of $539,437per structure. Then, as suggested in the FEMA publication, "State and Local Mitigation Planning How-to Guides" (Page 4-13), we calculated a low estimate (assuming 10% of the building is damaged) and a high estimate (assuming up to 50% of the building is damaged). The results, as shown in Table 24, indicate a range of damages from $421.3 million to $2,106.5 million due to flooding.

Table 24 - Estimated Damages from Flooding

Flood Hazard Area with Known Damages in Past	
Estimated Area of Hazard Areas	218.54 acres
Total Burlington Land Area	7,590.4 acres
Hazard Area as % of Total Land Area	2.88 %
Total Structures in Burlington (HAZUS)	7,810
Estimated # of Structures in Hazard Area (2.88 % of total)	225
Estimated Replacement Value of All Structures (HAZUS)	$ 4,213,000,000
Replacement Value Per Building	$539,437
Low Estimate of Potential Flooding Damages (10% Damage) Millions of dollars	$12,137,332
High Estimate of Potential Flooding Damages (50% Damage) Millions of dollars	$60,686,662

V. HAZARD MITIGATION GOALS

The Burlington Local Hazard Mitigation Planning Team reviewed and discussed the goals from the 2008 Hazard Mitigation Plan for the Town of Burlington. The Team modified their 2008 goals to reflect a more inclusive and streamlined approach for this plan update. All of the goals are considered critical for the Town and they are not listed in order of importance.

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

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

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

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

VI. EXISTING MITIGATION MEASURES

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

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

Flooding – Existing Town-wide mitigation

Burlington 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) – Burlington participates in the NFIP with 120 policies in force as of the July 31, 2015. FEMA maintains a database on flood insurance policies and claims. This database can be found on the FEMA website at https://www.fema.gov/policy-claim-statistics-flood-insurance/policy-claim-statistics-flood-insurance/policy-claim-13

The following information is provided for the Town of Burlington:

Flood insurance policies in force (as of July 31, 2015)	120
Coverage amount of flood insurance policies	$36,108,800
Premiums paid	$198,736
Total losses (all losses submitted regardless of the status)	42
Closed losses (Losses that have been paid)	31
Open losses (Losses that have not been paid in full)	0
CWOP losses (Losses that have been closed without payment)	11
Total payments (Total amount paid on losses)	$180,483.45

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.

Street sweeping – The town does a full sweeping of every road in the spring and additional sweeping during the year on an as-needed basis. The town does some of the work on its own and contracts out some of the work. The town has sufficient equipment to handle the work.

Catch basin cleaning – The town cleans out all 3,500 catch basins once a year. In addition, inlet screens are cleaned as needed in advance of storms. This work is done with town resources.

Stream Cleaning: The Town includes regular stream cleaning under its Capital Improvement Program. This reduces siltation and road sand build up, improves water quality and reduces flooding by providing additional water storage capacity.

Zoning Bylaw

Establishment of Districts - Article III of the Zoning Bylaw establishes a 100 Year Flood Plain zoning district. The boundaries of the 100 Year Flood Plain District are shown on the Flood Insurance Rate Maps and the Flood Boundary and Floodway maps dated July 5, 1984 prepared by FEMA.

The 100 Year Flood Plain District includes all areas designated A, AO and A1-A30 on the FIRM maps. The boundaries of the floodway within the Flood Plain District are the floodway boundaries on the FIRM rate map.

The 100 Year Flood Plain District is an overlay district. Any uses allowed in the underlying district are allowed in the Flood Plain District provided that they meet the additional requirements of the Flood Plain District as well as the provisions of the Massachusetts State Building Code dealing with construction in the flood plain.

Requirements for Development in the Floodway – All encroachments including fill, new construction or substantial improvements are prohibited unless the applicant provides certification by a registered engineer that the encroachment will not result in any increase in flood levels during a 100 year flood. Any encroachment permitted within the floodway must also comply with the floodplain requirements of the Massachusetts State Building Code.

Requirements for development within the Flood Plain District.- For all residential buildings, the lowest flood, including the basement, shall be elevated to or above the base flood elevation. For non-residential buildings, all development must either have the lowest floor including the basement elevated to or above the base flood elevation or designed so that the lowest floor is flood - proofed, as certified by a professional engineer. For all development and proposed subdivisions, the utilities shall be located and constructed to minimize flood damage. For all development, fully enclosed areas below the lowest floor that are subject to flooding shall be designed to automatically equalize hydrostatic flood forces on exterior walls. All utilities must be elevated above the base floor elevation or designed to prevent damage from flooding. On-site waste disposal systems shall be located to avoid impairment to them or contamination from flooding.

All manufactured homes shall be installed in such a way as to minimize flood damage. The manufactured home must be elevated so that the lowest floor is at or above the base flood elevation and anchored to resist flotation, collapse or lateral movement. If base flood elevation data is not provided on the FIRM maps, other data may be used subject to review and approval by the Planning Board or Building Inspector.

All applications for permission to develop in the Flood Plain District must be accompanied by sufficient information to permit the appropriate local official to make a

determination. Development may be exempted from the Flood Plain District requirements if the property owner or developer submits documentation that the Federal Government has reevaluated the flood plain designation and concluded that the property is not subject to flooding.

Within the Aquifer and Resource Protection overlay districts not less than forty percent (40%) of the lot shall be landscaped or if wooded, may be left in a natural state.

Section 9.3.4.4 Site Plan Approval submission criteria states that utilities and drainage in the vicinity shall be adequate.

Section 11.6.0 lays out the requirements for a Conservation Subdivision Design proposal. The plan must include an analysis of the site, including wetlands, wetlands zoning district boundaries, water bodies slopes, soil conditions, areas within the 100-year flood, and such other natural features as the Planning Board may request.

Wetlands Bylaw- In 2012, the Town of Burlington Conservation Commission updated Burlington Bylaw Article XIV Section 1.0, also known as the Wetlands Bylaw. Town Meeting approved the updated bylaw on May 20, 2013.

Stormwater Management and Erosion Control Bylaw- Burlington adopted a Stormwater Management Bylaw in 2006, which applies to any activity which alters or disturbs more than 10,000 square feet of land.

Public Education on Stormwater-The Town Conservation Commission maintains a web page on stormwater management and nonpoint source pollution prevention at: http://www.burlington.org/community_development/stormwater_management.php.

Open Space and Recreation Plan – The Town's 2011 Open Space and Recreation Plan identifies the Town's open space areas, as well as properties that could be acquired for open space, which serve a number of different purposes including mitigation of flooding and storm damage. Goal J of the plan is "To Protect Burlington's Water Resources." Objective J-1 is to "Develop strategies for protecting and preserving Burlington's water resources through public education, land acquisition and regulation." Goal K is "Actively manage, maintain and expand conservation areas." Objective K-3 is to "Establish and maintain funding sources for land acquisition" and Objective K-5 is to "Encourage the donation of land and creation of conservation restrictions in town."

Flooding – Existing Site Specific Mitigation

2008 Plan Flooding Areas of Concern mitigation measures

A Street: The Tender Learning and Kinder Academy Daycares installed infiltrator units in 2012 from catch basins and remediated flooding that had been occurring here.

Daniel Drive: The stream impacting this area has been cleaned yearly since 2008; flooding has been reduced and homes in the area are no longer impacted.

Ray Avenue: culverts were upgraded in 2009 and the area no longer floods.

Sears and Winn Streets: drainage was upgraded in 2009 and no longer floods.

Bruce and Alma Streets: Drainage upgrades performed 2009; no longer floods.

Dams

Mill Pond Dam and associated North and South Dikes are earthen dams with concrete core walls which impound Mill Pond Reservoir, a 53 acre pumped storage water supply reservoir for the town of Burlington, Massachusetts. The main dam and dikes were constructed in 1973 along with a water treatment plant located at the downstream toe of the main dam. A new water treatment plant was constructed at the toe of the main dam in 2008, replacing the 1973 plant. Much of the underground piping installed around the plant in 1973 remains in use. A 48 in. pipeline was installed downstream of the toe of the main dam during the 2008 water plant construction to divert the brooks around the newly constructed water plant. The pipes below the reservoir from 1973 remain. The main dam and south dike are classified as High Hazard Potential, Large dams in accordance with Massachusetts Office of Dam Safety regulations. The north dike is classified as Significant Hazard Potential, Large dam. Failure of the main dam or dikes would be expected to cause loss of life and extensive property damage downstream. Phase I Dam Safety evaluation reports were completed by the US Army Corps of Engineers (USACE) in 1980 and again by the Massachusetts DEM, Office of Dam Safety in 1987, 1994 and 1998. A Phase I dam safety inspection of the dam and dikes was also completed in 2006, 2008 and 2010 by the Town of Burlington.

Haley & Aldrich, Inc. visited the site on 22 July 2014 to complete a Phase I visual inspection of the main dam and dikes. Based on visual observation, the dam and dikes are judged to be in satisfactory condition. (*Emergency Action Plan, Mill Pond Dam, Burlington, MA:* Haley and Aldrich, January, 2014)

The 2014 Emergency Action Plan for the Mill Pond Dam includes notification of the Burlington Fire Department in the event of an emergency. The purpose of the Emergency Action Plan (EAP) is to safeguard the lives and reduce property damage of Burlington, Woburn and Wilmington, Massachusetts downstream of the Mill Pond Dam, along Maple Meadow Brook in the event of a breach or impending breach of the dam. The EAP is also employed during periods of unusually high water events that are not expected to result in a dam failure. (*Emergency Action Plan, Mill Pond Dam, Burlington, MA:* Haley and Aldrich, January, 2014)

Existing Wind Hazard Mitigation Measures

Tree-trimming program – The town does not consider downed trees to be a serious problem. The town does not have a tree-trimming program or any equipment to grind stumps and branches. The local utility company does trim and remove dead or diseased trees impacting it electric power distribution lines.

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.

Existing Winter Hazard Mitigation Measures

Roadway treatments – There are no specific measures beyond regular salting and sanding of the roads and local plowing. The town uses almost all sand on the roads and very little salt because of the need to protect the aquifer that supplies the town's drinking water.

