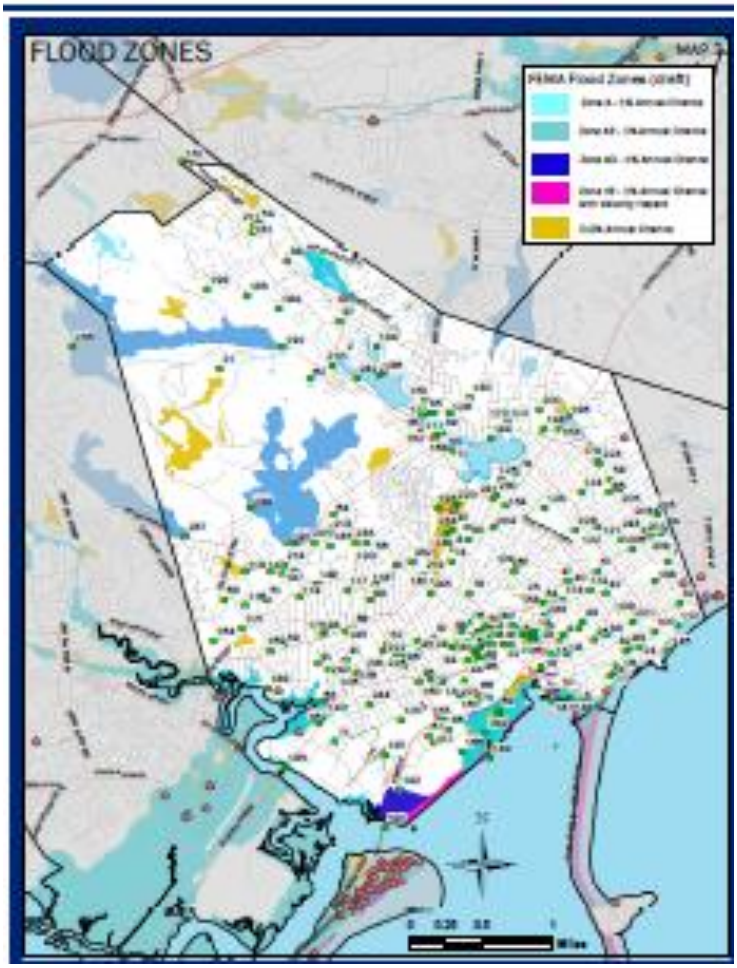
CITY OF LYNN
HAZARD MITIGATION PLAN
2016 UPDATE



Metropolitan Area Planning Council

Final Plan Update
Adopted June 21, 2016

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CITY OF LYNN HAZARD MITIGATION PLAN
2016 PLAN UPDATE

ACKNOWLEDGEMENTS AND CREDITS

This plan was prepared for the City of Lynn 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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Mary Ann O'Connor	Lynn Public Health Department
Chris Reddy	Lynn Police Department
Bill Klag	North Shore Medical Center
James McDonald	Lynn Fire Department
Don Walker	Lynn Office of Economic and Community Development

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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 Lynn Hazard Mitigation Plan update was led by the Lynn Local Hazard Mitigation Planning Committee, composed of staff from a number of different City Departments. This committee discussed where the impacts of natural hazards most affect the City, goals for addressing these impacts, and hazard mitigation measures that would benefit the City.

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 City takes to mitigate them. The Lynn Local Natural Hazard Committee met twice, with the first meeting on March 15, 2011 and the second meeting held May 10, 2011. Both meetings were open to public participation. At the first Local Committee meeting, MAPC staff reviewed the process and data mechanisms used to construct the 2005 NHM plan and gave an outline of the plan updating procedures. The NHM plan update draws on the materials and resources listed in Section X on page 101. In addition, two advertised public meetings were held, the first on September 13, 2011 with the Lynn Planning Board and the second on February 28, 2012 with the City Council Public Safety Committee. The draft Plan also was posted on the City's website for public review and comment for a ten day period following the two public meetings and completion of the first draft of the Plan. The City Council meeting was televised live and re-broadcast. Both meetings included a description of the hazard mitigation planning process, an overview of the plan and proposed mitigation actions, as well as directions on how the public could access the draft plan on the City website and make comments. The public was given time to ask questions and comment at all public meetings.

Preceding these meetings, a public, regional meeting of the North Shore Multiple Hazard Community Planning Team was held February 8, 2010 to re-introduce participating communities to the hazard mitigation planning process and to identify inter-community hazard mitigation issues. A follow-up inter-regional public meeting and Natural Hazard Mitigation workshop was held on September 14, 2011 in Danvers, sponsored by MEMA , MAPC and MA Coastal Zone Management.

A list of those submitting public comments can be found in Appendix C.

Risk Assessment

The plan update provides risk assessment for the following natural hazards in Lynn: flooding, wind, including hurricanes and Northeasters, brush fires, tornados, landslides and earthquakes.

Hazard Mitigation Goals

The Lynn Local Natural Hazard Committee established the following hazard mitigation goals for the city:

1. Promote cost-effective hazard mitigation actions that protect and promote public health and safety from all hazards with a particular emphasis on reducing damage to repetitive and severe repetitive loss properties.

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

3. Ensure that critical infrastructure sites are protected from natural hazards.

4. Protect the City's ability to respond to various natural hazard events.

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

6. Increase coordination and cooperation between City departments in implementing sound hazard mitigation planning and sustainable development.

Highlighted Potential Hazard Mitigation Actions

Install wave attenuator at Seaport Landing Facility.

Upgrade the storm drain system along Surfside Road.

Upgrade the Valley Road drainage culvert.

Conduct a study on how to prevent flooding, inflow and infiltration, and backup in the Lower Western Interceptor sewer line.

Conduct drainage and flooding study for the Bridge Street area to prevent flooding.

Finish mapping all stormwater outfalls and catch basins on GIS.

Incorporate hazard education awareness, mitigation planning and natural hazard incentives into City planning and community development operations.

Plan Review and Update Process

Table 1 Plan Review and Update

Chapter	Reviews and Updates
III – Public Participation	The Lynn Local Committee 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 presented to the Planning Board and the City Council in public meetings. The City Council's meeting was televised and re-broadcast. The plan was also available on the City's website for public comment.
IV – Risk Assessment	MAPC gathered the most recently available hazard and land use data and met with City staff to identify changes in local hazard areas and development trends. City 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 Local Hazard Mitigation Committee.
VI – Existing Mitigation Measures	The list of existing mitigation measures was updated to reflect current mitigation activities in the City.
VII & VIII – Hazard Mitigation Strategy	Mitigation measures from the 2005 plan were reviewed and assessed as to whether they were completed, on-going, or deferred. The Local Committee determined whether to carry forward measures into the 2014 plan or delete them. The 2014 Hazard Mitigation Strategy reflects both new measures and measures carried forward from the 2005 plan. The Committee re-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 City in incorporating hazard mitigation issues into other City planning and regulatory review processes and better prepare the City to update the plan in 2019.

Review of 2005 Natural Hazard Mitigation Plan

As indicated in more detail in the **Potential Mitigation Measures from the 2005 Plan Table** , Lynn made considerable progress on implementing mitigation measures identified in the 2005 Hazard Mitigation Plan. Although some projects were not able to be acted on due to budget constraints, many of the measures identified in that plan are now considered on-going aspects of the regular work of City staff from the department head level to the regular work of DPW staff. Moving forward into the next five year plan implementation period there will be many more opportunities to incorporate hazard mitigation into the City's decision making processes.

Lynn will be increasing its integration of natural hazard mitigation into its community planning processes by building on priority mitigation actions included in this update of its original plan. The City will begin to actively incorporate new hazard mitigation actions into its all of its land use, environmental, capital, and transportation planning efforts, building on the following core principles of sound hazard mitigation planning:

- Building on this plan update to continue assessing and mapping community risk;
- Creating local support for integration of natural hazard mitigation planning by increasing its hazard education and risk awareness outreach and education efforts;
- Integrating mitigation into local planning studies, bylaws and regulations;
- Incentivizing hazard mitigation best practices.

Though not formally done in the 2005 Plan, the City will document any actions taken within this iteration of the Natural Hazard Mitigation on challenges met and actions successfully adopted as part of the ongoing work of the biannual survey and four year update to be conducted by the Hazard Mitigation Implementation Team, as described in Section IX, Plan Adoption and Maintenance. The Hazard Implementation Team did not meet regularly, conduct a bi-annual survey or four year update as described in Section IX perhaps due to the absence of any one City department having being designated to follow up and implement. The City has rectified this by naming its Emergency Management Director to lead and coordinate this and future updates.

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.

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 City of Lynn and eight other North Shore communities to update their local Hazard Mitigation Plans, which were first adopted in as part of a North Shore Multi-Jurisdictional Hazard Mitigation Plan. Though the Multi-Jurisdictional Hazard Mitigation Model is no longer being created, the Regional Committee still serves as a sounding board to address multi-jurisdictional and regional issues. The local Hazard Mitigation Plan updates 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. The local Hazard Mitigation Plan updates produced under this grant are designed to individually meet the requirements of the Disaster Mitigation Act for each community.

A public, regional meeting of the North Shore Multiple Hazard Community Planning Team was held February 8, 2010 to re-introduce participating communities to the hazard mitigation planning process and to identify inter-community hazard mitigation issues. MAPC has also produced a regional document that summarizes the issues and recommendations for the North Shore communities.

In addition, Lynn was able to participate in a North Shore Natural Hazard Mitigation Plan Workshop held on September 14, 2011, sponsored jointly by MEMA, MA Coastal Zone Management and MAPC staff. The workshop was designed to help assist communities draft successful PDM plans, as well as providing a forum for sharing individual community plans on a regional basis; exploring inter-community questions, challenges and how to address them. See Appendix C for a list of those submitting comments on the draft 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 City of Lynn has experienced 17 natural hazards that triggered federal or state disaster declarations since 1991. These are listed in Table 2 below. The vast majority of these events involved flooding.

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)
December Blizzard (December 1992)	FEMA Public Assistance Project Grants	Counties of Barnstable, Dukes, Essex, Plymouth, Suffolk
	Hazard Mitigation Grant Program	Counties of Barnstable, Dukes, Essex, Plymouth, Suffolk (7 projects)
March Blizzard (March 1993)	FEMA Public Assistance Project Grants	Statewide

DISASTER NAME (DATE OF EVENT)	TYPE OF ASSISTANCE	DECLARED AREAS
January Blizzard (January 1996)	FEMA Public Assistance Project Grants	Statewide
October Flood (October 1996)	FEMA Public Assistance Project Grants	Counties of Essex, Middlesex, Norfolk, Plymouth, Suffolk
	FEMA Individual Household Program	Counties of Essex, Middlesex, Norfolk, Plymouth, Suffolk
	Hazard Mitigation Grant Program	Counties of Essex, Middlesex, Norfolk, Plymouth, Suffolk (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
February Snowstorm (Feb 17-18, 2003)	FEMA Public Assistance Project Grants	Statewide
January Blizzard (January 22-23, 2005)	FEMA Public Assistance Project Grants	Statewide
Hurricane Katrina (August 29, 2005)	FEMA Public Assistance Project Grants	Statewide
May Rainstorm/Flood (May 12-23, 2006)	Hazard Mitigation Grant Program	Statewide

DISASTER NAME (DATE OF EVENT)	TYPE OF ASSISTANCE	DECLARED AREAS
April Nor'easter (April 15-27, 2007)	FEMA Public Assistance Project Grants	Barnstable, Berkshire, Dukes, Essex, Franklin, Hampden, Hampshire, Plymouth
	Hazard Mitigation Grant Program	Statewide
Flooding (March, 2010)	FEMA Public Assistance FEMA Individuals and Households Program SBA Loan	Bristol, Essex, Middlesex, Suffolk, Norfolk, Plymouth, Worcester
	Hazard Mitigation Grant Program	Statewide
Tropical Storm Irene (August 27-28, 2011)	FEMA Public Assistance	Statewide
Severe snowstorm and Flooding (February 8-09, 2013	FEMA Public Assistance; Hazard Mitigation Grant Program	Statewide

(Source: database provided by MEMA)

FEMA Funded Mitigation Projects

Over the last 20 years the City of Lynn has received funding from FEMA for one mitigation project under the Hazard Mitigation Grant Program. The project is summarized in Table 3 below.

Table 3 FEMA-Funded Mitigation Projects
(Utilizing the Hazard Mitigation Grant Program)

Project Title	Scope of Work	Total Cost	Federal Funding	Local Funding
Drainage Infrastructure Improvements	(1) installation of 770' of 3' x 5' concrete box culvert from Stetson Street to Granite Street (2) video inspection of Strawberry Brook	$786,339	$540,353	$245,986

(Source: database provided by MEMA, 2010)

Community Profile

Lynn is a city in Essex County, Massachusetts, United States. The population was 90,329 at the 2010 census. An old industrial center, Lynn is home to Lynn Beach and Lynn Heritage State Park and is about 7 miles (11 km) north of downtown Boston.