Catch basin Cleaning: The Burlington DPW clears snow from clogged catch basins to prevent flooding.

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.

Existing Brush Fire Hazard Mitigation Measures

Permits required for outdoor burning - The Town does allow outdoor burning but a permit is required. In order to obtain a permit, a property owner must call the fire station to discuss the date, time and location of the burning and the materials to be burned.

Subdivision review - The Fire Department is involved in reviewing subdivision plans from conceptual design through occupancy to ensure that there is adequate access for fire trucks and an adequate water supply.

Existing Geologic Hazard Mitigation Measures

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

Section 1612.2.5 sets up seismic hazard exposure groups and assigns all buildings to one of these groups according to 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.

Existing Extreme Temperature Mitigation Measures

Burlington opened a new cooling/warming center in 2011 at 61 Center Street, the Kelley Murray Wing of the Human Services Building, the town's primary emergency shelter, for elderly, disabled and other persons in need of a cooling center during extreme heat waves. The town's Council on Aging keeps a list of elderly and disabled people and contacts them during heat waves and during power outages and heat loss periods during winter storms.

Existing Multihazard Mitigation

Capital Improvement Plan (CIP) allocates funding over a 10 year period, including for stream cleaning and drainage repair, equipment replacement and facilities improvements. Projects that address natural hazard mitigation are listed below.

Stream cleaning and drainage repair 2016 -2025: $200,000 per year

DPW vehicle replacement 2016 -2025: varies by year

Comprehensive Emergency Management Plan (CEMP)

Every community in Massachusetts is required to have a Comprehensive Emergency Management Plan. These plans address mitigation, preparedness, response and recovery from a variety of natural and man-made emergencies. These plans contain important information regarding flooding, hurricanes, tornadoes, dam failures, earthquakes, and winter storms. Therefore, the CEMP is a mitigation measure that is relevant to all of the hazards discussed in this plan. The Town of Burlington's current CEMP was updated in 2014.

Emergency Management

In the Town of Burlington, The Emergency Management Agency is responsible for the coordination of all emergency response disaster operations.

The Fire Chief serves as the Emergency Management Director and the Assistant Fire Chief serves as the Deputy Director.

The Burlington Emergency Management Agency shall be responsible for managing the following:

- All four phases of emergency management which includes preparation, mitigation, response, and recovery.
- Activation and operation of the Burlington Emergency Operations Center (EOC).
- Activation and operation of any local Emergency Shelter.
- Conduct training exercises for local officials involving both natural and man made disasters.

In the event of a natural or manmade disaster:

- Burlington's primary Emergency Operations Center (EOC) is located in the Town Hall Annex basement located at 25 Center Street.
- Burlington's primary Emergency Shelter is located in the Kelley Murray Wing of the Human Services Building located at 61 Center Street.
- Burlington's alternative Emergency Shelter is located in the Burlington High School located at 123 Cambridge Street.

  See the Town web page at
  http://www.burlington.org/departments/emergency_management/index.php

Public Health and Safety

Burlington is a member of Region 4A Medical Reserve Corps (MRC). It was formed to promote public health and safety across the region in three key areas:

1. Public Health Emergencies – events that threaten public health, such as a disease outbreak or toxic chemical release.
2. Mass Casualty Incidents – disasters that cause injury or threats to large numbers of people. These can include a building collapse, fire, storm, flood, or other event that displaces groups of residents that must be moved to emergency shelters.
3. Community Service Activities – opportunities to foster the well-being of local residents; such as health fairs, blood pressure clinics, or training programs.

See the MRC webpage at http://www.region4a-ma.org/About

Natural Hazards Public Education- The Board of Health maintains on how to prepare for extreme cold and how to protect food and water in emergencies.

Table 25- Summary Existing Hazard Mitigation Measures

Hazard	Area	Mitigation Measure	Update/comments
Flooding	Town-wide	Participation in the National Flood Insurance Program (NFIP)	Effective / 120 policies in force
		Massachusetts Building Code	Effective
		Floodplain Conservancy District	Updated /Effective
		Stormwater Management Bylaw and Regulations	Effective
		Street sweeping	Effective
		Catch basin cleaning	
		Zoning: Flood plain district, Wetlands Bylaw and Regulations, Aquifer and Resource Protection districts	Effective
		Stormwater Management Bylaw and Regulations	Effective
		Town cleans & inspects catch basins every other year.	Effective
		Public Education on Stormwater	Effective
		2011 Open Space and Recreation Plan	Effective
		Existing Site Specific Flooding Mitigation	Effective
Dams		Mill Pond Dam Inspection and EAP	Updated/Effective
		DCR dam safety regulations	Effective
		DCR Dam Safety Regulations	Effective
		Emergency Action Plan for Burlington Reservoir Dam	Implementation of EAP: Up to date
Wind	Town-wide	Tree trimming by utility company	Effective
		State Building Code addresses wind standards	Effective for new construction
Winter-Related	Town-wide	Regular snow removal operations and roadway treatments	Effective

Table 25- Summary Existing Hazard Mitigation Measures

Hazard	Area	Mitigation Measure	Update/comments
		Catch basin cleaning to maintain drainage	Effective
		State Building Code addresses snow load standards	Effective for new construction
Fire	Town-wide	Outdoor burning permits	Effective
Fire	Town-wide	Subdivision review	Effective
Extreme Temperatures	Town-wide	Heating and cooling center 2011	Effective
Geologic	Town-wide	State Building Code addresses earthquake standards	Effective for new construction / Town has many older buildings
Multi hazard	Town-wide	Capital Improvement Plan (CIP)	Effective/Up to date
Multi hazard	Town-wide	Comprehensive Emergency Management Plan (CEMP)	Effective/Up to date
Multi hazard	Town-wide	Emergency Management Agency	Effective
Multi-hazard	Town-wide	Extreme cold and food and water protection Public Education	Update with Ready link http://www.ready.gov/
		2015 Master Plan	Add Climate Adaptation to new plan update

Local Capacity for Implementation

The Town of Burlington 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 Burlington Department of Public Works will address the needs for catch basin cleaning, repairs and upgrades to drainage infrastructure. The Town's Planning Board will address the updates to the Master Plan and implementation of the Zoning Ordinance, Floodplain District, and Subdivision Rules and Regulations. The Conservation Commission will oversee implementation of the Wetlands Bylaw and the Open Space Plan. The Department of Public Works together with the Planning Board and Conservation Commission will coordinate implementation and enforcement of the Stormwater Bylaw

VII. MITIGATION MEASURES FROM THE 2008 PLAN

Implementation Progress on the Previous Plan

At a meeting of the Burlington Hazard Mitigation Planning Committee, Town staff reviewed the mitigation measures identified in the 2008 Burlington 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 26 summarizes the status of mitigation measures, and mitigation projects completed are described in more detail below.

Table 26- Mitigation Measures from the 2008 Plan

Mitigation Measure	Priority	Lead Implementation	Current Status	Include in 2016 Plan/Priority
Install stormwater management devices at Thomas, Carol and Susan Streets	High	DPW	Complete: the stream has been cleaned twice since 2008 and is now part of continuing maintenance under CIP.	No
Upgrade drainage at Sears and Winn Streets	High	DPW	Completed: drainage upgraded in 2009 and no longer floods.	No
Install stormwater management devices at Sandy Brook Road	High	DPW	Not completed	Yes: High
Coordinate with Bedford on improvements to Wilson Mill Dam (Network Drive flood area)	High	Conservation Commission, DPW	Completed: Bedford improved the dam and backflow preventers were installed to prevent backup.	No
Purchase a brush fire truck	High	Burlington Fire Department	Complete: New 4x4 brush fire truck purchased in 2013.	No

Mitigation Measure	Priority	Lead Implementation	Current Status	Include in 2016 Plan/Priority
Undertake a drainage study of the Great Meadow/Vine Brook area	High	DPW	Not completed: no plan to do study as the area is very low lying and hard to mitigate and mostly impacts backyards and not road or homes.	No
Clean drain pipes at the Mill Pond Dam	High	DPW	Completed: the pipes are cleaned every two years.	No
Acquire land along Sandy Brook.	Medium	Conservation Commission	Not completed	Yes: Medium
Restore wetlands at Burlington High School	Medium	Conservation Commission	Completed: The high school practice field was elevated and the wetlands were restored in 2013.	No
Install stormwater management devices at Wyman Street	Medium	DPW	Not completed: only one home is impacted.	No
Maintain access roads into wooded areas for fire fighting	Medium	Fire Department	Completed: Boy Scouts cleared the roads in 2009.	No
Install a drainage system at Nelson and Hershey Streets	Low	DPW	Not completed: only one house impacted	No
Stream cleaning at Stewart and Wilmington Streets	Low	Conservation Commission	Not completed	Not specifically but will be addressed through CIP stream cleaning.

Burlington has made considerable progress on implementing mitigation measures identified in the 2008 Hazard Mitigation Plan. Among the most significant projects, the installation of stormwater management devices at Thomas, Carol and Susan Streets and the drainage upgrades at Winn and Sears Streets were completed. The Town coordinated with Bedford to install backflow preventers and has incorporated drainage system upgrades and stream cleaning into a comprehensive and ongoing capital improvement planning and implementation process. The Town also adopted a stormwater bylaw and regulations, updated their wetlands bylaw and regulations, purchased a new brush fire truck and improved their fire road access.

Overall, two mitigation measure from the 2008 plan will be continued in the plan update. The Town will continue to try and acquire land along Sandy Brook and install stormwater management devices at Sandy Brook Road. Stream cleaning at Stewart and Wilmington Streets will be included under the Capital Improvements drainage/stream cleaning program.

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

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

VIII. HAZARD MITIGATION STRATEGY

What is Hazard Mitigation?