Originally settled in 1629, Lynn played a major role in the regional tannery and shoe-making industries from the nineteenth through the mid-twentieth centuries. In 1850, the northern section of Lynn, attracting wealthy patrons and growing as a resort town, seceded and became the town of Swampscott. Lynn continued to expand and thrive as an industrial center until the 1950s, when it began to decline, much like many other Massachusetts urban centers. Several large fires devastated part of the downtown area in the 1970s and 1980s, which have since been redeveloped into a campus of the North Shore Community College. Lynn remains home to several large national employers such as General Electric, Garelick Farms, and Durkee-Mower, makers of "Marshmallow Fluff". In the early 2000s, a number of new development projects contributed to what officials hope will be the city's renaissance. Industrial buildings that were formerly vacant have been converted into loft spaces by real estate developers, and bought by young home-buyers who seek the urban lifestyle of Boston proper. City Hall is encouraging the community's resurgence, with new antique-style lighting, signage, brickwork, and a multipurpose municipal football stadium. Lynn is also actively implementing its 2007 Waterfront Master Plan to spur economic revitalization within the City. (Narrative from *2007 Lynn Waterfront Master Plan Report* and Wikipedia)

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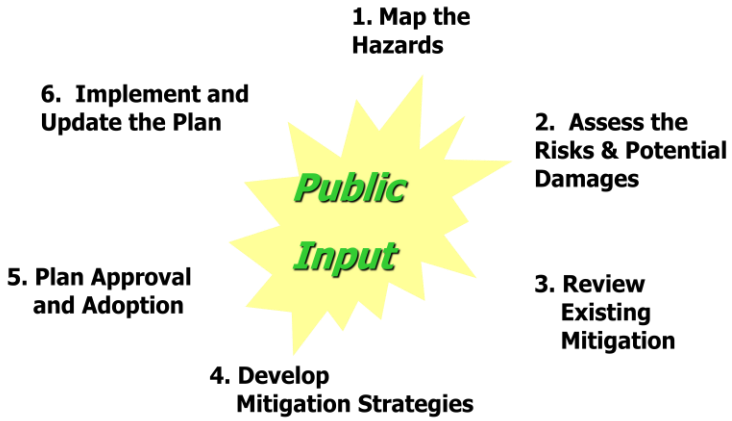
III. PUBLIC PARTICIPATION

MAPC employs a six step planning process based on FEMA's hazard mitigation planning program 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. This process is illustrated and described below.



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

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

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

4. Develop Mitigation Strategies – MAPC works with the local municipal staff to identify new mitigation measures, utilizing information gathered from the hazard

identification, vulnerability assessments, and the community's existing mitigation efforts to determine where additional work is necessary to reduce the potential damages from hazard events. Additional information on the development of hazard mitigation strategies can be found in Chapter VII.

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

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

Public participation occurred at four levels; the North Shore Multiple Hazard Community Planning Team (regional committee) and the Lynn Multiple Hazard Community Planning Team (local committee). In addition, the City held two advertised meetings open to the general public to present the plan and hear citizen input. Following the presentation of the draft plan at the two public meetings, the draft was placed on the City website for ten days for public comment and questions. Commenters are listed in Appendix C.

In addition, Lynn was able to participate in a North Shore Natural Hazard Mitigation Plan Workshop held on September 14, 2011, sponsored jointly by MEMA, MA Coastal Zone Management and MAPC staff. The workshop was designed to help assist communities draft successful PDM plans, as well as providing a forum for sharing individual community plans on a regional basis; exploring inter-community questions, challenges and how to address them. See Appendix C.

Lynn's Participation in the Regional Committee

On January 15, 2010, a letter was sent notifying the communities of the first meeting of the North Shore Regional Committee 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 Lynn on the regional committee:

James McDonald	Fire Chief
Manny Alcantara	Associate Director of Public Works

The regional committee served as an opportunity for neighboring communities to discuss hazard mitigation issues of shared concern. The North Shore Regional Committee met on February 8, 2010 at the Saugus Public Safety Building. At that meeting, representatives

from each of the nine North Shore communities beginning the process of reviewing and revising their 2005 Natural Hazard Mitigation Plans were re-introduced to the following items:

- The Massachusetts State Hazard Mitigation Plan and the FEMA hazard mitigation planning and grant process;
- The concept of each community engaging staff and the public to update its current Natural Hazard Mitigation Plan;
- FEMA plan overview and requirements and plan eligibility;
- Review of the overall scope of work and plan revision schedule
- Question and of Discussion of local issues, inter-community and North Shore Region hazard mitigation issues and how to address.
- Re-introduction to identifying and mapping municipal Critical Facilities, municipal Areas of Concern, Inter-Community Areas of Concern, and Regional Shared areas of Concern.
- Municipal representatives were also briefed on the importance of trying to create a diversified presence on the local Multiple Hazard Community Planning Team in advance of local team meetings, being asked to contact major employers, business owners, schools and non-profit organizations to participate in the process.

In addition, as the same group of MAPC staff is working on each community's plan, these issues of shared concern, and other issues that may arise between neighboring communities, are discussed in greater detail in local committee meetings and resulting actions reflected in the identified mitigation measures, as noted in Chapter VIII.

The Lynn Hazard Community Planning Team

In addition to the regional committee meetings, MAPC worked with the local community representatives to organize a local Hazard Community Planning Team for Lynn (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 and citizens at large.

Lynn Hazard Community Planning Team Meetings

On March 15, 2011 and May 10, 2012 MAPC conducted meetings of the Lynn Local Hazard Community Planning Team. The purpose of the meetings was to review the existing plan and mitigation goals, including gathering information on local hazard mitigation issues, updating existing mitigation practices, and determining the status of mitigation measures from the 2005 plan. The meeting also included discussion of new or modified mitigation measures and a process for public involvement and outreach. Table 4 lists the attendees at each meeting of the team. The agenda for these meeting is included in Appendix A.

Table 4

Attendance at the Lynn Local Committee Meeting

Name	**Representing**
March 15, 2011	
Michael Murray	Lynn Office of Economic and Community Development
Joe Zukas	Lynn Fire Department
Jack Barry	Lynn Fire and Emergency Management Departments
Manny Alcantara	Lynn Department of Public Works
Andrew Hall	Lynn Water and Sewer Commission
Mary Ann O'Connor	Lynn Public Health Department
Chris Reddy	Lynn Police Department
James McDonald	Lynn Fire Department
May 10, 2012	
Joe Zukas	Lynn Fire Department
Thomas Hines	Lynn Emergency Management and Fire Departments
Don Walker	Lynn Office of Economic and Community Development
Joe Carritte	Lynn Department of Public Works
Mary Chalmers	Mayor's Office
Bill Murray	Lynn Fire Department
Andrew Hall	Lynn Water and Sewer Commission
Bill Klag	North Shore Medical Center

Public Meetings

The plan was introduced to the public at two public meetings, both while the draft plan was being completed. The public had an opportunity to provide input to the planning process during a meeting of the Lynn Planning Board on September 13, 2011 held in the Lynn City Hall. The draft plan was also presented for public comment at a meeting of the Lynn City Council Public Safety Committee on February 28, 2012 at the City Hall.

Both the Planning Board and City Council meetings were advertised as public meetings. The attendance list for each meeting can be found in Table 5. I. In addition to staff and elected officials, approximately five people attended the Planning Board meeting and ten at the City Council meeting. In addition, the plan was made available on the City's website for public review following edits by the Lynn Natural Hazard Mitigation Team. MAPC staff announced at both the Planning Board and City Council public meetings that the draft plan would be available for comments and questions for a ten day posting period

and encouraged Board members and public attendees to read the plan and submit comments

Table 5
Attendance at Public Meetings

Name	Representing
First Public Meeting	
Paul Price	Lynn Planning Board
Stephen Upton	Lynn Planning Board
Robert Sticia	Lynn Planning Board
James Mahoney	Lynn Planning Board
Michael Donovan	Lynn Planning Board
Sam Cleaves	MAPC
Members of the public	
Second Public Meeting	
Council President Timothy Phelan	Lynn City Council, President
Council Vice-President Richard J. Ford	Lynn City Council, Vice President
Councilor-At-Large Buzzy Barton	Lynn City Council
Councilor-At-Large Daniel F. Cahill	Lynn City Council
Councilor-At-Large Hong Net	Lynn City Council
Ward One Councilor Wayne A. Lozzi	Lynn City Council
Ward Two Councilor William R. Trahant, Jr.	Lynn City Council
Ward Three Councilor Darren P. Cyr	Lynn City Council
Ward Four Councilor Richard C. Colucci	Lynn City Council
Ward Five Councilor Brendan P. Crighton	Lynn City Council
Ward Six Councilor Peter L. Capano	Lynn City Council
Thomas Hines	Lynn EMD
Don Walker	Lynn Office of Economic and Community Development
Sam Cleaves	MAPC
Members of the public	

Planning Timeline-Table 6	
January 15, 2010	Letter to the municipalities initiating the project.
February 10, 2010	Meeting of the North Shore Regional Committee
March 15, 2011, May 10, 2012	Meetings of the Local Committee
September 13, 2011	First Public Meeting with the Planning Board
February 28,2012	Second Public Meeting with the City Council

March-	MAPC and City review and complete draft plan
July 5, 2012	Draft Plan submitted to MEMA
July 2012 – February, 2013-	MEMA Review Period and MAPC coordinates with City on revised draft plan
March 7, 2013	MEMA Review Comments Received
March – September, 2013	MAPC coordinates with City on revised draft plan
October 3, 2013	Revised Draft Plan Submitted to MEMA
March, 2014	FEMA Review Comments Received
March – August, 2014	Plan updated with new FIRM maps and , City data
August 11, 2014	Second Draft Revised Plan Submitted to MEMA
April 16, 2015	Revised Draft Plan Submitted to MEMA
July 30 2015	Approval Pending Adoption issued by FEMA
June 14, 2016	Adopted by the City of Lynn

IV. RISK ASSESSMENT

The risk assessment analyzes the potential natural hazards that could occur within the City of Lynn 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 Lynn's risk assessment, MAPC gathered the most recently available hazard and land use data and met with City staff to identify changes in local hazard areas and development trends. City 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 (described below) and assessed the potential impacts of flooding using the latest data.

Overview of Hazards and Impacts

The Massachusetts Hazard Mitigation Plan 2010 (state plan) provides an in-depth overview of natural hazards in Massachusetts. The state plan indicates that Massachusetts is subject to the following natural hazards (listed in order of frequency); floods, heavy rainstorms, nor'easters or winter storms, coastal erosion, hurricanes, tornadoes, urban and wildfires, drought and earthquakes. Previous state and federal disaster declarations since 1991 are summarized in Table 2.

Table 6 summarizes the hazard risks for Lynn. 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 Commonwealth of Massachusetts State Hazard Mitigation Plan, 2010. The statewide assessment reflects local conditions in Lynn using the definitions for hazard frequency and severity listed below Table 7.

Table 7
Hazard Risks Summary

Hazard	Frequency	Severity
Flooding	High	Serious
Dam failures	Low	Serious
Coastal Hazards	High	Serious
Tsunami	Very low	Extensive
Winter storms	High	Serious
Hurricanes	Medium	Serious
Tornadoes	Low	Serious
Brush fires	Medium	Minor

Earthquakes	Low	Extensive
Landslides	Low	Minor
Drought	Low	Minor
Extreme Temperature	Medium	Minor

Definitions used in the Commonwealth of Massachusetts State Hazard Mitigation Plan

Frequency

Very low frequency: events that occur less frequently than once in 1,000 years (less than 0.1% per year)

Low frequency: events that occur from once in 100 years to once in 1,000 years (0.1% to 1% per year);

Medium frequency: events that occur from once in 10 years to once in 100 years (1% to 10% per year);

High frequency: events that occur more frequently than once in 10 years (greater than 10% per year).

Severity

Minor: Limited and scattered property damage; no damage to public infrastructure (roads, bridges, trains, airports, public parks, etc.); contained geographic area (i.e. one or two communities); essential services (utilities, hospitals, schools, etc) not interrupted; no injuries or fatalities.

Serious: Scattered major property damage (more than 50% destroyed); some minor infrastructure damage; wider geographic area (several communities); essential services are briefly interrupted; some injuries and/or fatalities.

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

Catastrophic: Property and public infrastructure destroyed; essential services stopped, thousands of injuries and fatalities.

Flood Related Hazards

Flooding was the most prevalent serious natural hazard identified by local officials in Lynn. Flooding can be caused by hurricanes, nor'easters, severe rainstorms, and thunderstorms among other causes. Sea level rise, as well as more intense storms brought on by global climate change, has the potential to increase the frequency and extent of flooding from all of these causes.

Overview of City-Wide Flooding

Lynn is subject to three kinds of flooding: *coastal flooding* where wind and tide leads to flooding along tidal waterways: *inland/riverine flooding* where the rate of precipitation and/or amount of stormwater runoff overwhelms the capacity of natural or structured drainage systems causing overflows; urban *flooding* in which precipitation causes the water table to rise and leads to flooding of low-lying areas such as streets and underpasses. These types of flooding are often combined as storm events lead to large amounts of draining stormwater, which is blocked by the inland push of wind and tide driven water.

There are two major drainage or watershed areas within the City. The first is the Saugus River, which drains a 38-square mile region and is the western boundary of the City. The second area begins with Cedar Brook in the northeastern part of the City and drains the area to the east of the Lynn Woods Reservation. The brook enters Cedar Pond and extends south into Sluice Pond. The most significant locations for flooding exist south of the Lynnway along the Waterfront at Lynn Harbor and along the entire bank of the Saugus River. In many rivers and streams, years of shoreline modifications, land reclamation, stream piping, and development have severely altered the natural flow of water in Lynn. Stormwater drainage from developed areas occurs primarily through the manmade system of storm drains.

A large portion of the city center and major housing areas are all at risk of flooding. Lynn residents have a median HH income of $43,741 (2010 US Census) contributing to the community's limited financial preparation to resolve any natural disaster damages that may occur. Lynn has the largest and most diverse population of the cities surrounding it. The cities only real safety barrier is the Lynnway and Lynn Shore Drive. These two roads act as barriers for the coast of Lynn; they will be able to absorb some of the initial flood damage and reduce the risk to population's further inland.

Source: *Sea Level Rise Inundation Impacts for Coastal Southern Essex County, MA*
Joanna Orfanos, Phillip Shafovaloff, Simon Tolstopyatenko, December, 2009)

Inland/Riverine Flooding

Inland/riverine flooding occurs when water overflows the banks of an existing stream or river. These flood events can cause serious damage to structures and property and can threaten the lives and safety of area residents. Large amounts of impervious area in the city's four watersheds s increase the frequency and severity of flooding because storm water is prevented from absorbing into the ground and flows overland directly into the waterway, increasing the volume of flow. This type of flooding most often occurs within the mapped floodplain areas.