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

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

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

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

Regional and Inter-Community Considerations

Some hazard mitigation issues are strictly local. The problem originates primarily within the municipality and can be solved at the municipal level. Other issues are inter- community

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

Regional Partners

In the densely developed communities of the study area, mitigating natural hazards, particularly flooding, is more than a local issue. The drainage systems that serve these communities are a complex system of storm drains, roadway drainage structures, pump stations and other facilities owned and operated by a wide array of agencies including but not limited to the Town of Burlington, the Department of Conservation and Recreation (DCR), the Massachusetts Water Resources Authority (MWRA), Massachusetts Highway Department (MHD) and the Massachusetts Bay Transportation Authority (MBTA). The planning, construction, operations and maintenance of these structures are integral to the flood hazard mitigation efforts of communities. These agencies must be considered the communities regional partners in hazard mitigation. These agencies also operate under the same constraints as communities do including budgetary and staffing constraints and numerous competing priorities. In the sections that follow, the plan includes recommendations for activities to be undertaken by these other agencies. Implementation of these recommendations will require that all parties work together to develop solutions.

Inter-Community Considerations

Mill Pond Dam Failure and its potential impact on Wilmington - If the Mill Pond Dam burst, there would be a greater threat to the Town of Wilmington than there would be for Burlington. The Emergency Action Plan for the Mill Pond Dam includes notification of the Wilmington Fire Department in the event of an emergency. Once that notification has been made, the Town of Wilmington is responsible for notifying residents. Any necessary evacuations are also the responsibility of the Town of Wilmington. The plan includes a "Resident Evacuation/Notification Table which lists 17 residences on Main Street, 6 on Butters Row, 6 on Factory Street, one business on Eames Street and 27 residences on Chestnut Street

Process for Setting Priorities for Mitigation Measures

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

Priority setting was based on local knowledge of the hazard areas, including impacts of hazard events, the extent of the area impacted, and the relation of a given mitigation measure to the City's goals. In addition, the local Hazard Mitigation Planning Team also took into consideration factors such as the number of homes and businesses affected, whether or not road closures occurred and what impact closures had on delivery of emergency services and the local economy, anticipated project costs, whether any environmental constraints existed, and whether the Town would be able to justify the costs relative to the anticipated benefits.

Table 27 below demonstrates the prioritization of the Town's potential hazard mitigation measures. For each mitigation measure, the geographic extent of the potential benefiting area is identified as is an estimate of the overall benefit and cost of the measures. The benefits, costs, and overall priority were evaluated in terms of:

Estimated Benefits

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

Estimated Costs

High	Estimated costs greater than $100,000
Medium	Estimated costs between $10,000 to $100,000
Low	Estimated costs less than $10,000 and/or staff time

Priority

High	Action very likely to have political and public support and necessary maintenance can occur following the project, and the costs seem reasonable considering likely benefits from the measure
Medium	Action may have political and public support and necessary maintenance has potential to occur following the project
Low	Not clear if action has political and public support and not certain that necessary maintenance can occur following the project

Table 27- Mitigation Measure Prioritization

Mitigation Action	Geographic Coverage	Estimated Benefit	Estimated Cost	Priority
Flood Hazard Mitigation				
1.Install stormwater management devices at Sandy Brook Road	Sandy Brook Road	Medium	High	High
2. Acquire land along Sandy Brook	Sandy Brook floodplain	High	High	Medium
3. Implement Stream Cleaning and Drainage Repair under CIP	Town-wide	High	High	High
Wind Mitigation Measures				
4. Public Education on Wind mitigation, residents/businesses	Town-wide	High	Low	Medium
Brushfire Mitigation				
5. Increase brush fire risk awareness by offering GIS hazard mapping online for Burlington residents and interested parties.	Town-wide	High	Low	Medium
6. Organize fire department tours to show town officials and residents the most vulnerable areas for brushfires and increase their knowledge of the risks.	Town-wide	High	Low	Medium
Winter Storm Hazard Mitigation				
7. Evaluate public buildings for ability to withstand snow loads; retrofit if needed to greatest degree feasible.	Town-Wide	Medium	Low	Low
8. Assist vulnerable populations by identifying specific at-risk populations that may be exceptionally vulnerable during long term power outages.	Town-Wide	Medium	Low	Medium
Earthquake Mitigation				
9. Determine which buildings may be most vulnerable to earthquake damage and conduct a structural assessment if needed.	Town-Wide	Medium	Low	Low
10.Assess the vulnerability of	Localized	Low	Low	Low

Table 27- Mitigation Measure Prioritization

Mitigation Action	Geographic Coverage	Estimated Benefit	Estimated Cost	Priority
roadways and utilities in high liquefaction susceptibility areas				
Dam Mitigation				
11. Update the Emergency Action Plan for the Mill Pond Reservoir Dam spillway area every two years	Burlington Reservoir spillway area	Medium	Medium	High
Extreme Temperature Mitigation				
12. Site Design to increase tree plantings near buildings, increase the percentage of trees used in parking areas, and along public ways.	Town-Wide	Medium	Medium	Medium
13. Promote Green Building and Cool Roof designs	Town-Wide	Medium	Low	Medium
14. Assess placement of cooling centers at schools, senior center and emergency shelters.	Town-wide	Medium		High
Drought Mitigation				
15. Promote drought tolerant landscaping and site design measures	Town-Wide	Medium	Low	Medium
Climate Resilience/Adaptation				
16. Incorporate climate resilience/adaptation components into the next Comprehensive Plan	Town-Wide	High	Medium	High

Potential Mitigation Measures

The potential mitigation measures are provided in this section and summarized in Table 28.

Flooding, Drainage Infrastructure, and Dams

Install stormwater management devices at Sandy Brook Road; carried forward from 2008.

Acquire land along Sandy Brook to increase flood storage capacity in the floodplain; carried forward from 2008.

Implement Stream Cleaning and Drainage Repair under the Town's 10-year Capital Improvement Program.

Update the Emergency Action Plan for the Burlington Reservoir Dam spillway area every two years- An update of the EAP was completed in 2014.

Wind Hazards

Public Education on Wind mitigation, residents/businesses- The Town has a webpage with links to food and water protection and extreme cold mitigation measure but with wind hazards increasing, it should implement further wind awareness and public education by expanding the web page to include links to wind mitigation and offering public education on wind hazard preparedness actions.

Fire Hazards

The Town should increase brush fire risk awareness by:
1) Offering GIS hazard mapping online for Burlington residents and interested parties and;
2) By organizing fire department tours to show town officials and residents the most vulnerable areas for brushfires and increase their knowledge of the risks.

Winter Hazards

Evaluate public buildings for ability to withstand snow loads; retrofit if needed to greatest degree feasible.

Assist vulnerable populations by identifying specific at-risk populations that may be exceptionally vulnerable during long term power outages.

Earthquakes

Earthquake building assessment—Determine which buildings may be most vulnerable to earthquake damage and conduct a structural assessment if needed.

Earthquake infrastructure assessment— Assess the vulnerability of roadways and utilities in high liquefaction susceptibility areas.

Extreme Temperatures

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

Promote guidelines for Green Building and Cool Roof designs.

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

Drought

Promote guidelines for drought tolerant landscaping and site design measures.

Climate Change

Incorporate climate resilience/adaptation components into the Town's current update of its Master Plan .

Introduction to Potential Mitigation Measures Table (Table 28)

Description of the Mitigation Measure – The description of each mitigation measure is brief and cost information is given only if cost data were already available from the community. The cost data represent a point in time and would need to be adjusted for inflation and for any changes or refinements in the design of a particular mitigation measure.

Priority – As described above and summarized in Table 28, the designation of high, medium, or low priority was done considering potential benefits and estimated project costs, as well as other factors in the STAPLEE analysis.

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

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

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

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

> Army Corps of Engineers (ACOE) – The website for the North Atlantic district office is http://www.nae.usace.army.mil/. The ACOE provides assistance in a number of types of projects including shoreline/stream bank protection, flood damage reduction, flood plain management services and planning services.

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

Abbreviations Used in Table 28

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

ACOE = Army Corps of Engineers.
DHS/EOPS = Department of Homeland Security/Emergency Operations
DEP (SRF) = Department of Environmental Protection (State Revolving Fund)
USDA = United States Department of Agriculture
Mass DOT = Massachusetts Department of Transportation
DCR = MA Department of Conservation and Recreation
CIP= Capital Improvement Program
HMPT=Hazard Mitigation Planning Team
EM=Emergency Management

Table 28 – Potential Mitigation Measures					
Mitigation Measure	**Priority**	**Lead Implementation**	**Time Frame**	**Estimated Cost**	**Potential Funding Sources**
FLOODING/DAMS					
1. Install stormwater management devices at Sandy Brook Road	High	Public Works	Short Term 2015- 2016	Medium $50,000	CIP 2015- 2025
2. Acquire land along Sandy Brook	Medium	Public Works	Long Term 2015- 2020	Medium $55,000	Town operating budget or bond
3. Implement Stream and Drainage Repair under CIP	High	Public Works	Long Term 2015-2020	$200,000/ year High	CIP 2015-2025
4. Update the Emergency Action Plan for the Mill Pond Reservoir Dam spillway area every two years	High	Public Works	Medium Term 2016-2017	Medium $50,000	Town operating budget
WIND RELATED HAZARDS					
5.Public Education on Wind mitigation, residents/businesses	Medium	HMPT/ Health	Long Term 2015-2020	Low Staff time	Town operating budget
BRUSHFIRES					
6. Offer GIS hazard mapping online for Burlington residents and interested parties.	Medium	Fire/EM	Medium Term 2016-2017	Low Staff time	Town operating budget
7. Organize fire department tours to show town officials and residents the most vulnerable areas for brushfires and increase their knowledge of the risks	Medium	Fire/EM	Medium Term 2016-2017	Low Staff time	Town operating budget
WINTER STORMS					
8. Evaluate public buildings for ability to withstand snow loads; retrofit if needed to greatest degree feasible.	Low	Building/HMPT	Long Term 2015-2020	Low	Staff time / Town operating budget

Table 28 – Potential Mitigation Measures					
Mitigation Measure	**Priority**	**Lead Implementation**	**Time Frame**	**Estimated Cost**	**Potential Funding Sources**
9. Assist vulnerable populations by identifying specific at-risk populations that may be exceptionally vulnerable during long term power outages.	Medium	Public Works	Medium Term 2016-2017	Low Staff time	Town general operating budget
EARTHQUAKES					
10. Determine which buildings may be most vulnerable to earthquake damage and conduct a structural assessment if needed.	Low	Building/HMPT	Long Term 2015-20120	Low	Staff time / Town general operating budget
11.Assess the vulnerability of roadways and utilities in high liquefaction susceptibility areas	Low	Public Works/HMPT	Long Term 2015-2020	Low	Staff time / Town general operating budget
EXTREME TEMPERATURES					
12. Site Design to increase tree plantings near buildings, increase the percentage of trees used in parking areas, and along public ways.	Medium	Planning / Conservation	Long Term 2015-2020	Low	Staff time / Town general operating budget
13. Promote Green Building and Cool Roof designs	Medium	Building/Planning	Long Term 2015-2020	Low	Staff time / Town general operating budget
14. Assess placement of cooling centers at schools, senior center and emergency shelters.	High	Fire/HMPT	Short Term 2015-2016	Low	Staff time / Town general operating budget

Table 28 – Potential Mitigation Measures					
Mitigation Measure	**Priority**	**Lead Implementation**	**Time Frame**	**Estimated Cost**	**Potential Funding Sources**
DROUGHT					
15. Promote drought tolerant landscaping and site design measures	Medium	Planning / Conservation	Long Term 2015-2020	Low	Staff time / Town general operating budget
CLIMATE RESILIENCE / ADAPTATION					
16. Incorporate climate resilience/adaptation components into the next Comprehensive Plan	High	HMPT/Planning/ Conservation/ Public Works/ Public Health	Long Term 2015-2020	Medium	Town general operating funds / Staff time

IX. PLAN ADOPTION AND MAINTENANCE

Plan Adoption

The Burlington Hazard Mitigation Plan 2016 Update was adopted by the Board of Selectmen on June 13, 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 and integrate it with other Town planning processes. 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 Burlington Hazard Mitigation Planning Team to prepare this plan. After approval of the plan by FEMA, this group will meet on a regular basis, at least annually, to function as the Hazard Mitigation Implementation Team, with the Commissioner of Public Works designated as the coordinator. Additional members could be added to the local implementation team from businesses, non-profits and institutions. The Town will encourage public participation during the next 5-year planning cycle. As updates and a review of the plan are conducted by the Hazard Mitigation Implementation Team, these will be placed on the Town's web site, and any meetings of the Hazard Mitigation Implementation Team will be publicly noticed in accordance with Town and state open meeting laws.

Implementation and Evaluation Schedule

Mid-Term Survey on Progress– The coordinator of the Hazard Mitigation Implementation Team will prepare and distribute a survey in year three of the plan. The survey will be distributed to all of the local implementation group members and other interested local stakeholders. The survey will poll the members on any changes or revisions to the plan that may be needed, progress and accomplishments for implementation, and any new hazards or problem areas that have been identified.

This information will be used to prepare a report or addendum to the local hazard mitigation plan in order to evaluate its effectiveness in meeting the plan's goals and identify areas that need to be updated in the next plan. The Hazard Mitigation Implementation Team, coordinated by the Commissioner of Public Works, will have primary responsibility for tracking progress and updating the plan.

Begin to Prepare for the next Plan Update -- Given the lead time needed to secure funding and conduct the planning process, the Hazard Mitigation Implementation Team will begin to prepare for an update of the plan in year three. The team will use the

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

Prepare and Adopt an Updated Local Hazard Mitigation Plan – FEMA's approval of this plan is valid for five years, by which time an updated plan must be approved by FEMA in order to maintain the Town's approved plan status and its eligibility for FEMA mitigation grants. Once the resources have been secured to update the plan, the Hazard Mitigation Implementation Team may decide to undertake the update themselves, contract with the Metropolitan Area Planning Council to update the plan or to hire another consultant. However the Hazard Mitigation Implementation Team decides to update the plan, the group will need to review the current FEMA hazard mitigation plan guidelines for any changes. The Burlington Hazard Mitigation Plan Update will be forwarded to MEMA and DCR for review and to FEMA for approval.

Integration of the Plans with Other Planning Initiatives

Upon approval of the Burlington Hazard Mitigation Plan 2016 Update by FEMA, the Local Hazard Mitigation Team will provide all interested parties and implementing departments with a copy of the plan and will initiate a discussion regarding how the plan can be integrated into that department's ongoing work. At a minimum, the plan will be reviewed and discussed with the following departments:

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

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

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

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X. LIST OF REFERENCES

Burlington Capital Improvement Program, FY 2015 – 2026

Burlington Comprehensive Emergency Management Plan, 2014

Open Space and Recreation Plan for the Town of Burlington,
Burlington Conservation Commission, 2011

Emergency Action Plan, Mill Pond Dam, Burlington
Norman Lavigne, Water Quality Production Manager
Town of Burlington DPW, 25 Center Street, Burlington
January, 2014

Burlington Town By-Laws

Burlington Zoning By-Law

Burlington Subdivision Regulations

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

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

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

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

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

MA Office of Dam Safety, Inventory of Massachusetts Dams

Metropolitan Area Planning Council, Geographic Information Systems Lab

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

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

NOAA, National Climatic Data Center, website

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

USGS, National Water Information Center, website

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APPENDIX A

HAZARD MITIGATION PLANNING TEAM MEETING AGENDAS

Meeting Agenda
Local Natural Hazard Mitigation Plan
Town of Burlington, Town Hall Annex
June 19, 2014, 10:00 – 11:30 AM

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1) Welcome and Introductions

2) Overview Presentation on Hazard Mitigation Planning

- Questions and discussion

3) Review of Project Scope (See attached summary)

1. Planning Process and Community Participation
2. Hazard Identification, Critical Facilities, and Vulnerability Analysis
3. Assessment of Existing Mitigation Measures
4. hazard Mitigation Strategies
5. Local Hazard Mitigation Plan Maintenance
6. Local hazard Mitigation Plan Adoption and Approval

4) Local Team Meeting #1 (Information Gathering) – Fall 2014

a) Hazard Mitigation Planning Map Series and Digitized Ortho Photo Map
b) Identify Critical Facilities
c) Identify local hazards:
   i) Flood Hazard Areas
   ii) Fire Hazard Areas (brushfires./ wildfires)
   iii) Dams
   iv) Future Potential Development Areas
d) Review Plan Goals and Objectives
e) Discuss Public Involvement and Outreach
   i) Identify local stakeholders
   ii) Schedule first public meeting

5) Local Team Meeting #2 (Analysis and Review) – Spring 2015

a) Review and finalize Critical Facilities
b) Review and finalize local hazard identification
c) Review vulnerability analysis
d) Review Existing Mitigation Measures
e) Discuss Potential Mitigation Measures

6) Local Team Meeting #3 (Recommendations and Draft Plan) – Mid-2015

a) Review and finalize Potential Mitigation Measures
b) Prioritize Potential Mitigation Measures
c) Review draft plan
d) Schedule 2nd Public Meeting and outreach to stakeholders

7) Next Steps/Adjourn

Meeting Agenda
Local Natural Hazard Mitigation Plan
Town of Burlington, Town Hall Annex
October 1, 2014, 10:00 AM – 12:00 PM

Local Team Meeting #1 (Information Gathering)

a) Hazard Mitigation Planning Map Series and Digitized Ortho Photo Map
b) Review 2008 mitigation actions
c) Identify Critical Facilities
d) Identify local hazards:
   i) Flood Hazard Areas
   ii) Fire Hazard Areas (brushfires/wildfires)
   iii) Dams
   iv) Ice jams
   v) Thunderstorms
   vi) Drought
   vii) Extreme Temps
   viii) Tornadoes
   ix) High winds
   x) Snow and Blizzards
   xi) Ice storms
   xii) Earthquakes
   xiii) Landslides
   xiv) Future Potential Development Areas

e) Review Plan Goals and Objectives- see over

f) Discuss Public Involvement and Outreach
   i) Identify local stakeholders
   ii) Schedule first public meeting
g) Identify draft priority projects and funding for update

Project Overview - MAPC received a grant to prepare natural hazards *Pre-Disaster Mitigation Plan* for the communities of Burlington, Dover, Hanover, Holliston, Burlington, Marlborough and Burlington. MAPC is working with the seven communities to update their plans to mitigate potential damages of natural hazards such as floods, winter storms, hurricanes, earthquakes and wild fires, before such hazards occur. The federal *Disaster Mitigation Act of 2000* requires that all municipalities adopt a *Pre-Disaster Mitigation Plan* for natural hazards in order to remain eligible for FEMA Disaster Mitigation Grants.

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

2008 Burlington Goals

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

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

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

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

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

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

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

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

Recommended to align with State 2013 Plan and FEMA Guidelines

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

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

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

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

APPENDIX B
HAZARD MAPPING

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

The map series consists of eight maps as described below. The maps in this appendix are necessarily reduced scale versions for general reference. Full sized higher resolution PDF's of the maps can be downloaded from:

https://www.dropbox.com/sh/j6r2t00hh72nw15/AABcwOLZPIcvUf5M6sZBxc5Za?dl=0

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

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

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

Map 3: Flood Zones – The map of flood zones used the FEMA NFIP Flood Zones as depicted on the FIRMs (Federal Insurance Rate Maps) for Middlesex County as its source. This map is not intended for use in determining whether or not a specific property is located within a FEMA NFIP flood zone. The currently adopted FIRMS for Burlington 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.