Regionally Significant Storms

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

- March 1968
- The Blizzard of 1978
- January 1979
- April 1987
- October 1991 ("The Perfect Storm")
- October 1996
- June 1998
- March 2001
- April 2004
- May 2006
- April 2007
- March 2010

These floods were all regionally significant but affected individual communities to varying degrees.

Overview of Coastal Flooding

There are minor hazard zones around each of the ponds and in two low wet areas within Lynn Woods. The most significant locations for flooding exist south of the Lynnway along the Waterfront at Lynn Harbor and along the entire bank of the Saugus River.

The areas of greatest flooding are found along the Lynn Shore Drive in the vicinity of the Nahant rotary, the southern portion of Nahant Street, Surfside Road and Beach Road. Another problem area is the Little River area from River Street to Cooper Street from Western Avenue to the Saugus River. Flooding here is often due to tidal impacts. The drainage system does not function at high tides. The drainage system would need to be raised and a pump station installed. The area that floods is a mixture of residential, commercial and light industrial. Other areas that often experience flooding include near the Sluice Pond Overflow, from Broadway to Magnolia Avenue and Conomo Avenue to Broadway. Linton Road is sometimes impacted by flooding. Areas of flooding are shown on Map 7 in Appendix B.

There is flooding in the eastern part of the City from Fosters Pond in Swampscott. The design of the grate at the headwall is inadequate and it gets blocked with debris. The City of Lynn has offered to replace the grate.

The combined sewer overflow system (CSO) in place in Lynn creates a capacity problem in the drainage system. When there are heavy flows to the treatment plant, the plant is not able to pump as much water and the wet wells flood in the lower areas of the

collection system. This situation is being alleviated by sewer separation which will eventually cost in the range of $50 -54 million. Most of the CSO separation work has been completed in the eastern portion of the City.

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

Flood Insurance Rate Map Zone Definitions

Zones A1-30 and AE: Special Flood Hazard Areas that are subject to inundation by the base flood, determined using detailed hydraulic analysis. Base Flood Elevations are shown within these zones.

Zone A (Also known as Unnumbered A Zones): Special Flood Hazard Areas where, because detailed hydraulic analyses have not been performed, no Base Flood Elevations or depths are shown.

Zone AO: Special Flood Hazard Areas that are subject to inundation by types of shallow flooding where average depths are between 1 and 3 feet. These are normally areas prone to shallow sheet flow flooding on sloping terrain.

Zone VE, V1-30: Special Flood Hazard Areas along coasts that are subject to inundation by the base flood with additional hazards due to waves with heights of 3 feet or greater. Base Flood Elevations derived from detailed hydraulic analysis are shown within these zones.

Zone B and X (shaded): Zones where the land elevation as been determined to be above the Base Flood Elevation, but below the 500 year flood elevation. These zones are not Special Flood Hazard Areas.

Zones C and X (unshaded): Zones where the land elevation has been determined to be above both the Base Flood Elevation and the 500 year flood elevation. These zones are not Special Flood Hazard Areas

The second source of flooding information was input from local officials and residents. The Locally Identified Areas of Flooding described below were identified by City staff as areas where flooding is known to occur. These areas do not necessarily coincide with the flood zones from the FIRM maps. They may be areas that flood due to inadequate drainage systems or other local conditions rather than location within a flood zone. The numbers correspond to the numbers on Map 8, “Hazard Areas”. The numbers do not reflect priority order.

Additional areas of flooding (as identified by the LEPC and other plan participants) are as follows:

Locally Identified Areas of Flooding

1) Surfside Road: low-lying neighborhood with silted drain lines
2) Valley Road: under-sized culvert and blocked upstream outlet
3) Lower Western Interceptor/Drain Line: Combined Sewer Overflow line in low lying area that backs up during heavier precipitation events combining with high tides and coastal surge. This is part of the CSO separation project.
4) Bridge Street at Boston Street: tidal back up of Strawberry Brook during heavy precipitation and coastal surge causes backup.
5) Maple Street at Flax Pond: Pond overtops during spring runoff; outlet is closed off.
6) Cedar Pond: undersized drain line causes flooding.
7) Floating Bridge Pond Outlet: increased runoff from upstream development and now under-sized drainage outlet caused flooding during heavy precipitation events.
8) Alley Street: Combined Sewer Overflow partially caused by inflow and infiltration of groundwater into drainage lines.
9) Johnson Street: Stormwater backup and flooding contributed to by inflow and infiltration into Combined Sewer Overflow line.
10) Silsby Street: low elevation road gathers storm water runoff and floods during heavy precipitation events

Previous Occurrences and Impacts

The City does not collect data on flooding occurrences. The best available data was for Essex County,. Essex County, which includes Lynn, experienced 26 non-Coastal or non-Urban Small Stream flood events from January 1, 1950 – March 1, 2014. There were two deaths and three injuries reported and the flooding events associated with property damage totaled $20.637million dollars.

The most severe recent flooding occurred during the major storm of March 2010, when Essex County broke the record of 11 inches of rain set in 1953.
The weather pattern that caused these floods consisted of early springtime prevailing westerly winds that moved three successive storms, combined with tropical moisture from the Gulf of Mexico, across New England. Torrential rain falls lasting ten days caused March 2010 to be the wettest month on record for Essex County. Historically, NWS determined that March 2010 was the fourth wettest of any month since 1872.

Based on data from the National Weather Service, National Climatic Data Center, FEMA disaster declarations, the Essex County FIS, and local data sources, historic flood events from 1950 through April 30, 2014 were compiled and are summarized in Table 8. The table does not include events classified as Coastal Flood or Urban/Small Stream Floods.

Table 7: Essex County Flood Events 1950 – 4/30/2014 (Source: NOAA NCDC)

Location	County/Zone	State	Date	Time	Type	Dth	Inj	Prd
Totals:						2	3	20.637 M
WESTERN ESSEX (ZONE)	WESTERN ESSEX (ZONE)	MA	10/22/1996	12:00	Flood	0	0	0.00K
WESTERN ESSEX (ZONE)	WESTERN ESSEX (ZONE)	MA	10/22/1996	15:00	Flood	0	0	0.00K
WESTERN ESSEX (ZONE)	WESTERN ESSEX (ZONE)	MA	06/17/1998	17:00	Flood	0	0	0.00K
WESTERN ESSEX (ZONE)	WESTERN ESSEX (ZONE)	MA	06/18/1998	04:00	Flood	0	0	0.00K
EASTERN ESSEX (ZONE)	EASTERN ESSEX (ZONE)	MA	03/05/2001	08:00	Flood	0	0	0.00K
WESTERN ESSEX (ZONE)	WESTERN ESSEX (ZONE)	MA	04/03/2004	05:00	Flood	0	0	0.00K
WESTERN ESSEX (ZONE)	WESTERN ESSEX (ZONE)	MA	04/03/2004	12:00	Flood	0	0	0.00K
EASTERN ESSEX (ZONE)	EASTERN ESSEX (ZONE)	MA	10/15/2005	12:50	Flood	0	0	50.00K
EASTERN ESSEX (ZONE)	EASTERN ESSEX (ZONE)	MA	10/25/2005	15:26	Flood	0	0	45.00K
COUNTYWIDE	ESSEX CO.	MA	05/13/2006	10:30	Flood	0	0	0.00K
COUNTYWIDE	ESSEX CO.	MA	05/13/2006	10:30	Flood	2	0	7.000M
LYNN	ESSEX CO.	MA	07/11/2006	14:56	Flood	0	0	10.00K
PEABODY	ESSEX CO.	MA	07/28/2006	18:10	Flood	0	0	20.00K
PEABODY	ESSEX CO.	MA	03/02/2	12:45	Flood	0	0	20.00K

			007					
HAVERHILL	ESSEX CO.	MA	04/16/2007	01:25	Flood	0	0	45.00K
HAVERHILL	ESSEX CO.	MA	02/13/2008	15:20	Flood	0	0	30.00K
LITTLE NAHANT	ESSEX CO.	MA	03/08/2008	18:00	Flood	0	0	0.00K
SALEM	ESSEX CO.	MA	08/08/2008	18:42	Flood	0	0	25.00K
TAPLEYVILLE	ESSEX CO.	MA	09/06/2008	21:54	Flood	0	0	5.00K
SOUTH ESSEX	ESSEX CO.	MA	03/14/2010	07:28	Flood	0	1	9.800M
NEWBURY	ESSEX CO.	MA	03/30/2010	11:45	Flood	0	2	3.270M
NEWBURY	ESSEX CO.	MA	04/01/2010	00:00	Flood	0	0	0.00K
LYNN	ESSEX CO.	MA	08/05/2010	15:16	Flood	0	0	7.00K
SALEM MARITIME NHS	ESSEX CO.	MA	08/25/2010	09:44	Flood	0	0	0.00K
HAWTHORNE	ESSEX CO.	MA	10/04/2011	05:28	Flood	0	0	0.00K
SOUTH LAWRENCE	ESSEX CO.	MA	10/04/2011	06:38	Flood	0	0	5.00K
TOPSFIELD	ESSEX CO.	MA	10/04/2011	11:00	Flood	0	0	300.00K
PEABODY	ESSEX CO.	MA	06/23/2012	17:04	Flood	0	0	0.00K
SOUTH LYNNFIELD	ESSEX CO.	MA	06/23/2012	17:08	Flood	0	0	0.00K
LYNN	ESSEX CO.	MA	08/10/2012	18:04	Flood	0	0	0.00K
NORTH SAUGUS	ESSEX CO.	MA	06/24/2013	19:06	Flood	0	0	5.00K
MARSH CORNER	ESSEX CO.	MA	07/01/2013	15:18	Flood	0	0	0.00K

SALEM MARITIME NHS	ESSEX CO.	MA	07/01/2013	15:20	Flood	0	0	0.00K
RIVERVIEW	ESSEX CO.	MA	07/01/2013	16:14	Flood	0	0	0.00K
Totals:						2	3	20.637 M

Column Definitions:
'Dth': Deaths, 'Inj': Injuries, 'PrD': Property Damage

Previous Occurrences and Impacts of Coastal Flooding

In Lynn, the coast is protected by a sea wall which averages between 3-4 meters in height. The more inland part of Lynn is less directly protected since it has indirect protection from the Nahant causeway which blocks waves from entering the Lynn harbor. However, in an especially large storm surge this road would be largely underwater and provide little intended protection. Those affected; would be many businesses along the Lynnway such as car dealerships, Wal-Mart, Dunkin Donuts, Garelick Farms milk factory and a few grocery stores.

Examining the area it shows that the preparation is made for a storm of a certain size. Flooding from storms is usually expected at a certain level, however if it reaches over this limit the communities have a much greater risk of experiencing severe damage. Sea level has the potential rise due to climate factors and storm surges. In knowing this, it is important to be prepared for larger future flooding impacts, which may eventually come. Investing and preparing for flooding today will assist in protecting the communities.

Source: *Sea Level Rise Inundation Impacts for Coastal Southern Essex County, MA*
Joanna Orfanos, Phillip Shafovaloff, Simon Tolstopyatenko, December, 2009)

City-specific data for previous City-wide coastal flooding occurrences is not collected by the City and county flooding data was used as the next best available data for reviewing past events, calculating impacts and helping to determine future probability. Essex County, which includes Lynn, experienced twenty-two Coastal Flood events from 1950 – April 30, 2014. No deaths or injuries were reported and the total reported property damage was $7.015 million dollars.

In March of 2010, a stacked low pressure system (surface low and upper level low on top of each other) moved southeast of Nantucket, spreading rain across Southern New England. This resulted in widespread rainfall totals of three to six inches. In eastern Massachusetts, a strong southeasterly low level jet pumped ample moisture into the area, resulting in rainfall totals on the order of six to ten inches. This resulted in major flooding

across eastern Massachusetts and Rhode Island, including small stream, urban, and poor drainage flooding. In addition, the Concord River at Lowell, the Shawsheen River at Wilmington, and the Pawtuxet River at Cranston reached record flood stages within two to four days of the rain. The Governor of Massachusetts declared a state of emergency and this was followed by a federal disaster declaration for seven Massachusetts counties. Strong winds associated with the low pressure system and the low level jet affected both the east and south coasts, resulting in numerous downed trees and wires and some minor structural damage to a few buildings. (NWS).
See Table 9.