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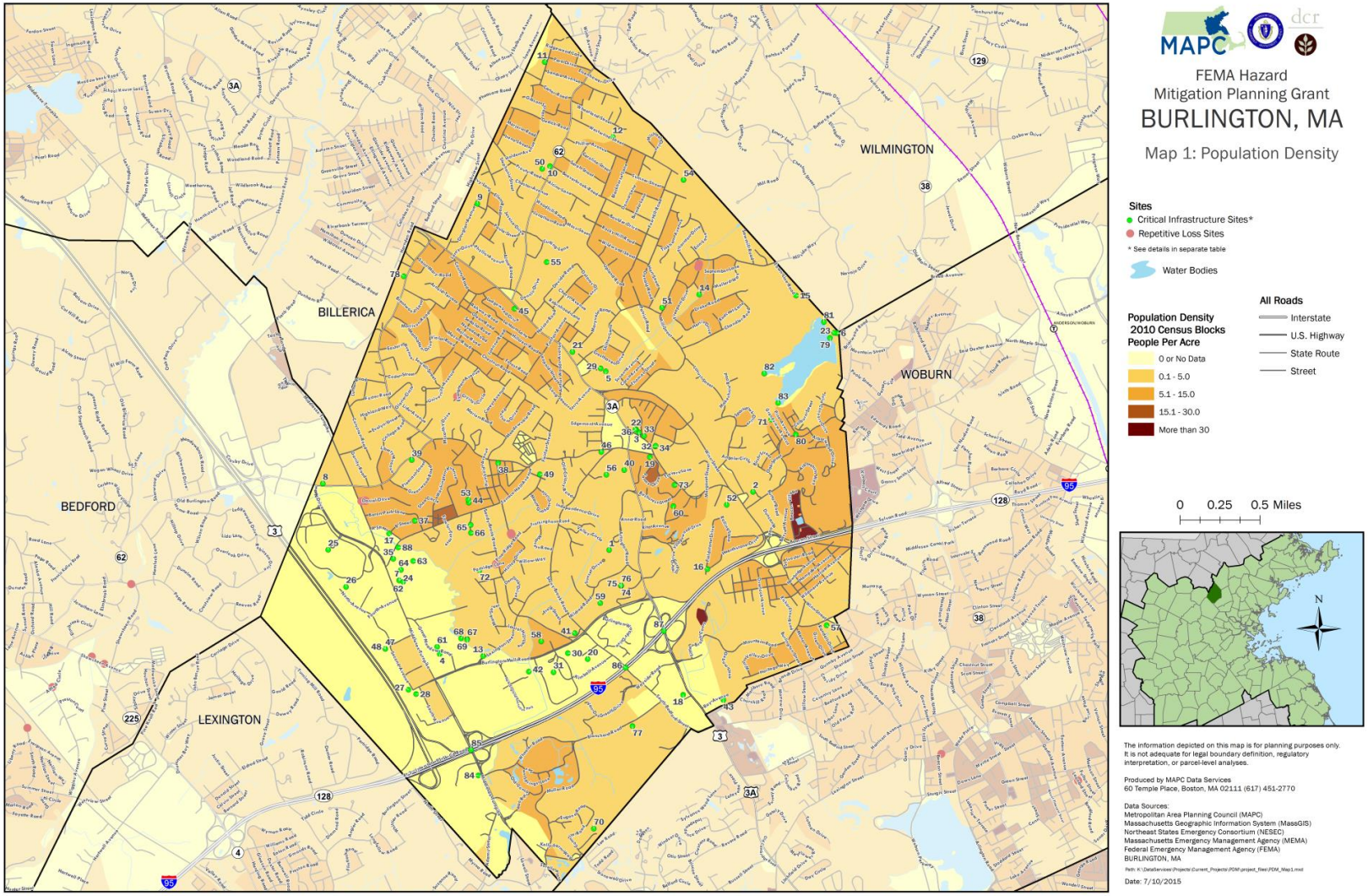
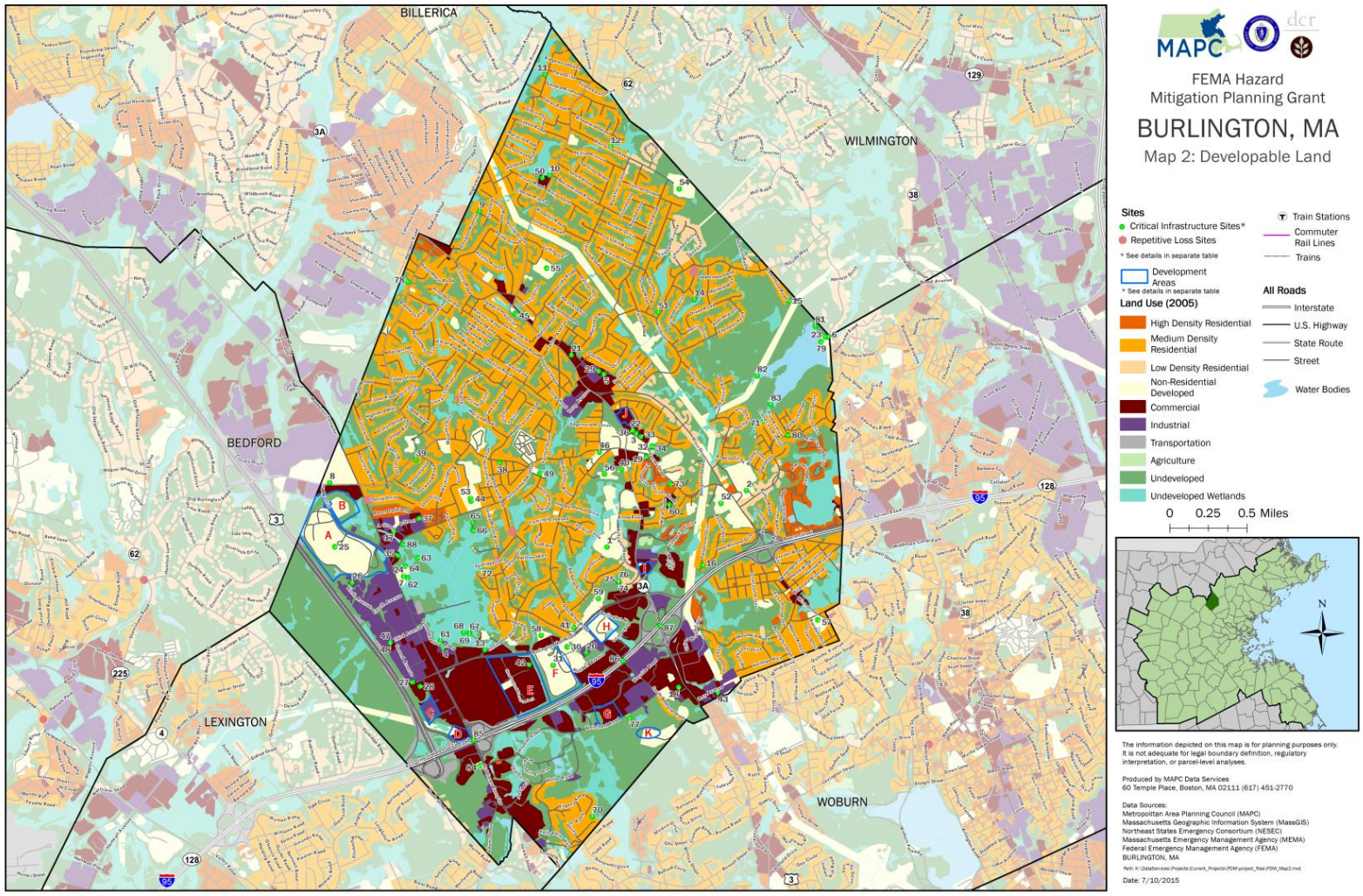

MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
BURLINGTON, MA
Map 1: Population Density
Sites
Critical Infrastructure Sites*
Repetitive Loss Sites
* See details in separate table
Water Bodies
Population Density
2010 Census Blocks
People Per Acre
0 or No Data
0.1 - 5.0
5.1 - 15.0
15.1 - 30.0
More than 30
All Roads
Interstate
U.S. Highway
State Route
Street
0 0.25 0.5 Miles
N
BILLERICA
WILMINGTON
WOBURN
BEDFORD
LEXINGTON
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)
BURLINGTON, MA
Date: 7/10/2015


BILLERICA
WILMINGTON
BEDFORD
LEXINGTON
WOBURN
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
BURLINGTON, MA
Map 2: Developable Land
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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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)
BURLINGTON, MA
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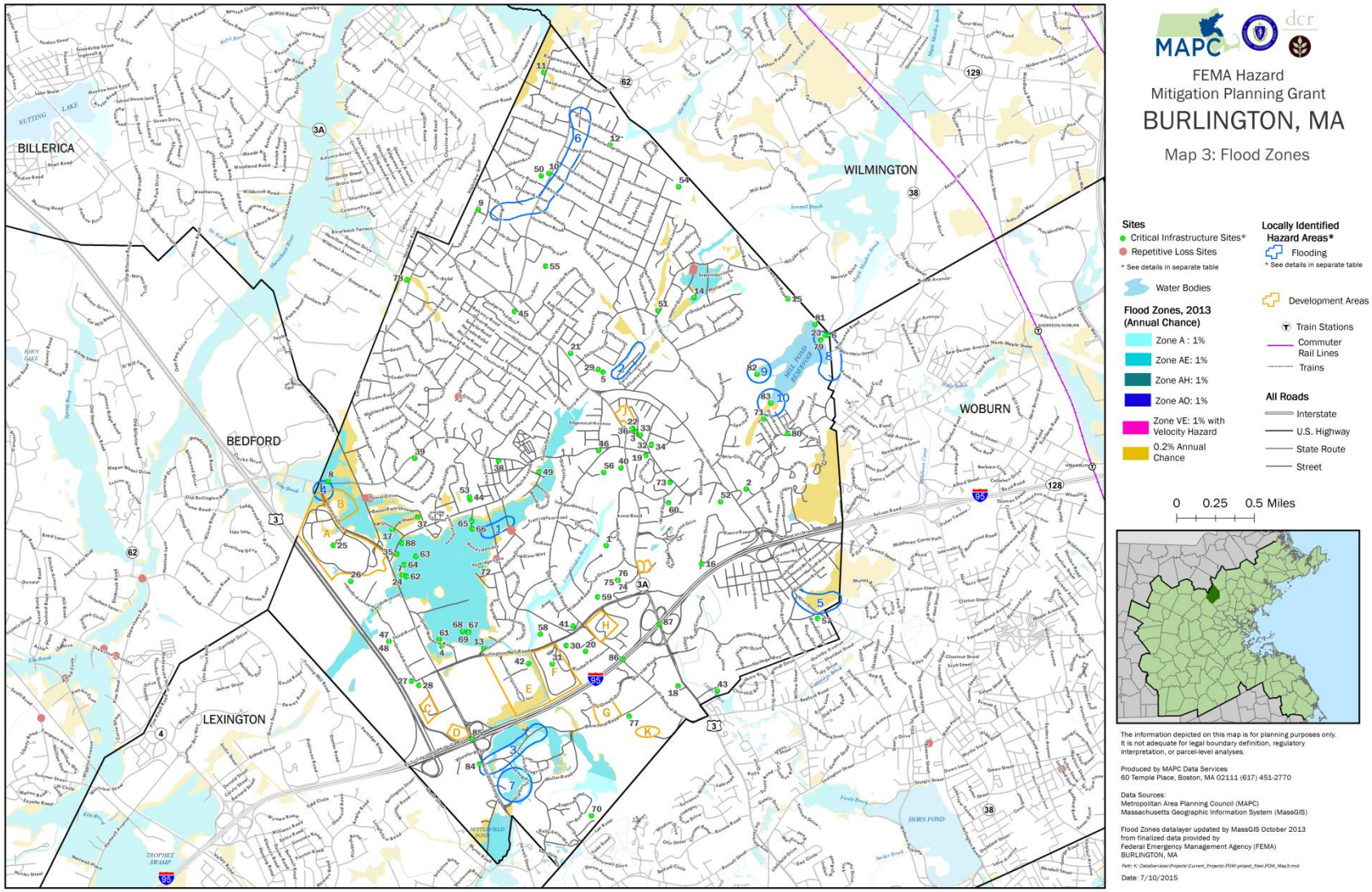
Date: 7/10/2015