Table 9.
Essex County Coastal Flood Events 1950 – 4/30/2014 (Source: NOAA NCDC)

Location	County/Zone	State	Date	Time	Type	Dth	Inj	PrD
Totals:						0	0	7.015M
EASTERN ESSEX (ZONE)	EASTERN ESSEX (ZONE)	MA	01/31/2006	12:22	Coastal Flood	0	0	60.00K
EASTERN ESSEX (ZONE)	EASTERN ESSEX (ZONE)	MA	04/15/2007	21:00	Coastal Flood	0	0	5.00K
EASTERN ESSEX (ZONE)	EASTERN ESSEX (ZONE)	MA	04/16/2007	09:00	Coastal Flood	0	0	5.00K
EASTERN ESSEX (ZONE)	EASTERN ESSEX (ZONE)	MA	04/17/2007	22:00	Coastal Flood	0	0	20.00K
EASTERN ESSEX (ZONE)	EASTERN ESSEX (ZONE)	MA	11/03/2007	18:15	Coastal Flood	0	0	10.00K
EASTERN ESSEX (ZONE)	EASTERN ESSEX (ZONE)	MA	11/25/2008	09:40	Coastal Flood	0	0	0.00K
EASTERN ESSEX (ZONE)	EASTERN ESSEX (ZONE)	MA	06/21/2009	20:41	Coastal Flood	0	0	0.00K
EASTERN ESSEX (ZONE)	EASTERN ESSEX (ZONE)	MA	01/02/2010	10:34	Coastal Flood	0	0	0.00K
EASTERN ESSEX (ZONE)	EASTERN ESSEX (ZONE)	MA	02/25/2010	19:37	Coastal Flood	0	0	0.00K

EASTERN ESSEX (ZONE)	EASTERN ESSEX (ZONE)	MA	03/01/2010	10:00	Coastal Flood	0	0	0.00K
EASTERN ESSEX (ZONE)	EASTERN ESSEX (ZONE)	MA	03/04/2010	01:45	Coastal Flood	0	0	0.00K
EASTERN ESSEX (ZONE)	EASTERN ESSEX (ZONE)	MA	03/15/2010	11:30	Coastal Flood	0	0	0.00K
EASTERN ESSEX (ZONE)	EASTERN ESSEX (ZONE)	MA	12/27/2010	03:00	Coastal Flood	0	0	75.00K
EASTERN ESSEX (ZONE)	EASTERN ESSEX (ZONE)	MA	10/30/2011	01:15	Coastal Flood	0	0	10.00K
EASTERN ESSEX (ZONE)	EASTERN ESSEX (ZONE)	MA	06/02/2012	20:46	Coastal Flood	0	0	0.00K
EASTERN ESSEX (ZONE)	EASTERN ESSEX (ZONE)	MA	06/03/2012	21:35	Coastal Flood	0	0	30.00K
EASTERN ESSEX (ZONE)	EASTERN ESSEX (ZONE)	MA	06/04/2012	09:30	Coastal Flood	0	0	0.00K
EASTERN ESSEX (ZONE)	EASTERN ESSEX (ZONE)	MA	06/04/2012	22:14	Coastal Flood	0	0	0.00K
EASTERN ESSEX (ZONE)	EASTERN ESSEX (ZONE)	MA	12/27/2012	09:00	Coastal Flood	0	0	0.00K
EASTERN ESSEX (ZONE)	EASTERN ESSEX (ZONE)	MA	02/09/2013	08:33	Coastal Flood	0	0	5.800M
EASTERN ESSEX (ZONE)	EASTERN ESSEX (ZONE)	MA	03/07/2013	05:45	Coastal Flood	0	0	1.000M
EASTERN ESSEX (ZONE)	EASTERN ESSEX (ZONE)	MA	01/02/2014	11:05	Coastal Flood	0	0	0.00K
EASTERN	EASTERN	MA	01/03/201	11:34	Coastal	0	0	0.00K

ESSEX (ZONE)	ESSEX (ZONE)		4		Flood			
Totals:						0	0	7.015M

Repetitive Loss Structures

There are 18 repetitive loss structures in Lynn as of February 28, 2014, the latest data available from MA DCR. , This is an increase from the 9 structures identified in the 2005 *Lynn Hazard Mitigation Plan*. As defined by the Community Rating System (CRS) of the National Flood Insurance Program (NFIP), a repetitive loss property is any property which the NFIP has paid two or more flood claims of $1,000 or more in any given 10-year period since 1978. For more information on repetitive losses see http://www.fema.gov/business/nfip/replps.shtm.

Table 10. Repetitive Loss Properties Summary through 2/28/2014

	Number of Claims	Building Losses $	Contents Losses $	Total Losses Paid $
Single Family	20	174,896.42	26,009.65	200,906.07
2-4 Family	9	62,066.61		62,066.61
Other Residential	3	53,371.44		53,371.44
Non-Residential	14	5,256.00	201,630.02	206,886.02
TOTAL	**46**	**$295,590.47**	**$227,639.67**	**$523,230.14**

Dams and Dam Failure

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

There are over 2,500 dams in Massachusetts. The Army Corps of Engineers and the MA Department of Conservation and Recreation have determined that over 50 of these dams are "structurally unsafe". Three hundred dams, including over 40 of those rated as "High Hazard" dams by DCR's Office of Dam Safety, defines "High Hazard": as: 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).

Many of the dams in the state date back to the 19th century and were used to help power the industrial revolution, with some dams even going back to the 18th century. These dams, which pose significant risks, must be factored into local hazard mitigation planning under ordinary circumstances. They become an even greater risk under stress from an earthquake, when they could overtop or fail.

In accordance with changes in the Massachusetts dam safety regulations, dam owners are now responsible for registering, inspecting, reporting inspection results to the MA Office of Dam Safety and maintaining their dams in good operating condition.

In 2002 the Massachusetts legislature enacted revisions of the Dam Safety Statute, MGL Chapter 253 §§ 44-50, which significantly changes the responsibilities of dam owners to register, inspect and maintain dams in good operating condition. Amendments to Dam Safety Regulations 302 CMR 10.00-10.16 became effective November 4, 2005 and are reflective of the statutory changes. MGL Chapter 253 and 302 CMR 10.00 requires Emergency Action Plans be prepared, maintained and updated, by dam owners, for High Hazard Potential dams and certain Significant Hazard Potential dams.

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

In the event of a dam failure, the energy of the water stored behind even a small dam can cause loss of life and property damage if there are people or buildings downstream. The number of fatalities from a dam failure depends on the amount of warning provided to the population and the number of people in the area in the path of the dam's floodwaters. The Lynn Comprehensive Emergency Management Plan has a section on dam failure. The plan notes that dam failure in general is infrequent but has the potential for severe impacts.

The Department of Conservation and Recreation (DCR) Office of Dam Safety lists twelve dams located in Lynn. These are summarized in Table 8 and described below. Eight of the dams are rated as high hazard; one is rated as a significant hazard and one as a low hazard. DCR defines "Significant" and "Low Hazard dams as the following:

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

There have been no recorded dam breaches in Lynn.

Table 11 - Lynn Dams

Dam	Owner	Owner Type	Rating	Condition
Walden Pond East End Dam	Lynn Water and Sewer	Municipal	High Hazard	Fair
Birch Pond Dam	Lynn Water and Sewer	Municipal	High Hazard	Fair
Breed's Pond Outlet Dam #5	Lynn Water and Sewer	Municipal	High Hazard	Poor
Breed's Pond Lantern Rock Dike #4	Lynn Water and Sewer	Municipal	High Hazard	Fair
Breed's Pond Dike #8	Lynn Water and Sewer	Municipal	High Hazard	Satisfactory
Breed's Pond Dike #10	Lynn Water and Sewer	Municipal	High Hazard	Fair
Breed's Pond Dike #11	Lynn Water and Sewer	Municipal	High Hazard	Fair
Breed's Pond Dike #12	Lynn Water and Sewer	Municipal	High Hazard	Fair
Lynn Reservoir Dam	Lynn Water and Sewer	Municipal	Significant Hazard	Satisfactory
Sluice Pond Dam	Lynn	Municipal	Low Hazard	Fair
Hawkes Pond Outlet Dam	Lynn Water and Sewer	Municipal	High Hazard	Fair
Saugus River Dam	Lynn Water and Sewer	Municipal	Low Hazard	Fair

Walden Pond East End Outlet Dam is of earthen construction, a gravity dam. Its length is 2190 feet. Its capacity is 5500 acre feet. Normal storage is 4100 acre feet. It drains an area of 1.7 square miles. Built in 1905, the dam has had adequate levels of maintenance and standard procedures, though listed in only fair condition. There is a formal written Emergency Action Plan on file with the Lynn Emergency Management Department

Birch Pond Dam: The dam is L-shaped, about 80 ft. long and 27 ft. high. The dam is in poor condition. The upstream face is overgrown and eroded, the embankment crest deteriorated and abused by improper usage. It falls within the small size category and in the high hazard category. Failure of the dam would cause a flood through a thickly settled area. The City EMD has an Emergency Action Plan for the dam on file.

Breed's Pond Outlet Dam #5: The dam was built in 1914. Though listed in poor condition, adequate levels of maintenance and standard procedures have been instituted and detailed, updated written Emergency Action Plan (EAP) is available at Lynn EMD and filed with MA DCR.

Breed's Pond Lantern Rock Dike #4: Listed in fair condition; a written EAP is on file with the Lynn EMD. The dam is owned by the Lynn Water and Sewer Commission.

Breed's Pond Dike #8: Listed in satisfactory condition and a written EAP is on file with Lynn EMD. The dam is owned by the Lynn Water and Sewer Commission.

Breed's Pond Dike #10: Listed in fair condition and a written EAP is on file with Lynn EMD. The dam is owned by the Lynn Water and Sewer Commission.

Breed's Pond Dike #11: Listed in fair condition and a written EAP is on file with Lynn EMD. The dam is owned by the Lynn Water and Sewer Commission.

Breed's Pond Dike #12: Listed in fair condition and a written EAP is on file with Lynn EMD. The dam is owned by the Lynn Water and Sewer Commission.

Lynn Reservoir Dam: Listed in satisfactory condition and a written EAP is on file with Lynn EMD. The dam is owned by the Lynn Water and Sewer Commission.

Sluice Pond Dam: Construction was completed in 1900. It is owned by the City of Lynn. Sluice Pond Dam is of earthen construction, a gravity dam. Its length is 130 feet. Its capacity is 322 acre feet. Normal storage is 210 acre feet. It drains an area of 1.8 square miles. Listed as being in fair condition and classified as Low Hazard, there is no EAP for this dam on file.

Hawkes Pond Outlet Dam is of earthen construction, rock fill, a gravity dam. Its length is 1270 feet. Its capacity is 1250 acre feet. Normal storage is 850 acre feet. It drains an area of 1.8 square miles. Construction was completed in 1895. It is owned by Lynn Water and Sewer. A written EAP is on file with Lynn EMD for this dam.

Saugus River Dam: Located at the Wakefield/Lynnfield line on the Saugus River, this dam is low hazard and is not required to maintain an EAP.

All of the dams owned by the Lynn Water and Sewer Commission (LWSC) are critical to the water supply and are maintained and inspected on a regular basis.

The LWSC inspected all of its dams and dikes in 2003 and submitted a report to the DEM Office of Dam Safety. This report identified all rehabilitation work required at each dam. The Walden Pond dams were rehabilitated in 1999-2000 and the Hawkes Pond Dams were rehabilitated in 1997-1998. Birch Pond Dam, Breeds Pond Dam at Lantern Rock and Breeds Pond Outlet Dam have all been rehabilitated since 2005.

Coastal Hazards

Erosion and flooding are the primary coastal hazards that lead to the loss of lives or damage to property and infrastructure in developed coastal areas. Coastal storms are an intricate combination of events that impact a coastal area. A coastal storm can occur any time of the year and at varying levels of severity. One of the greatest threats from a coastal storm is coastal flooding due to storm surge. This is the inundation of land areas along the oceanic coast and estuarine shoreline by seawaters over and above normal tidal action.
High winds, erosion, heavy surf, unsafe tidal conditions, and fog are ordinary coastal hazard phenomena. Some or all of these processes can occur during a coastal storm, resulting in an often detrimental impact on the surrounding coastline. Storms including northeasters and hurricanes, decreased sediment supplies, and sea-level rise contribute to these coastal hazards.

Hurricanes and Nor'easters

Hurricanes and Nor'easters are two storm types that impact the coast and coastal resources. For this report Hurricanes and Nor'easters are identified and analyzed as an atmospheric and winter related hazard.

A northeast coastal storm, known as a nor'easter, is typically a large counter-clockwise wind circulation around a low-pressure center often resulting in heavy snow, high winds, and rain. Frequently, Nor'easters are a coastal event for Massachusetts.

Hurricanes are relatively fast moving, rarely impacting the coast over multiple tidal cycles. When landfall is made, these concentrated, strong low-pressure systems usually pound south facing shores with high winds, precipitation, and storm surge. A Category 2 storm can cause millions of dollars in damage.

Characteristics or impacts of coastal storms

	Nor'easters	Hurricanes
Similarities		
	Economic Impacts Winds Surge and Wave Action Inland Flooding potentials	
Differences		
Duration	Lasting days on average	Lasting only hours
Season	October-May	August-October
Evacuations	Fewer coastal area evacuations, off season	Very populated coastal areas
Debris impacts	Less foliage	Full foliage

Source: 2010 Mass. State Hazard Mitigation Plan

Decreased Sediment Supplies

Coastal landforms such as coastal banks are essential to maintaining a supply of sediment to beaches and dunes. Where engineered structures are used to stabilize shorelines, the natural process of erosion is interrupted, decreasing the amount of sediment available and causing erosion to adjacent areas. Under conditions of reduced sediment, the ability of coastal resource areas such as dunes and beaches to provide storm damage prevention and flood control benefits is continually reduced. A major challenge is to ensure that regional sediment supplies are managed effectively and in ways that allow the beneficial storm damage prevention and flood control functions of natural coastal processes to continue— both for future projects and, where possible, existing coastal development.

<u>Location</u>
In Lynn , the are greatest example of infrastructure that impacts sediment supplies to beaches is the Lynn Shore Drive seawall along King's Beach.
Coastal Erosion and Shoreline Change

Coastal shorelines change constantly in response to wind, waves, tides, sea level fluctuation, seasonal and climatic variations, human alteration, and other factors that influence the movement of sand and material within a shoreline system. The loss (erosion) and gain (accretion) of coastal land is a visible result of the way shorelines are reshaped in the face of these dynamic conditions. Shorelines tend to change seasonally, accreting slowly during the summer months when sediments are deposited by relatively low energy waves and eroding dramatically during the winter when sediments are moved offshore by high-energy storm waves, such as those generated by nor'easters. Regardless of the season, coastal storms typically cause erosion. With the anticipated change in

climate an increase in intensity and frequency of storms is expected. This will, in turn, increase the likelihood of severe erosion episodes along the coast of Massachusetts.

Coastal erosion and shoreline change can result in significant economic loss through the destruction of buildings, roads, infrastructure, natural resources, and wildlife habitats. Damage often results from the combination of an episodic event with severe storm waves and dune or bluff erosion.

Some of the methods used by property owners to stop, or slow down, coastal erosion or shoreline change can actually exacerbate the problem. Attempting to halt the natural process of erosion with seawalls and other hard structures typically worsens the erosion in front of the structure, prevents any sediment behind the structure from supplying down drift properties with sediment and subjects down drift beaches to increased erosion. Without the sediment transport associated with erosion, some of the Commonwealth's and LynnLynn's greatest assets and attractions – beaches, dunes, barrier beaches, salt marshes, and estuaries are threatened and will slowly disappear as the sediment sources that feed and sustain them are eliminated.

The Massachusetts Office Coastal Zone Management (CZM) has been collecting new data and studying and monitoring shoreline change. Additional information on shoreline change may be found in CZM's Fact Sheet on New Data on Shoreline Change online at http://www.mass.gov/czm/hazards/index.htm or http://www.mass.gov/czm/coastguide/online/index.htm

Location

Coastal Hazards are a City-wide hazard in regard to hurricanes and nor'easters. In addition, many of the same areas in Lynn vulnerable to coastal flooding are also subject to decreased sediment, coastal erosion and shoreline change including the following areas: Lynn Shore Drive in the vicinity of the Nahant rotary, the southern portion of Nahant Street, Surfside Road and Beach Road.

Extent and Previous Occurrences

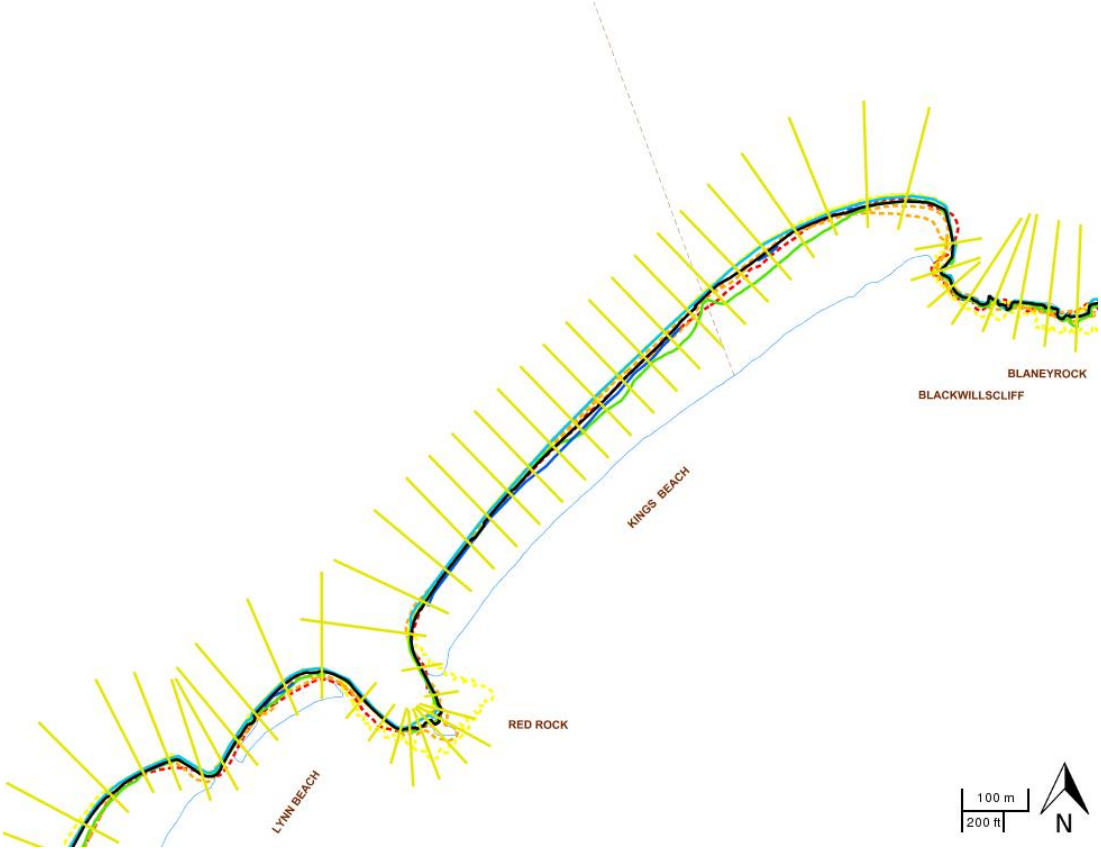
Erosion

Approximately 75 percent of the U.S. ocean shoreline is eroding. Massachusetts' ocean-facing shore is no exception. A study of shoreline change in Massachusetts by the U.S. Geological Survey, Woods Hole Oceanographic Institution Sea Grant Program, and Cape Cod Cooperative Extension reveals that approximately 68 percent, or 513 miles, of Massachusetts' ocean-facing shore exhibits a long-term erosion trend, 30 percent, or 226 miles, shows long-term accretion, and two percent, or 15 miles, shows no net change.

For the entire ocean-facing Massachusetts shore, from the mid -1800's to 1994, the long-term average annual shoreline change rate ranges between -0.58 and 0.75 feet per year.

Approximately 46 percent of the Massachusetts shore is eroding at one foot or less per year, while 22 percent of the shore is accreting at one foot or less per year. Eighty-one percent of the shore fluctuates +/-2 feet per year. Based on other studies (Pilkey & Thieler, 1992), 75 percent of the U.S. ocean shore is eroding, with the U.S. East Coast eroding at an average rate of 2-3 feet per year (Leatherman, 1993). Thus, Massachusetts' average annual shoreline change rate is lower than the East Coast average.

Figure 1. Historical Shoreline Change in Lynn's Shore Drive region from 1844-2009



Shoreline Change Transects

High Water Shorelines (1800s-2009)
1844 - 1897
1909 - 1938
1943 - 1969
1970 - 1982
1994
2000
2001
2007 - 2009

Massachusetts Municipal Boundaries
Lines
Towns
Interstate
Coast

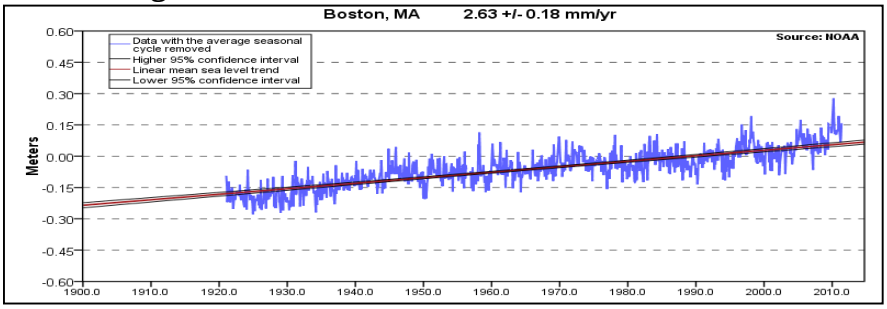
Geographic Place Names - Hypsographic Features

Source: MA CZM Shoreline Change Project

Sea Level Rise

A higher sea level increases the frequency and extent of coastal flooding. In the past 100 years, the relative change in sea level in nearby Boston Harbor has been a rise of about one foot (Figure 2). The change is relative, because it consists of two components: a rise in the absolute sea level and a sinking of the land. In the past 100 years, these two factors have been roughly equal, and, for the most part, represent long-term processes that have been underway since the end of the last Ice Age, approximately 14,000 years ago.

Figure 2 – Boston Sea Level Trends, 1920-2011



Source: National Oceanic and Atmospheric Administration (NOAA)

Climate change is accelerating the rate of global (absolute) sea-level rise (SLR) primarily by warming the oceans, causing the water already in them to expand, and by warming the land and air, causing ice on land (glaciers, ice sheets) to melt and flow into the ocean. A

recent report as part of the U.S. National Climate Assessment states that there is "very high confidence (>9 in 10 chance) that global mean sea level will rise at least 0.2 meters (8 inches) and no more than 2.0 meters (6.6 feet) by 2100."[1] The low end of this range represents a continuation of the current trend, which has a relatively small contribution from melting ice. The higher end includes greater contributions from melting ice, for which there is an increasing amount of data, though still not enough to resolve some uncertainties. The report presents four scenarios of sea-level rise that could be used depending on the time frame of projects and the level of risk that communities are willing to accept. Whatever the actual amount of sea-level rise by the end of the century, the oceans will likely continue to rise after that.

Table 12 - Global Sea-Level Rise Scenarios[2]

Scenario	SLR by 2100 (m)*	SLR by 2100 (ft)*
Highest	2.0	6.6
Intermediate-High	1.2	3.9
Intermediate-Low	0.5	1.6
Lowest	0.2	0.7

* Using mean sea level in 1992 as a starting point.

In addition to the rise of the global average, changes to the distribution of water around the globe will vary the amount of absolute sea-level rise that different localities experience. Changes in the temperature and salinity of water will affect ocean currents, and the melting of ice will alter the Earth's gravitational field. Both of these mechanisms could cause the Boston coastal region (and the Northeast coast overall) to see sea-level rise that, in the higher scenarios, is more than a foot greater than the global average. Early evidence of the predicted ocean-current effect was published in June 2012.[3]

Tables 13 and 14 show the extent of commercial and residential land that would be inundated by a range of 1-4 meters rise in sea level. Data is aggregate for Nahant, Lynn, Swampscott and Saugus.

Table 13. Commercial Inundation- Nahant, Lynn, Swampscott, Saugus

	Commercial/Industrial Inundation	% total Commercial
One Meter Inundation	104 Square Meters	0.16%
Two Meter Inundation	1231 Square Meters	1.90%

[1] Parris, Adam, et al. *Global Sea Level Rise Scenarios for the United States National Climate Assessment*, NOAA Technical Report OAR CPO-1, National Oceanic and Atmospheric Administration, December 2012.
[2] ibid.
[3] Sallenger Jr, A. , K. Doran, P. Howd, "Hotspot of accelerated sea-level rise on the Atlantic coast of North America," Nature Climate Change (2012) 2, 884–888, doi:10.1038/nclimate159724, June 2012. See also, Parris et al., supra., for a summary of all contributing factors.

Three Meter Inundation	10472 Square Meters	16.15%
Four meter Inundation	22195 Square Meters	34.23%
*Total Commercial/Industrial Land: 64,842 Square Meters out of 700,530 total land area (9.26%)		

Table 14. Residential Inundation- Nahant, Lynn, Swampscott, Saugus

	Residential Inundated	%
One Meter Inundation	282 Square Meters	0.10%
Two Meter Inundation	2671 Square Meters	0.93%
Three Meter Inundation	11400 Square Meters	3.96%
Four meter inundation	18280 Square Meters	6.34%
*Total Residential Land: 288,105 Square Meters out of 700,530 total land area (41.13%)		

Source: *Sea Level Rise Inundation Impacts for Coastal Southern Essex County, MA* Joanna Orfanos, Phillip Shafovaloff, Simon Tolstopyatenko, December, 2009)

Probability of Future Coastal Hazard Events

Coastal hazards, excepting Hurricanes, are classified as High frequency events as defined by Table 6. Coastal Hazards are hazard events that may occur more frequently than once in 10 years, (greater than 10% per year). Hurricanes, also described in Wind Related Hazards, are classified as Medium frequency events, a hazard event that may occur from once in 10 years to once in 100 years (1% to 10% per year).

Atlantic Based Tsunami

The Federal Emergency Management Agency defines tsunami as a series of enormous seismic sea waves created by an underwater disturbance caused by geologic activity in the form of earthquakes, volcanic eruptions, underwater landslides or meteorites striking the Earth. A tsunami can move hundreds of miles per hour in the open ocean and smash into land with waves as high as 100 feet or more. Earthquake induced movement of the ocean floor most often generates tsunamis. If a major earthquake or landslide occurs close to shore, the first wave in a series could reach the shore in a few minutes, even before a warning is issued. Coasts that are at greater risk are areas less than 25 feet above sea level and within a mile of the shoreline.

Location

Tsunamis are a City-wide hazard. Tsunami wave action over the shore is variable and mainly dependent of the combination of both submarine and land topography in the area and the orientation of the arriving waves. The extent of damage and impact from tsunami depends upon the source and severity of onset on the tide cycle. As such, all of Lynn would be considered vulnerable to coastal inundation from tsunami. Tsunamis were listed in the Massachusetts Hazard Mitigation Plan starting in 2010 and Lynn did not included Tsunamis in its 2005 Plan and does not have specific existing mitigation measures in place for the hazard.

Previous Occurrences

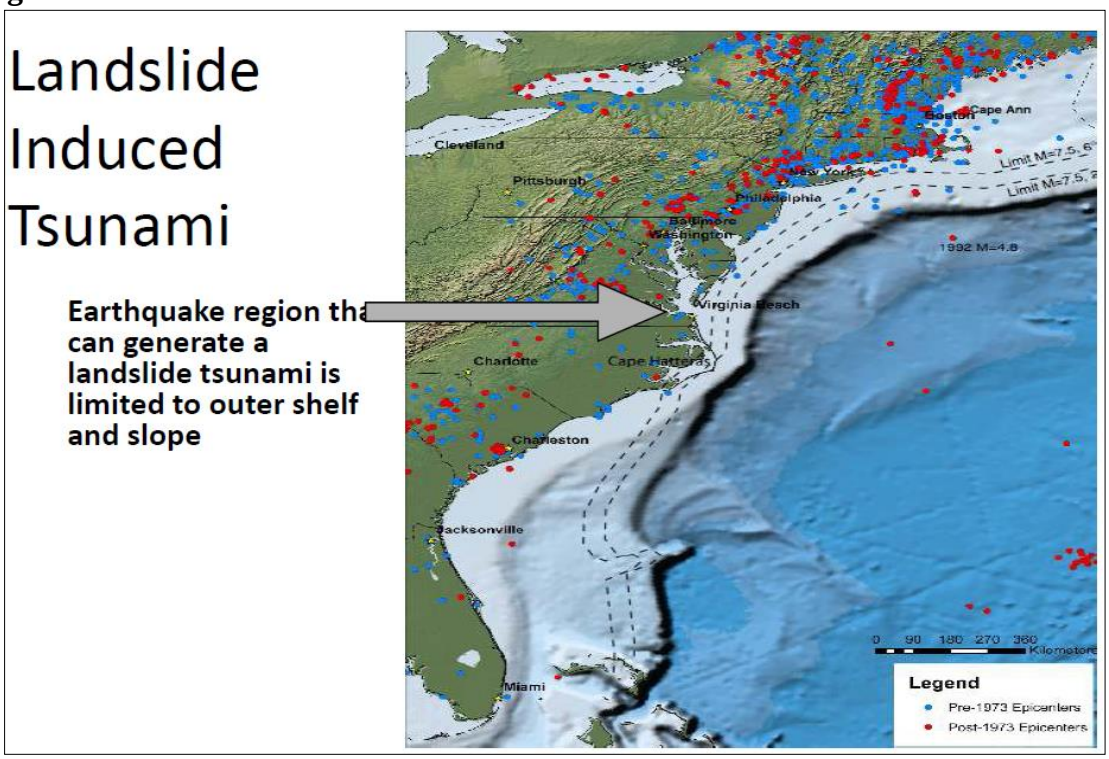
There have been no recorded instances of tsunamis in Essex County or Lynn.