BILLERICA
BEDFORD
LEXINGTON
WILMINGTON
WOBURN
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
BURLINGTON, MA
Map 3: Flood Zones
Sites
Critical Infrastructure Sites*
Repetitive Loss Sites
* See details in separate table
Water Bodies
Flood Zones, 2013
(Annual Chance)
Zone A : 1%
Zone AE: 1%
Zone AH: 1%
Zone AO: 1%
Zone VE: 1% with
Velocity Hazard
0.2% Annual
Chance
Locally Identified
Hazard Areas*
Flooding
* See details in separate table
Development Areas
Train Stations
Commuter
Rail Lines
Trains
All Roads
Interstate
U.S. Highway
State Route
Street
0 0.25 0.5 Miles
The information depicted on this map is for planning purposes only.
It is not adequate for legal boundary definition, regulatory
interpretation, or parcel-level analyses.
Produced by MAPC Data Services
60 Temple Place, Boston, MA 02111 (617) 451-2770
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Flood Zones datalayer updated by MassGIS October 2013
from finalized data provided by
Federal Emergency Management Agency (FEMA)
BURLINGTON, MA
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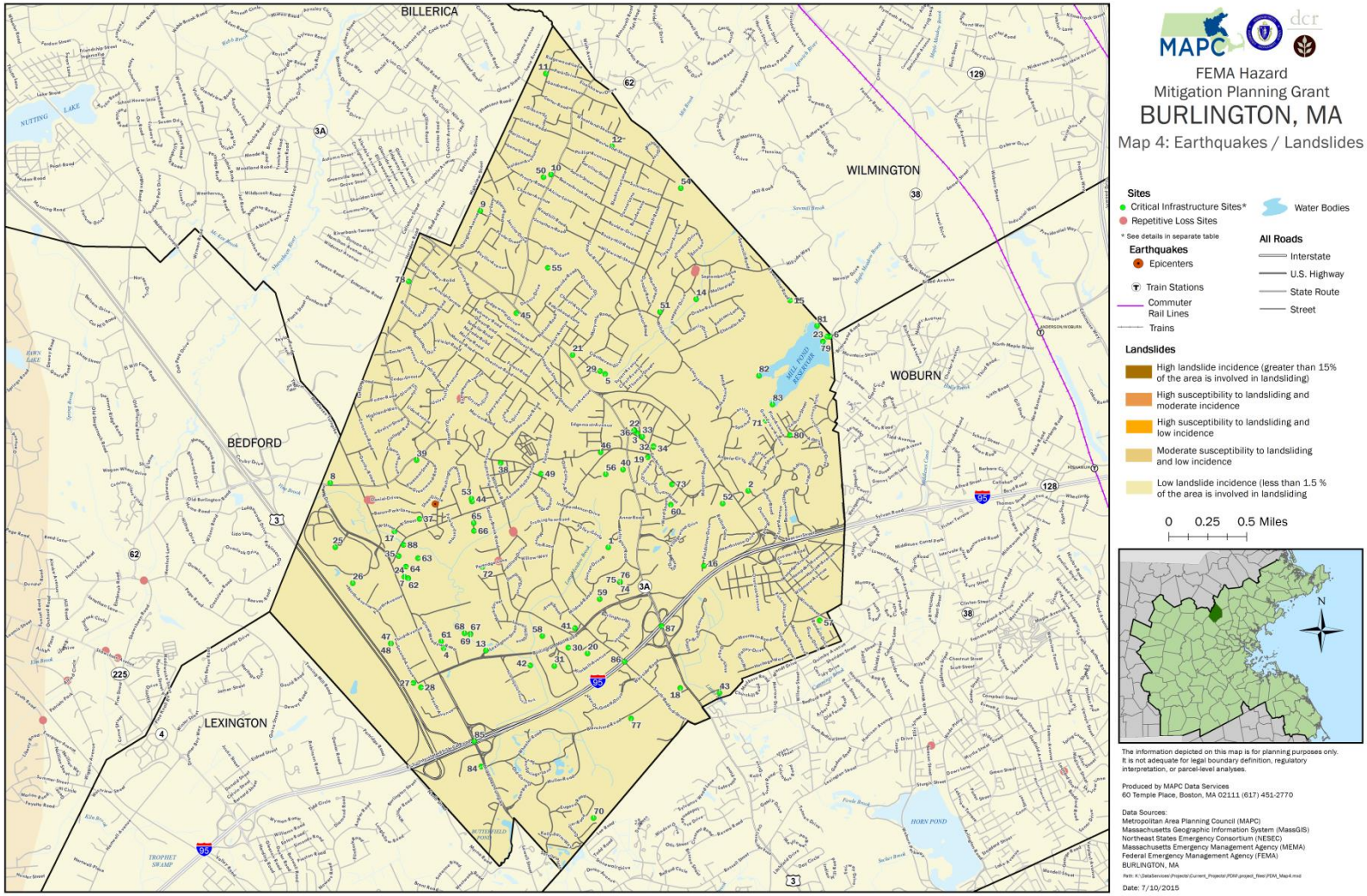
Date: 7/10/2015


BILLERICA
WILMINGTON
WOBURN
BEDFORD
LEXINGTON
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
BURLINGTON, MA
Map 4: Earthquakes / Landslides
Sites
Critical Infrastructure Sites*
Repetitive Loss Sites
* See details in separate table
Earthquakes
Epicenters
Train Stations
Commuter Rail Lines
Trains
Water Bodies
All Roads
Interstate
U.S. Highway
State Route
Street
Landslides
High landslide incidence (greater than 15% of the area is involved in landsliding)
High susceptibility to landsliding and moderate incidence
High susceptibility to landsliding and low incidence
Moderate susceptibility to landsliding and low incidence
Low landslide incidence (less than 1.5 % of the area is involved in landsliding
0 0.25 0.5 Miles
N
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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)
BURLINGTON, MA
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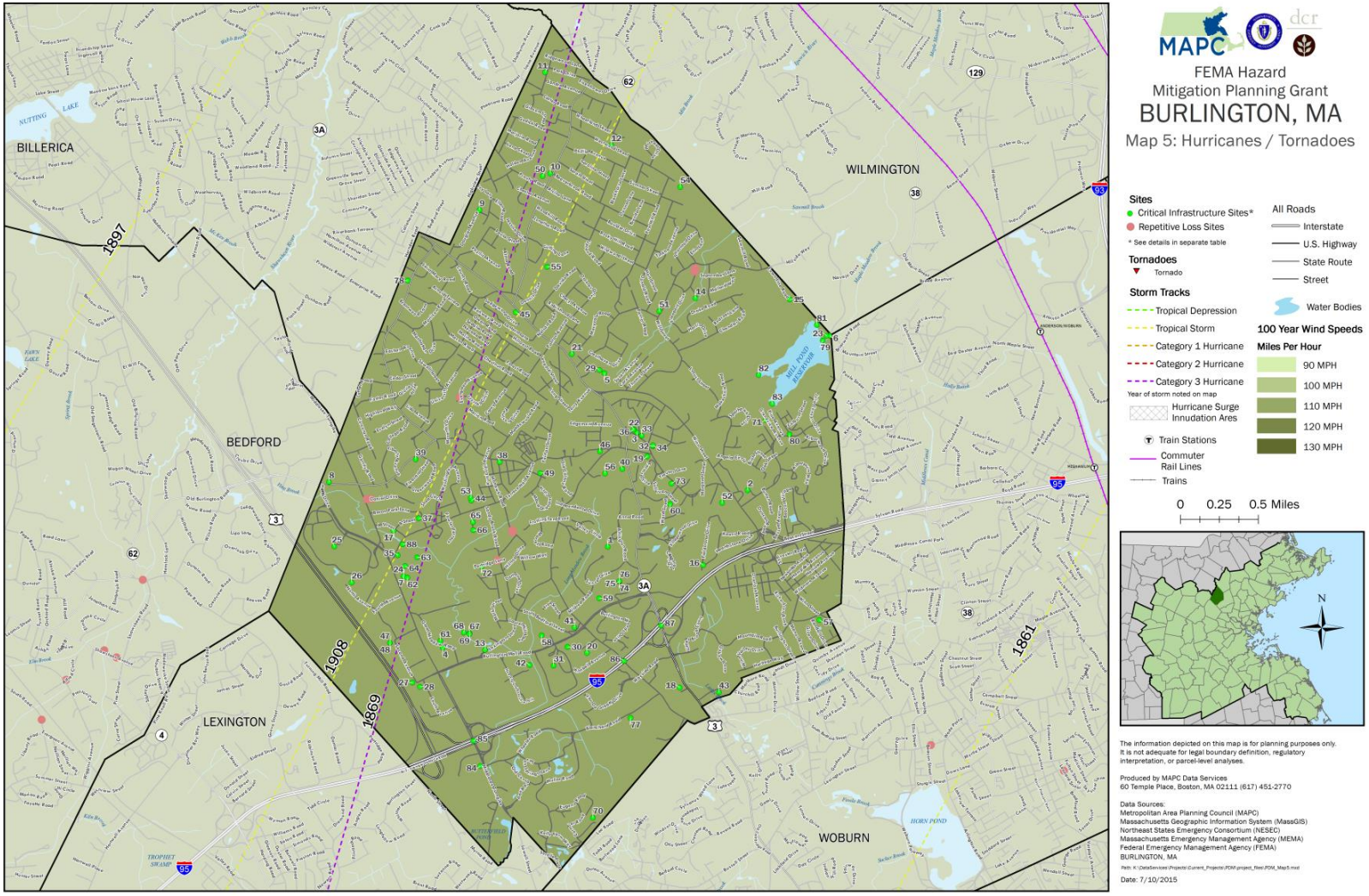
Date: 7/10/2015


MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
BURLINGTON, MA
Map 5: Hurricanes / Tornadoes
BILLERICA
WILMINGTON
BEDFORD
LEXINGTON
WOBURN
1897
1908
1869
1861
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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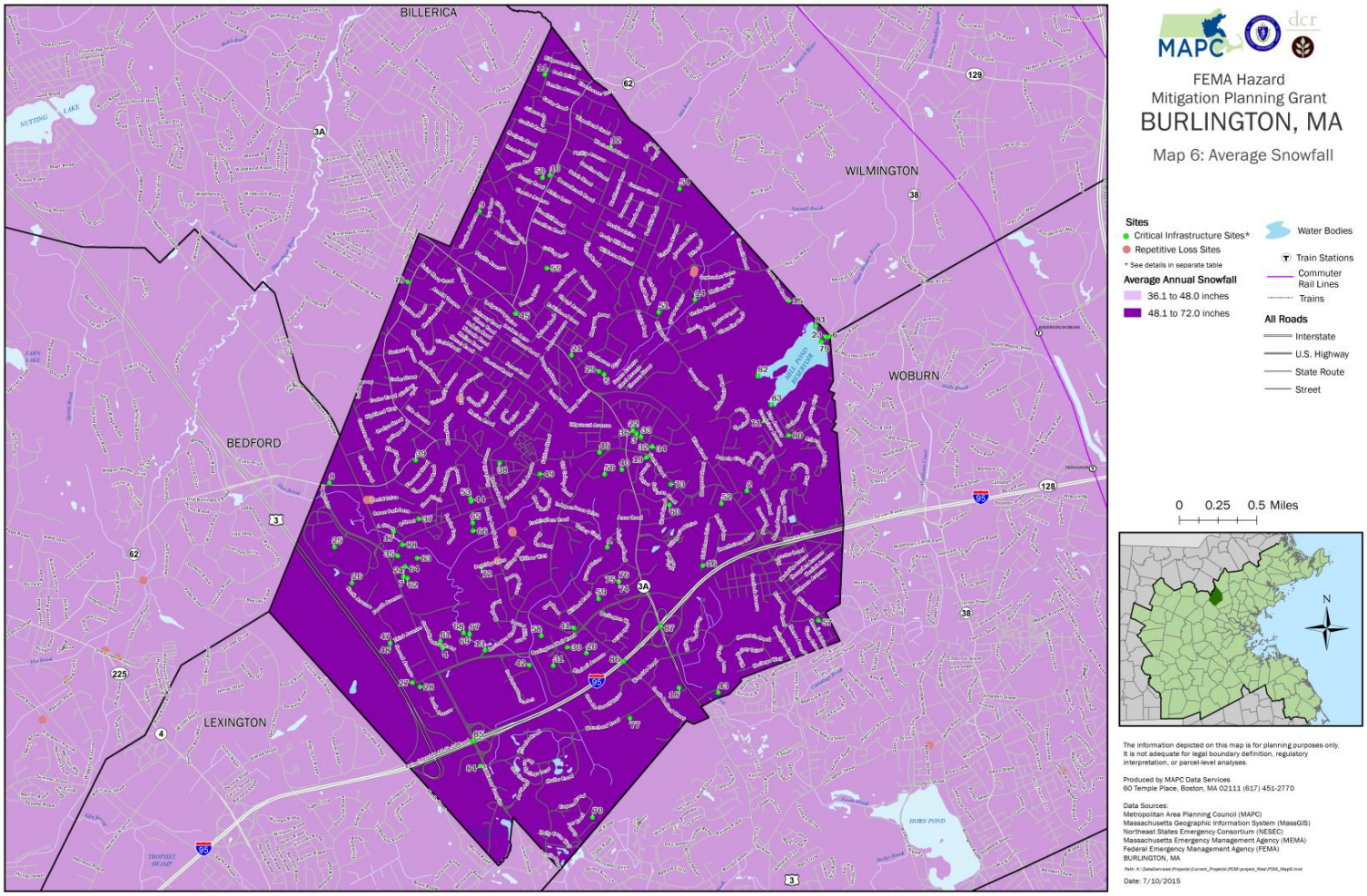
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
BURLINGTON, MA
Date: 7/10/2015


BILLERICA
WILMINGTON
WOBURN
BEDFORD
LEXINGTON
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
BURLINGTON, MA
Map 6: Average Snowfall
Sites
Critical Infrastructure Sites*
Repetitive Loss Sites
* See details in separate table
Average Annual Snowfall
36.1 to 48.0 inches
48.1 to 72.0 inches
Water Bodies
Train Stations
Commuter Rail Lines
Trains
All Roads
Interstate
U.S. Highway
State Route
Street
0 0.25 0.5 Miles
N
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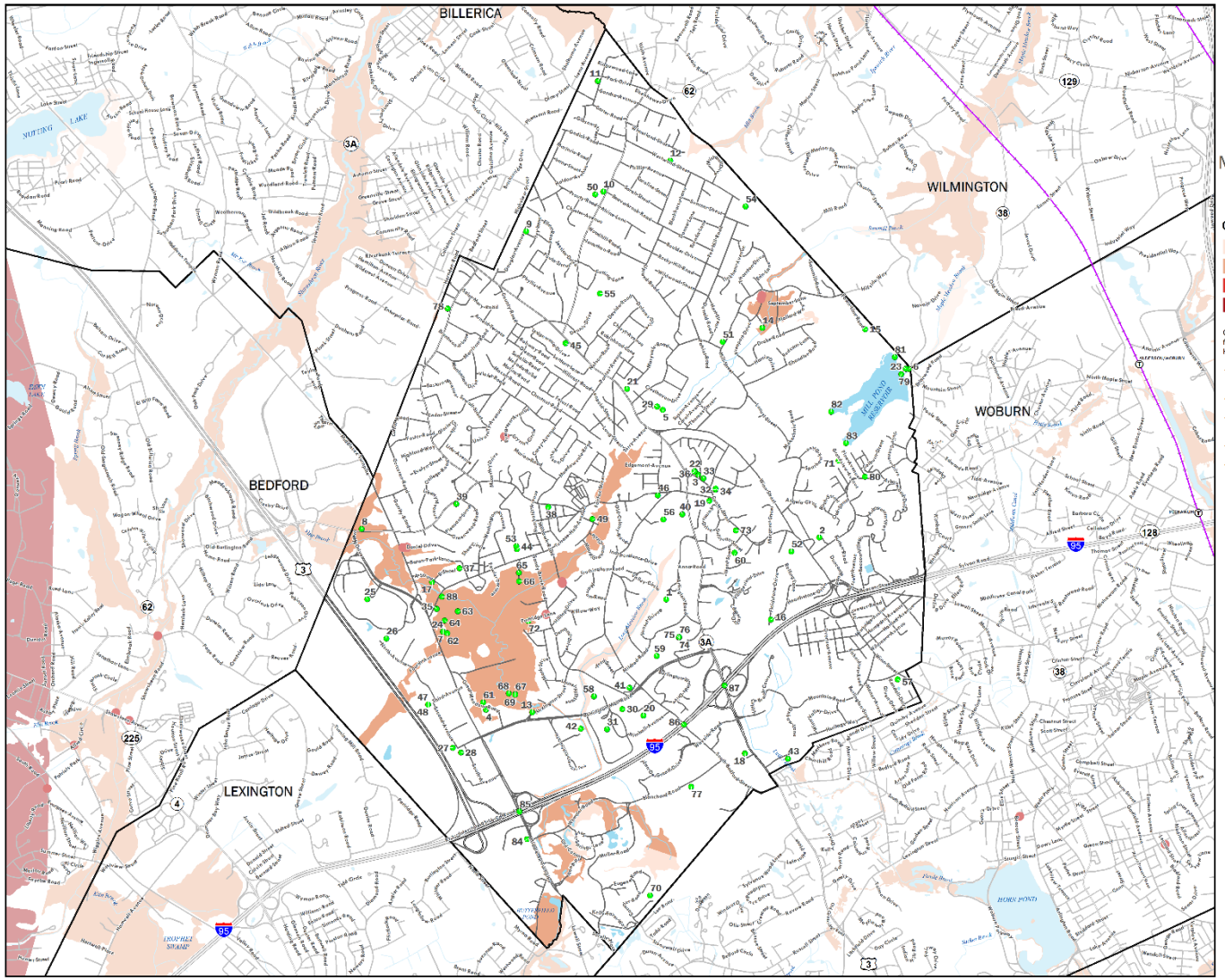
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
BURLINGTON, MA
Date: 7/10/2015