Probability of Future Occurrences

According to the West Coast and Alaska Tsunami Warning Center (WCATWC), an Atlantic based tsunami threat level for the US east coast is low when compared to the US Pacific and Caribbean coasts. Although the probability is low, a tsunami threat does exist and it is not out of the realm of possibility for the Atlantic. Geophysics specialists and geologists from the U.S. Geologic Survey and the Woods Hole Oceanographic Institute have researched Georges Bank Lower Slope of the western North Atlantic and the relationship there between submarine landslides and earthquakes (see Figure XX). "The US Atlantic coast would be particularly vulnerable to devastation from tsunami because of the high density of population and infrastructure along its low lying coastal areas and estuaries."(Dr. Uri S ten Brink, et.al. Marine Geology 264, 2009, p.65) Further, Dr. ten Brink confirms that "the likelihood that a tsunami will hit this coast is fairly low. However, the most likely source will be a landslide that happens underwater at an area of about 215 miles offshore from Lynn in an area known as the Continental Slope. This is the area that separates the very wide and shallow shelf. The shelf is about 100 to 150 meters deep from the deep ocean." The US Geologic Survey is researching the probability of a landslide on the Continental Shelf.

Based on this assessment, the probability of a future tsunami hazard event in LynnLynn is very low, an event that could occur less frequently than once in 1,000 years, less than 0.1% per year.

Figure 3- Atlantic Based Tsunami- Potential Threat



Wind Related Hazards

Wind related hazards include hurricanes and tornadoes as well as high winds during severe rainstorms and thunderstorms

Lynn has been subject to a number of strong storms. These storms caused damage from rainfall and runoff, wind damage to buildings and utilities and the blocking of roads with debris – hindering emergency response. Lynn has experienced "micro-bursts" during thunderstorms when the wind blows in one direction and knocks down trees and creates debris.

Hurricanes

Hurricanes begin as tropical storms over the warm moist waters of the Atlantic, off the coast of West Africa, and Pacific Oceans near the equator. As the moisture evaporates, it rises until enormous amounts of heated, moist air are twisted high in the atmosphere. The winds begin to circle counterclockwise north of the equator or clockwise south of the equator. The center of the hurricane is called the eye.

Tropical cyclones (Tropical Depressions, Tropical Storms, and Hurricanes) form over the warm, moist waters of the Atlantic, Caribbean, and Gulf of Mexico. When water temperatures are at least 80° F, hurricanes can grow and thrive, generating enormous amounts of energy, which is released in the form of numerous thunderstorms, flooding rainfall, and, very damaging winds. The damaging winds help create a dangerous storm surge (rise in the water above the normal astronomical tide).

A Tropical Depression is declared when there is a low pressure center in the tropics with sustained winds of 25-33 mph. A Tropical Storm, which is given a name, is defined as having sustained winds from 34-73 mph. If sustained winds reach 74 mph or greater, it becomes a Hurricane.

Hurricanes can range from compact storms only 50 miles across, to huge storms, as much as 500 miles wide -- Hurricane Allen in 1980 took up the entire Gulf of Mexico. There generally are two source regions for the storms that have the potential to strike New England: 1) off the Cape Verde Islands near the west coast of Africa and 2) in the Bahamas. The Cape Verde storms tend to be very large in diameter, since they have a week or more to traverse the Atlantic Ocean and grow. Bahamas' storms tend to be smaller, but they can also be just as powerful and their effects can reach New England in only a day or two. (Source: 2010 Mass. Hazard Mitigation Plan)

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

Location

Hurricanes are a City-wide hazard. As with many communities damage to buildings and cars, tree loss and falling limbs, including downed power lines, are a serious hazard in Lynn. Removal of trees diseased trees and the potential for power loss and electrical safety due to tree blow downs on power lines and streets remains a concern for Lynn, as it did in its 2005 Plan. Since the 2005 Plan, Lynn has continued to invest in ongoing wind mitigation programs such as regular tree-trimming and removal of diseased trees as well as requiring all new construction to place its utilities underground. Two mitigation

measures in place are adherence to the Massachusetts State Building Code and the City's Comprehensive Emergency Management Plan, though the CEMP does so mostly from a response perspective. Lynn has begun to recently address hurricane preparedness by identifying densely populated, high risk areas subject to storm surge, developing evacuation route and personal preparedness outreach in multiple languages.

Previous Occurrences.
A Category One Hurricane passed through Lynn in 1944 as well as a tropical storm in 1923. The Category One Hurricane of 1944 brought winds of between 74-95 miles per hour to the City and it experienced elevated coastal surge and localized flooding. The City does not have a specific record of damage that may have occurred. A hurricane or tropical storm track is the line that delineates the path of the eye of the hurricane or storm. The City also feels the impacts of the wind and rain of other coastal storms and hurricanes, regardless of whether the track passes through the City. The hazard mapping indicates that the 100 year wind speed is 110 miles per hour. Information on hurricanes is shown on Map 5 in Appendix B.

Table 15 Hurricane Records for Massachusetts 1938 - 2013

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

Table 16- Hurricane Disaster Declarations-includes Lynn

Disaster	**Title**	**Dates**	**Disaster**
DR-751	Hurricane Gloria	9/27/1985	DR-751
DR-914	Hurricane Bob	8/19/1991	DR-914
EM-3252	Hurricane Katrina Evacuation	8/29/2005-10/1/2005	EM-3252
EM-3315	Hurricane Earl	9/1/2010-9/4/2010	EM-3315
EM-3350	Hurricane Sandy	10/29/12–10/30	EM-3350

It is important to note, that Hurricane Irene from August 21 – 30, 2011 and most recently Hurricane Sandy from October 22 – 31, 2012 fortunately did not track directly over Lynn. Hurricane Sandy was a Category 3 hurricane at its peak intensity and weakened to a Category 2 off the northeastern Atlantic coast. Hurricane Sandy became the largest Atlantic hurricane on record with winds spanning 1,100 miles. Strong tropical force winds from the northeast quadrant of the post tropical cyclone, Sandy developed into a super storm nor'easter that impacted Lynn and Essex County.

Local impacts from Hurricane Sandy included the following reported items:

"City officials designated the school a city shelter Sunday evening, outfitted it with cots and provided food. City workers assigned to the school said nine people spent time there between 9 a.m. and 3:30 p.m.

District Fire Chief Lawrence Godbout said emergency workers took a man struck on the head by a tree limb to Salem Hospital. The accident occurred on Jones Terrace off Boston Street at about 2:40 p.m. Wind damage and downed limbs calls came from locations across the city including Parrott Street, Boston Street near North Franklin Street, and Holyoke Street.

Firefighters converged on 682 Summer St., Lynn, where high winds stripped part of the flat roof off a three-family apartment building.

As of 5 p.m. Monday, National Grid listed 2,976 customers without power in Saugus; 988 in Lynn where outages were listed in the Highlands and off Lynnfield Street earlier in the day, and 904 in Revere.

Mayor Judith Flanagan Kennedy closed City Hall early after a telephone conference with the Massachusetts Emergency Management Agency. She said the MEMA update said winds would peak between 2 p.m. and 10 p.m.

National Grid reported 1,037 customers without power on its website shortly before 1 p.m. with some of the outages reported in the Highlands and near Harris Road off Lynnfield Street.

Lynn's Emergency Management Director, Thomas Hines, said four River Street residents voluntarily evacuated their homes shortly before 11 a.m. Monday out of concern for Saugus River flooding related to storm-related tidal surges.

State and Lynn police shut down Lynn Shore Drive to traffic from Nahant Street and Eastern Avenue shortly before 11 a.m. as Hurricane Sandy surged into the Drive's seawall, sending waves crashing into the Red Rock Park seawall."

Source: *Lynn Item*, Tuesday, October 30, 2012

Lynn Shore Drive- Hurricane Sandy
Courtesy of Karen Carduff Bowden, *LynnHappens.com*

Uprooted Tree near Flax Pond in Lynn, Hurricane Sandy
Courtesy of Chris Cole, *LynnHappens.com*

Tornados

A tornado is a narrow, violently rotating column of air that extends from the base of a thunderstorm to the ground. Because wind is invisible, you can't always see a tornado. A visible sign of the tornado is the dust and debris which can get caught in the rotating column made up of water droplets. Tornados are the most violent of all atmospheric storms.

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 (i.e., from southeast at the surface to west aloft)
- Increasing wind speed 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

Tornados can form from individual cells within severe thunderstorm squall lines. They can form from an isolated 'supercell' thunderstorm. They can be spawned by tropical cyclones or even their remnants that are passing through. And, weak tornados can even sometimes occur from air that is converging and spinning upward, with little more than a rain shower occurring in the vicinity.

Typically, there are 1 to 3 tornados somewhere in southern New England per year. Most occur in the late afternoon and evening hours, when the heating is the greatest. The most common months are June, July, and August, but the Great Barrington, MA tornado (1995) occurred in May and the Windsor Locks, CT tornado (1979) occurred in October.

(2010 Mass. State Hazard Mitigation Plan)

Waterspout

A waterspout is a rapidly rotating column of air extending from the cloud base (typically a cumulonimbus thunderstorm) to a water surface, such as a bay or the ocean. There are two methods of formation.

First, unlike a tornado, waterspouts can form on a clear, sunny day if the right amount of instability and wind shear exists. These storms can have wind speeds ranging from 60 to 100 mph, but since they do not move very far, they can often be navigated around. These can become a threat to land if they do drift onshore.

A tornadic waterspout, on the other hand, is a true tornado that happens to be moving over water at the time (tornado over water). These form from the same processes that cause Tornados (see section above).

The National Weather Service issues a Special Marine Warning (SMW) for waterspouts over the coastal waters. They also issue a Tornado Warning (TOR) if a waterspout shows signs of moving toward land.

The Enhanced Fujita Tornado Scale

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). It is considerably more complicated than the original F-scale, and it allows surveyors to create more precise assessments of tornado severity.

Figure 4: Enhanced Tornado Fujita Scale

Fujita Scale			Derived		Operational EF Scale	
F Number	Fastest ¼ mile (mph)	3-second gust (mph)	EF Number	3-second gust (mph)	EF Number	3-second 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, 2010

Location

Tornados are a City -wide hazard. Tornados tend to be quite rare in eastern Massachusetts and there have been no recorded tornados in the City.. There have been no changes since the 2005 NHM Plan to address tornados in Lynn beyond maintaining emergency shelter in the event that they were needed.

The City has adopted the Massachusetts State Building Code. The code's provisions are the most cost-effective mitigation measure against tornados given the lower probability of occurrence of a large tornado . The City does maintain certified emergency shelters at the Lynn English, Lynn Classical, and Lynn Technical School High Schools if they were needed in case of evacuations due to tornadoes or other emergencies. If a tornado were to occur in Lynn, damages would be most likely be serious due to the prevalence of older construction and the density of development.

Previous Occurrences

Lynn does not collect local data for tornado occurrence or related impacts to the community. Essex County data is the best available data to help understand previous occurrences, related impacts and the probability of future tornado hazard events. Essex County, which includes Lynn, experienced 11 tornado events from 1950 – April 30,

2014. There were no reported deaths but four injuries were reported for Essex County and there was $562,780 in reported property damage. Nine of the tornados were F-1 magnitude and two were F-2. (NOAA National Climate Data Center)

On Monday, July 28, 2014 a tornado struck the City of Revere, MA which is located adjacent to Lynn, though located in Suffolk County. There were several minor injuries but no deaths. Property damage estimates are preliminary but public property damages are thought to be at least $2 million dollars with private estimates still incomplete. The tornado was F-2 in magnitude and was on the ground for approximately four minutes in Revere.

Table 17- Essex County Tornados 1950 – 4/30/2014

Location Countye	St.	Date	Time	T.Z.	Type	Mag	Dth	Inj	PrD
							0	4	562.78K
ESSEX CO.	MA	08/21/1951	14:00	CST	Tornado	F2	0	0	2.50K
ESSEX CO.	MA	06/13/1956	15:45	CST	Tornado	F1	0	0	2.50K
ESSEX CO.	MA	11/21/1956	22:40	CST	Tornado	F2	0	0	25.00K
ESSEX CO.	MA	12/18/1956	09:15	CST	Tornado	F1	0	0	0.25K
ESSEX CO.	MA	07/13/1960	15:00	CST	Tornado	F0	0	0	0.03K
ESSEX CO.	MA	07/21/1962	17:00	CST	Tornado	F1	0	3	25.00K
ESSEX CO.	MA	05/19/1964	14:25	CST	Tornado	F0	0	0	2.50K
ESSEX CO.	MA	05/19/1964	14:35	CST	Tornado	F1	0	0	2.50K
ESSEX CO.	MA	08/10/1965	16:30	CST	Tornado	F1	0	0	0.00K
ESSEX CO.	MA	07/01/1968	19:00	CST	Tornado	F1	0	1	250.00K
ESSEX CO.	MA	07/21/1972	15:22	CST	Tornado	F1	0	0	2.50K
ESSEX CO.	MA	08/15/1991	16:35	EST	Tornado	F1	0	0	250.00K
Total					**11**		**0**	**4**	**562.78K**

Source: National Climatic Data Center

Probability of Future Tornado Events

Based on the record of previous occurrences since 1950, Tornado events in Lynn are now a Medium frequency event as defined by the 2010 Massachusetts State Hazard Mitigation Plan. This hazard may occur from once in 10 years to once in 100 years, 1% to 10% per year.

Winter Storms

Snow and Blizzards

Snow is frozen precipitation in the form of a six-sided ice crystal. Snow formation requires temperatures to be below freezing in all or most of the atmosphere from the surface up to cloud level.

Snow can fall when surface temperatures are above freezing in a relatively shallow layer. In situations like this, the snow will not have enough time to melt before reaching the ground - though it will be quite wet with large flakes, the result of wet snowflakes sticking to one another.

Generally, ten inches of snow will melt into one inch of water. Sometimes the snow-liquid ratio may be much higher - on the order of 20:1 or 30:1. This commonly happens when snow falls into a very cold air mass, with temperatures of 20 degrees or less at ground-level. Blowing snow is wind driven snow that reduces visibility to six miles or less causing significant drifting. Blowing snow may be snow that is falling and/or loose snow on the ground picked up by the wind.

A Blizzard is a winter snow storm with sustained or frequent wind gusts to 35 mph or more, accompanied by falling or blowing snow reducing visibility to or below ¼ mile. These conditions must be the predominant condition over a 3 hour period. Extremely cold temperatures are often associated with blizzard conditions, but are not a formal part of the definition. The hazard created by the combination of snow, wind and low visibility significantly increases, however, with temperatures below 20 degrees.

A severe blizzard is categorized as having temperatures near or below 10 °F, winds exceeding 45 mph, and visibility reduced by snow to near zero.

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. In New England, 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 impact of heavy snowfall is to impair the flow of vehicles needed for day-to-day commuting, local businesses and public safety response. The average annual snowfall for the Town is 36.1 inches to 48 inches. See Map 6 in Appendix B for more information.

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:

Figure 5. Northeast Snowfall Impact Scale

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: 2010 State Hazard Mitigation Plan

Location

Winter snow storms and extended cold weather are frequent hazards in New England and Lynn. Snow, Nor'easters and blizzards are City-wide hazards. The impact of heavy snowfall is to impair the flow of vehicles needed for day-to-day commuting, local businesses and public safety response. Lynn has experienced several record breaking storms since the 1978 storm and has developed training, techniques and practices to efficiently deal with these events.

Because a major feature of winter storms is the tendency for higher tides with associated flooding, the same mitigation measures in place for flooding are all important for mitigating the impacts of winter storms. However, the rapid melting of snow after major storms, combined with rainfall, is more of a common flooding threat.

The DPW works to clear roads as requested by emergency service providers and carries on general snow removal operations. The MA Department of Transportation removes snow from State Highways 107 and 129, as well as parts of State Route 1A. Since 2005, the City has also reduced its use of sand, opting for 100% salt, which reduces the sand which must be swept from the streets once winter has passed.

The City continues to ban on-street parking at nights during snow storm events and during snow removal to ensure that streets can be plowed and public safety vehicle access is maximized. Information on winter storm related hazards can be found on Map 6 in Appendix B.

Information on winter storm related hazards can be found on Map 6 in Appendix B.

Previous Occurrences

The City does not collect data on snow and blizzard events. The most severe winter storm in recent history, the Great Blizzard of 1978 heavily impacted the Lynn, Revere, and Saugus coastal areas. It damaged 25% of Revere's homes, left 3,000 people homeless, and flooded over 3,000 buildings in the Lynn, Revere, Saugus and Malden area. The storm's impacts led these communities to request the Army Corps of Engineers to develop and implement the Saugus River and Tributaries Flood Damage Reduction Project, which was completed by 1989. Included in the plans recommendations and since installed, were dikes and a pooling area for Revere Beach, floodgates for the Saugus River (located just south of the entrance to Lynn Harbor), and a series of dikes, walls and revetments along Lynn Harbor. (ACOE)

Historically, severe winter storms impacting Lynn have occurred in the following years:

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

Essex County, which includes Lynn, is the best available data to help understand previous occurrences, related impacts and the probability of future snow and blizzard hazard events. According to present NCDC records, the County experienced one blizzard between 1950 and4/30/ 2014, in 2013, which resulted in no deaths or injuries but with$56,000 in property damage in Essex County. For the same time period, Essex County and Lynn experienced 60 heavy snowfall event days, resulting in 0 deaths, no injuries and $7.313 million dollars in property damage. Using the NESIS scale for magnitude and the National Weather Service's definition of heavy snowfall, it can be deduced that Lynn and heavily urbanized Essex County have experienced 60 NESIS Category 3 Major heavy snowfall events since 1950.

See Tables 18 and 19 below for Blizzard and Heavy Snow events and impacts.

Table 18. Blizzard Events and Impacts in Essex County from 1950 – 4/30/2014.

Location County/Zone	St.	Date	Time	T.Z.	Type	Mag	Dth	Inj	PrD
							0	0	56.00K
EASTERN ESSEX (ZONE)	MA	02/08/2013	18:00	EST-5	Blizzard		0	0	56.00K
WESTERN ESSEX (ZONE)	MA	02/08/2013	19:00	EST-5	Blizzard		0	0	0.00K
							0	0	56.00K

Table 19. Heavy Snow Events and Impacts in Essex County from 1950 – 4/30/2014.

Location Cunty/Zone	St.	Date	Time	T.Z.	Type	Mag	Dth	Inj	PrD
							0	0	7.313M
EASTERN ESSEX (ZONE)	MA	01/02/1996	21:00	EST	Heavy Snow		0	0	0.00K
WESTERN ESSEX (ZONE)	MA	01/02/1996	21:00	EST	Heavy Snow		0	0	0.00K
EASTERN ESSEX (ZONE)	MA	01/07/1996	17:00	EST	Heavy Snow		0	0	1.000M
WESTERN ESSEX (ZONE)	MA	01/07/1996	17:00	EST	Heavy Snow		0	0	1.000M
EASTERN ESSEX (ZONE)	MA	01/10/1996	00:00	EST	Heavy Snow		0	0	0.00K
WESTERN ESSEX (ZONE)	MA	01/12/1996	14:00	EST	Heavy Snow		0	0	0.00K
EASTERN ESSEX	MA	02/02/1996	22:00	EST	Heavy Snow		0	0	0.00K

(ZONE)									
EASTERN ESSEX (ZONE)	MA	02/16/1996	13:00	EST	Heavy Snow		0	0	0.00K
WESTERN ESSEX (ZONE)	MA	03/02/1996	10:00	EST	Heavy Snow		0	0	0.00K
EASTERN ESSEX (ZONE)	MA	03/02/1996	10:00	EST	Heavy Snow		0	0	0.00K
EASTERN ESSEX (ZONE)	MA	03/07/1996	10:00	EST	Heavy Snow		0	0	0.00K
WESTERN ESSEX (ZONE)	MA	03/07/1996	10:00	EST	Heavy Snow		0	0	0.00K
EASTERN ESSEX (ZONE)	MA	04/09/1996	18:00	EST	Heavy Snow		0	0	0.00K
WESTERN ESSEX (ZONE)	MA	04/09/1996	18:00	EST	Heavy Snow		0	0	0.00K
EASTERN ESSEX (ZONE)	MA	12/06/1996	08:00	EST	Heavy Snow		0	0	0.00K
WESTERN ESSEX (ZONE)	MA	12/06/1996	08:00	EST	Heavy Snow		0	0	0.00K
EASTERN ESSEX (ZONE)	MA	12/07/1996	16:00	EST	Heavy Snow		0	0	1.360M
WESTERN ESSEX (ZONE)	MA	12/07/1996	16:00	EST	Heavy Snow		0	0	1.360M
EASTERN ESSEX (ZONE)	MA	02/16/1997	21:00	EST	Heavy Snow		0	0	0.00K
WESTERN ESSEX (ZONE)	MA	03/31/1997	14:00	EST	Heavy Snow		0	0	0.00K

EASTERN ESSEX (ZONE)	MA	03/31/1997	22:00	EST	Heavy Snow		0	0	0.00K
WESTERN ESSEX (ZONE)	MA	04/01/1997	00:00	EST	Heavy Snow		0	0	2.500M
EASTERN ESSEX (ZONE)	MA	04/01/1997	00:00	EST	Heavy Snow		0	0	0.00K
WESTERN ESSEX (ZONE)	MA	11/14/1997	06:00	EST	Heavy Snow		0	0	0.00K
EASTERN ESSEX (ZONE)	MA	11/14/1997	06:00	EST	Heavy Snow		0	0	0.00K
WESTERN ESSEX (ZONE)	MA	12/23/1997	09:00	EST	Heavy Snow		0	0	0.00K
EASTERN ESSEX (ZONE)	MA	12/23/1997	09:00	EST	Heavy Snow		0	0	0.00K
EASTERN ESSEX (ZONE)	MA	01/15/1998	21:00	EST	Heavy Snow		0	0	0.00K
WESTERN ESSEX (ZONE)	MA	01/15/1998	21:00	EST	Heavy Snow		0	0	0.00K
WESTERN ESSEX (ZONE)	MA	01/14/1999	00:00	EST	Heavy Snow		0	0	0.00K
EASTERN ESSEX (ZONE)	MA	01/14/1999	00:00	EST	Heavy Snow		0	0	0.00K
WESTERN ESSEX (ZONE)	MA	03/06/1999	15:00	EST	Heavy Snow		0	0	0.00K
EASTERN ESSEX (ZONE)	MA	03/06/1999	15:00	EST	Heavy Snow		0	0	0.00K
WESTERN	MA	03/15/1999	00:00	EST	Heavy		0	0	0.00K

ESSEX (ZONE)					Snow				
EASTERN ESSEX (ZONE)	MA	03/15/1999	00:00	EST	Heavy Snow		0	0	0.00K
EASTERN ESSEX (ZONE)	MA	01/13/2000	06:00	EST	Heavy Snow		0	0	0.00K
WESTERN ESSEX (ZONE)	MA	01/13/2000	06:00	EST	Heavy Snow		0	0	0.00K
WESTERN ESSEX (ZONE)	MA	02/18/2000	12:00	EST	Heavy Snow		0	0	0.00K
EASTERN ESSEX (ZONE)	MA	02/18/2000	12:00	EST	Heavy Snow		0	0	0.00K
WESTERN ESSEX (ZONE)	MA	12/30/2000	13:00	EST	Heavy Snow		0	0	0.00K
WESTERN ESSEX (ZONE)	MA	01/20/2001	21:00	EST	Heavy Snow		0	0	0.00K
EASTERN ESSEX (ZONE)	MA	01/20/2001	21:00	EST	Heavy Snow		0	0	0.00K
WESTERN ESSEX (ZONE)	MA	02/05/2001	14:00	EST	Heavy Snow		0	0	0.00K
EASTERN ESSEX (ZONE)	MA	02/05/2001	14:00	EST	Heavy Snow		0	0	0.00K
WESTERN ESSEX (ZONE)	MA	03/05/2001	13:00	EST	Heavy Snow		0	0	0.00K
EASTERN ESSEX (ZONE)	MA	03/05/2001	13:00	EST	Heavy Snow		0	0	0.00K
WESTERN ESSEX	MA	03/09/2001	15:00	EST	Heavy Snow		0	0	0.00K

(ZONE)									
EASTERN ESSEX (ZONE)	MA	03/09/2001	15:00	EST	Heavy Snow		0	0	0.00K
WESTERN ESSEX (ZONE)	MA	03/30/2001	22:00	EST	Heavy Snow		0	0	0.00K
WESTERN ESSEX (ZONE)	MA	12/08/2001	23:00	EST	Heavy Snow		0	0	0.00K
EASTERN ESSEX (ZONE)	MA	02/01/2003	21:00	EST	Heavy Snow		0	0	0.00K
WESTERN ESSEX (ZONE)	MA	02/01/2003	21:00	EST	Heavy Snow		0	0	0.00K
EASTERN ESSEX (ZONE)	MA	03/16/2004	16:00	EST	Heavy Snow		0	0	0.00K
WESTERN ESSEX (ZONE)	MA	03/16/2004	16:00	EST	Heavy Snow		0	0	0.00K
WESTERN ESSEX (ZONE)	MA	02/21/2005	01:00	EST	Heavy Snow		0	0	0.00K
WESTERN ESSEX (ZONE)	MA	01/23/2006	10:45	EST	Heavy Snow		0	0	20.00K
EASTERN ESSEX (ZONE)	MA	12/13/2007	11:00	EST-5	Heavy Snow		0	0	0.00K
WESTERN ESSEX (ZONE)	MA	12/13/2007	11:00	EST-5	Heavy Snow		0	0	0.00K
EASTERN ESSEX (ZONE)	MA	12/16/2007	04:30	EST-5	Heavy Snow		0	0	0.00K
WESTERN ESSEX (ZONE)	MA	12/16/2007	04:30	EST-5	Heavy Snow		0	0	0.00K