MAPC dcr

FEMA Hazard Mitigation Planning Grant

BURLINGTON, MA

Map 7: Composite Natural Hazards

Composite Natural Hazards

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

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

- 100 year wind speed of 110 MPH or higher
- Moderate landslide risk
- FEMA Q3 flood zones (100 year and 500 year)
- Average snowfall of 36.1" or more
- Hurricane surge innundation areas

Sites

- Critical Infrastructure Sites*
- Repetitive Loss Sites

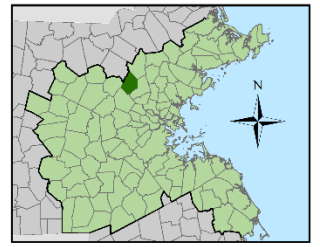
* See details in separate table

Water Bodies

All Roads

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

0 0.25 0.5 Miles



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Data Sources

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

Roads/Trains: MassDOT/ CTPS

Repetitive Loss Sites: DCR/Office of Flood Hazard Management

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

Date: 7/10/2015


NORTH READING
WILMINGTON
BILLERICA
READING
BEDFORD
WOBURN
STONEHAM
LEXINGTON
WINCHESTER
LINCOLN
MAPC
dcr
FEMA Hazard Mitigation Planning Grant
BURLINGTON, 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 0.25 0.5 Miles
N
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Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
BURLINGTON, MA
Date: 1/10/2015

APPENDIX C
DOCUMENTATION OF PUBLIC MEETINGS

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

CALENDAR LISTING / MEDIA ADVISORY

BURLINGTON'S NATURAL HAZARDS PLAN UPDATE IS FOCUS OF NOVEMBER 20 PUBLIC MEETING

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

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

What: The Burlington Emergency Management Team (EMT) will hold a public meeting to present an overview of the pending update of the Town of Burlington's Natural Hazards Mitigation Plan. The Metropolitan Area Planning Council (MAPC) is assisting the Town on the plan update, and a representative of MAPC will present an overview of the plan update.

The Town of Burlington adopted its first Hazard Mitigation Plan in 2008, which was approved by the Federal Emergency Management Agency (FEMA). The plan identifies natural hazards affecting Burlington such as floods, hurricanes, winter storms, and earthquakes, as well as actions that the Town can take to reduce the impacts of these hazards. FEMA requires that plans be updated regularly, so MAPC is assisting the Town prepare a 2016 updated plan.

When: November 20, 2014, 7 PM

Where: Burlington Town Hall Annex, 25 Center St.

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

##

Amanda Linehan, Communications Manager, Metropolitan Area Planning Council

617-933-0705, alinehan@mapc.org

CALENDAR LISTING / MEDIA ADVISORY

BURLINGTON'S DRAFT HAZARD MITIGATION PLAN TO BE PRESENTED AT SEPTEMBER 2 PUBLIC MEETING

Meeting to present the 2016 update of Burlington's Hazard Mitigation Plan and solicit public comments

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

What: The Burlington Emergency Management Team (EMT) will hold a public meeting to present an overview of the draft Burlington Hazard Mitigation Plan Update 2015. The Metropolitan Area Planning Council (MAPC) is assisting the Town on the plan update, and a representative of MAPC will present an overview of the plan update.

The Town of Burlington adopted its first Hazard Mitigation Plan in 2008, which was approved by the Federal Emergency Management Agency (FEMA). The plan identifies natural hazards affecting Burlington such as floods, hurricanes, winter storms, and earthquakes, as well as actions that the Town can take to reduce the impacts of these hazards. FEMA requires that plans be updated regularly, so MAPC is assisting the Town prepare a 2016 updated plan.

When: September 2, 2015, 7 PM

Where: Burlington Town Hall Annex, 25 Center St.

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

##

BURLINGTON HAZARD MITIGATION PLAN – NEIGHBORING COMMUNITIES OF BURLINGTON, MA

Notification of surrounding communities for public meetings:

Billerica
Anthony Fields - afields@Town.billerica.ma.us

Bedford
Glenn Garber- ggarber@bedfordma.gov

Wilmington Valerie Gingrich [vgingrich@wilmingtonma.gov]

Lexington Aaron Henry ahenry@lexingtonma.gov

Woburn
Tina Cassidy - tcassidy@cityofwoburn.com

Additional Organizations:
Burlington Chamber of Commerce

Burlington Conservation Commission

Burlington Department Directors – DPW, PUBLIC BUILDINGS, FIRE, POLICE, TOWN CLERK, RECREATION AND BOARD OF HEALTH.

Burlington Committee Members-Master Plan Steering Committee, Planning Board, Town Meeting Members

Burlington Union

HAZARD MITIGATION PLAN PUBLIC MEETING

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



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

Join the Town for a presentation and discussion about the update to the Burlington Hazard Mitigation Plan at a Public meeting:

Date: Thursday, November 20, 2014

Time: 7 PM

Location: Town Hall Annex, 25 Center St.

For more information, please contact Sam Cleaves via phone at (617) 933-0748 or email scleaves@mapc.org

MAPC
METROPOLITAN AREA PLANNING COUNCIL

HAZARD MITIGATION PLAN PUBLIC MEETING

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



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

Join the Town for a presentation and discussion about the update to the Burlington Hazard Mitigation Plan at a Public meeting:

Date: Wednesday, September 2, 2015

Time: 7 PM

Location: Town Hall Annex, 25 Center St.

For more information, please contact Sam Cleaves via phone at (617) 933-0748 or email scleaves@mapc.org

MAPC
METROPOLITAN AREA PLANNING COUNCIL

RECEIVED
By The Clerk's Office at 3:22 pm, Nov 13, 2014

Town of Burlington Planning Board
Notice of Public Meeting and Meeting Agenda

November 20, 2014

Main Hearing Room, Burlington Town Hall, 29 Center Street, Burlington, MA 01803

John D. Kelly, Chairman Barbara G. L'Heureux, Vice Chairman Paul F. Roth, Member Clerk
Ernest E. Covino, Jr Paul R. Raymond Joseph A. Impemba William Gaffney
Kristin Kassner, Planning Director Don Benjamin, Senior Planner Josh Morris, Assistant Planner
Jennifer Gelinas, Principal Clerk Noelle Judd, Recording Clerk

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The following times are approximate, except for items marked with an (*) which are new public hearings and will not start before the scheduled time.

7:00 p.m.

1) Call Planning Board Meeting Order
2) Citizens Time
3) Announcements
4) Legal Notices of Interest
5) Non-Approvals
6) Administrative Matters.
7) Matters of Appointment

   a. Continued Public Hearing – Petition to delete zoned welands overlay district as it applies to properties shown on Assessor's Map 11 Parcels 4-0, 5-0 and 5-1 and Assessors Map 10 Parcel 97-0 more commonly known as 17, 19, & 21 County Road & 3 Arnold Terrace – Submitted by Brown & Brown, P.C.

   b. MAPC Hazardous Mitigation Plan presentation

   c. Continued Public Hearing – Petition to amend the Zoning Bylaw, Article II "Definitions" and Article IV "Use Regulations" to address and define uses pertaining to structured parking – Submitted by the Planning Board

   d. Continued Public Hearing – Petition to amend the Planning Board Rules and Regulations Governing Planned Development Districts– Submitted by the Planning Board

8) Minutes
9) Other Business:
   a) Discussion
   b) Correspondence
   c) Reports from Town Counsel
   d) Subcommittee Reports
   e) Unfinished Business
   f) New Business

RECEIVED
By The Clerk's Office at 2:27 pm, Aug 05, 2015

TOWN OF BURLINGTON

Meeting Posting

Email Posting to meetings@burlington.org or Bring to the Clerks Office. Thank you
Notice of Public Meeting – (As required by G.L. c. 30 A, c. §18-25)

DEPT./BOARD: Burlington Hazard Mitigation Plan Public Meeting

DATE: Wednesday, September 2nd, 2015

TIME: 6 -7pm

PLACE: Town Hall Annex Basement meeting room

AGENDA

Join MAPC and the town's Emergency Management Team for a presentation and discussion about the 2015 update to the Burlington Hazard Mitigation Plan at a public meeting:

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

MAPC
METROPOLITAN AREA PLANNING COUNCIL

Smart Growth & Regional Collaboration

What is the Hazard Mitigation Plan Update?

Hazard Mitigation planning is a proactive effort to identify actions that can be taken to reduce the dangers to life and property from natural hazard events. Burlington adopted a hazard mitigation plan in 2008 and FEMA regulations require that the plan be updated every five years.

Why is this plan important?

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

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

What goes into a hazard mitigation plan?

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

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

What is the Local Hazard Mitigation Committee?

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

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

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

For more information, please contact:

Sam Cleaves, MAPC Regional Planner at 617-933-0748 or Email: scleaves@mapc.org

APPENDIX D
DOCUMENTATION OF PLAN ADOPTION

TOWN OF BURLINGTON

Board of Selectmen's/Town Administrator's Office

John Petrin, Town Administrator *Betty McDonough, Office Manager*

CERTIFICATE OF ADOPTION
BOARD OF SELECTMEN
TOWN OF BURLINGTON, MASSACHUSETTS

A RESOLUTION ADOPTING THE
TOWN OF BURLINGTON HAZARD MITIGATION PLAN 2016 UPDATE

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

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

WHEREAS, duly-noticed public meetings were held by the EMERGENCY MANAGEMENT TEAM on March 27, 2014, and June 9, 2015

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

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

ADOPTED AND SIGNED this 13th day of June 2016. By Burlington's Board of Selectmen.

Chairman

Selectman

Vice-Chairman

Selectman

Selectman

ELIZABETH C. McDONOUGH
Notary Public
COMMONWEALTH OF MASSACHUSETTS
My Commission Expires
March 13, 2020

ATTEST: _____, Public Notary

29 CENTER STREET • BURLINGTON, MASSACHUSETTS 01803 • TEL (781) 270-1635
jpetrin@burlington.org • www.burlington.org • bmcdonough@burlington.org