EASTERN ESSEX (ZONE)	MA	12/19/2007	16:00	EST-5	Heavy Snow		0	0	0.00K
WESTERN ESSEX (ZONE)	MA	12/19/2007	16:00	EST-5	Heavy Snow		0	0	0.00K
EASTERN ESSEX (ZONE)	MA	01/14/2008	04:00	EST-5	Heavy Snow		0	0	28.00K
WESTERN ESSEX (ZONE)	MA	01/14/2008	04:30	EST-5	Heavy Snow		0	0	20.00K
WESTERN ESSEX (ZONE)	MA	02/22/2008	12:00	EST-5	Heavy Snow		0	0	0.00K
EASTERN ESSEX (ZONE)	MA	02/22/2008	15:00	EST-5	Heavy Snow		0	0	0.00K
EASTERN ESSEX (ZONE)	MA	12/19/2008	13:50	EST-5	Heavy Snow		0	0	0.00K
WESTERN ESSEX (ZONE)	MA	12/19/2008	13:54	EST-5	Heavy Snow		0	0	0.00K
WESTERN ESSEX (ZONE)	MA	12/21/2008	07:48	EST-5	Heavy Snow		0	0	0.00K
EASTERN ESSEX (ZONE)	MA	12/31/2008	08:00	EST-5	Heavy Snow		0	0	0.00K
WESTERN ESSEX (ZONE)	MA	12/31/2008	08:00	EST-5	Heavy Snow		0	0	0.00K
EASTERN ESSEX (ZONE)	MA	01/11/2009	00:14	EST-5	Heavy Snow		0	0	0.00K
WESTERN ESSEX (ZONE)	MA	01/11/2009	03:00	EST-5	Heavy Snow		0	0	0.00K
WESTERN	MA	01/18/2009	05:12	EST-	Heavy		0	0	0.00K

ESSEX (ZONE)				5	Snow				
WESTERN ESSEX (ZONE)	MA	03/01/2009	23:00	EST-5	Heavy Snow		0	0	0.00K
EASTERN ESSEX (ZONE)	MA	03/01/2009	23:00	EST-5	Heavy Snow		0	0	0.00K
WESTERN ESSEX (ZONE)	MA	03/09/2009	04:00	EST-5	Heavy Snow		0	0	0.00K
EASTERN ESSEX (ZONE)	MA	12/20/2009	01:00	EST-5	Heavy Snow		0	0	0.00K
WESTERN ESSEX (ZONE)	MA	12/20/2009	01:00	EST-5	Heavy Snow		0	0	0.00K
WESTERN ESSEX (ZONE)	MA	01/18/2010	01:00	EST-5	Heavy Snow		0	0	0.00K
EASTERN ESSEX (ZONE)	MA	02/16/2010	08:40	EST-5	Heavy Snow		0	0	15.00K
WESTERN ESSEX (ZONE)	MA	02/16/2010	09:00	EST-5	Heavy Snow		0	0	0.00K
WESTERN ESSEX (ZONE)	MA	01/12/2011	02:00	EST-5	Heavy Snow		0	0	0.00K
EASTERN ESSEX (ZONE)	MA	01/26/2011	21:00	EST-5	Heavy Snow		0	0	0.00K
WESTERN ESSEX (ZONE)	MA	01/26/2011	22:00	EST-5	Heavy Snow		0	0	0.00K
EASTERN ESSEX (ZONE)	MA	02/08/2013	05:00	EST-5	Heavy Snow		0	0	0.00K
WESTERN ESSEX	MA	02/08/2013	06:00	EST-5	Heavy Snow		0	0	0.00K

(ZONE)									
EASTERN ESSEX (ZONE)	MA	03/07/2013	08:00	EST-5	Heavy Snow		0	0	0.00K
WESTERN ESSEX (ZONE)	MA	03/07/2013	08:00	EST-5	Heavy Snow		0	0	0.00K
WESTERN ESSEX (ZONE)	MA	03/18/2013	22:00	EST-5	Heavy Snow		0	0	0.00K
EASTERN ESSEX (ZONE)	MA	03/18/2013	23:00	EST-5	Heavy Snow		0	0	0.00K
EASTERN ESSEX (ZONE)	MA	12/14/2013	17:30	EST-5	Heavy Snow		0	0	0.00K
WESTERN ESSEX (ZONE)	MA	12/14/2013	17:30	EST-5	Heavy Snow		0	0	0.00K
EASTERN ESSEX (ZONE)	MA	12/17/2013	16:00	EST-5	Heavy Snow		0	0	0.00K
WESTERN ESSEX (ZONE)	MA	12/17/2013	16:00	EST-5	Heavy Snow		0	0	0.00K
EASTERN ESSEX (ZONE)	MA	01/02/2014	05:00	EST-5	Heavy Snow		0	0	0.00K
WESTERN ESSEX (ZONE)	MA	01/02/2014	05:00	EST-5	Heavy Snow		0	0	0.00K
WESTERN ESSEX (ZONE)	MA	01/18/2014	11:00	EST-5	Heavy Snow		0	0	10.00K
EASTERN ESSEX (ZONE)	MA	02/05/2014	03:00	EST-5	Heavy Snow		0	0	0.00K
WESTERN ESSEX (ZONE)	MA	02/05/2014	03:00	EST-5	Heavy Snow		0	0	0.00K

EASTERN ESSEX	MA	02/13/2014	06:30	EST-5	Heavy Snow		0	0	0.00K
WESTERN ESSEX	MA	02/13/2014	06:30	EST-5	Heavy Snow		0	0	0.00K
WESTERN ESSEX	MA	02/18/2014	10:00	EST-5	Heavy Snow		0	0	0.00K
TOTAL							**0**	**0**	**7.313M**

Fire Related Hazards

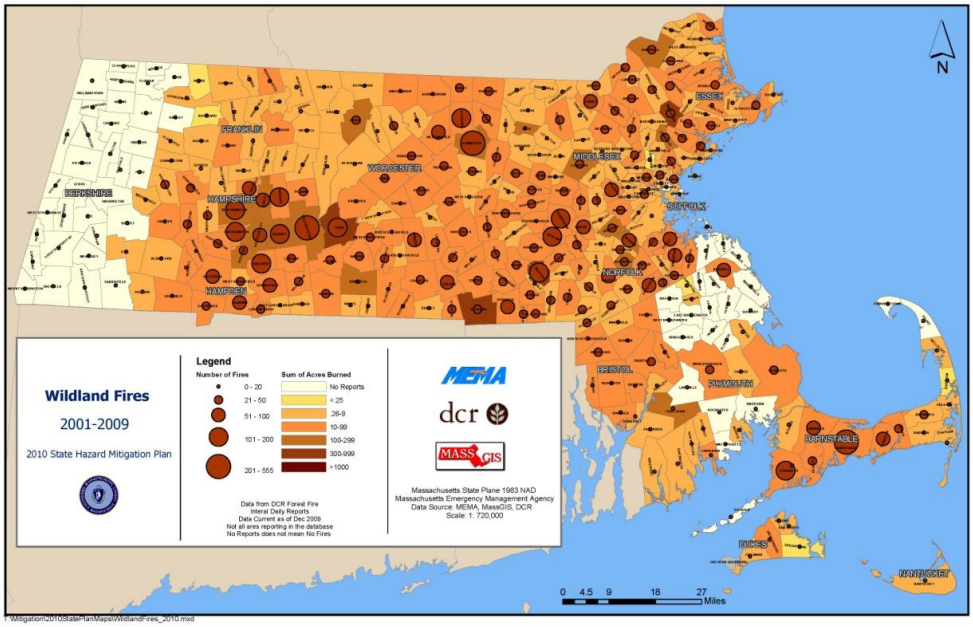
Wildfires

A wildfire is any uncontrolled fire that occurs in a suburban or a wilderness area. A wildfire differs greatly from other fires by its extensive size, the speed at which it can spread out from its original source, its potential to unexpectedly change direction, and its ability to jump gaps such as roads, rivers and firebreaks. Wildfire season can begin in March and usually ends in late November. The majority of wildfires typically occur in April and May, when the majority of vegetation is void of any appreciable moisture, making them highly flammable.

Extent

Wildfires in Massachusetts are measured by the number of fires and the sum of acres burned. The most recent data available for wildfires in Massachusetts, shown below in Figure 6, indicates that the wildfire extent in Lynn consists of 20-98 acres burned, with Lynn experiencing between 0-20 recordable fires between 2001 and 2009.

Figure.6 MA Wildfires 2001-2009



Location
. The City listed the following areas of concern for fire related hazards:

- Lynn Woods Reservation
- Spring Pond Woods
- Cedar Brook Road Area
- King's Lynn Woods

Mapped areas of brush fire concern can be found in Appendix B.

Outdoor burning is not allowed. While no loss of life has been recorded in fighting brush fires, several of the fires have spread into occupied buildings and caused firefighter injury. Most of the fires are seen to be caused by carelessness. There is wide access to wooded areas in Lynn from the neighboring communities of Saugus and Lynnfield and the City sees brush fires as a regional natural hazard issue. Brush fires are responded to as a regular fire by the Lynn Fire Department but the Fire Department would like to add some additional equipment to help with fire safety and rescue in forest fire situations.

The 2005 Hazard Mitigation Plan listed the Lynn Woods Reservation as its primary area of concern and the community felt that it had adequate equipment to address the problem. Education on fire risk for those using wooded areas was felt to be critical in reducing the number of brush fires in Lynn.

Urban Fires
Urban fires are a problem that can affect any area of the City. The frequency of fires depends on a wide range of factors, which include, but are not limited to, population or building density, building use, fire safety practices (or lack thereof) by building occupants, and criminal intent related to arson. These fires are almost always caused by human activities. There have been no urban fires caused by natural events in Lynn. The 2005 Plan did not reference Urban Fires.

Previous Occurrences
The City has responded to an average of 8-10 wildfires annually since the 2005 Plan and considers them a serious hazard. The City does not collect or maintain records on the date and exact locations of wildfires. The best available data used was for Essex County. From 1950 – April 30, 2014, there are no recorded Wildfire events for Essex County (NCDC: NOAA). For Lynn, the most extensive wildfire in over the last five years occurred on April 25, 2014 when a wildfire took place over 15 acres of woods off of Highland Avenue (Route 107) near the City's boundary with Salem.

Probability of Future Wildfires

The probability of future Wildfires frequency is High, an event that can be expected to occur more frequently than once every 10 years, greater than 10% per year.

Geologic Hazards

Earthquakes

An earthquake is the vibration, sometimes violent, of the earth's surface that follows a release of energy in the earth's crust due to fault fracture and movement. A fault is a fracture in the earth's crust along which two blocks of the crust have slipped with respect to each other. Faults are divided into three main groups, depending on how they move. Normal faults occur in response to pulling or tension: the overlying block moves down the inclined dip of the fault plane. Thrust (reverse) faults occur in response to squeezing or compression: the overlying block moves up the inclined dip of the fault plane. Strike-slip (lateral) faults occur in response to either type of stress; the blocks move horizontally along a vertical fault past one another. Most faulting along spreading zones is normal, along subduction zones is thrust, and along transform faults is strike-slip.

The focal depth of an earthquake is the depth from the Earth's surface to the region where an earthquake's energy originates (the focus). Earthquakes with focal depths from the surface to about 43.5 miles are classified as shallow. Earthquakes with focal depths from 43.5 to 186 miles are classified as intermediate. The focus of deep earthquakes may reach depths of more than 435 miles. The focuses of most earthquakes are concentrated in the crust and upper 20 miles of the Earth's crust. The depth to the center of the Earth's core is about 3,960 miles, so even the deepest earthquakes originate in relatively shallow parts of the Earth's interior.

The epicenter of an earthquake is the point on the Earth's surface directly above the focus, and the focus is the area of the fault where a sudden rupture initiates. The location of an earthquake is commonly described by the geographic position of its epicenter and by its focal depth. Earthquakes beneath the ocean floor sometimes generate immense sea waves or tsunamis if the earthquake causes upward or downward movement of the sea floor. The tsunami originates where this movement takes place.

The cause of earthquakes in eastern North America is the forces moving the tectonic plates over the surface of the Earth. New England is located in the middle of the North American Plate. One edge of the North American plate is along the west coast where the plate is pushing against the Pacific Ocean plate. The eastern edge of the North American plate is at the middle of the Atlantic Ocean, where the plate is spreading away from the European and African plates. New England's earthquakes appear to be the result of the cracking of the crustal rocks due to compression as the North American plate is being very slowly squeezed by the global plate movements.

Seismologists use a Magnitude scale (Richter Scale) to express the seismic energy released by each earthquake. Table 20 includes the typical effects of earthquakes in various ranges.

Table 20 – Earthquake Effects

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

Source: Nevada Seismological Library (NSL), 2005

Although each earthquake has a unique magnitude, its effects will vary greatly according to distance, ground conditions, construction standards and other factors. In seismology, a scale of seismic intensity is a way of measuring or rating the *effects* of an earthquake at different sites. The Modified Mercalli Intensity Scale) is commonly used in the United States by seismologists seeking information on the severity of earthquake effects. Intensity ratings are expressed as Roman numerals between I at the low end and XII at the high end (NSL 2005).

Table 21Measuring Earthquake Magnitude
(Modified Mercalli Intensity Scale)

Rating	Seismic Intensity/Effects
I	People do not feel any Earth movement.
II	A few people might notice movement if they are at rest and/or on the upper floors of tall buildings
III	Most people indoors feel movement. Hanging objects swing. Dishes, windows, and doors rattle. The earthquake feels like a heavy truck hitting the walls. A few people outdoors may feel movement. Parked cars rock.
IV	Almost everyone feels movement. Sleeping people are awakened. Doors swing open or close. Dishes are broken. Pictures on the wall move. Small objects move or are turned over. Trees might shake. Liquids might spill out of open containers.
V VI	Everyone feels movement. People have trouble walking. Objects fall from shelves. Pictures fall off walls. Furniture moves. Wall plaster might crack. Trees and bushes shake. Damage is slight in poorly built buildings. No structural damage.
VII	People have difficulty standing. Drivers feel their cars shaking. Some furniture breaks. Loose bricks fall from buildings. Damage is slight to moderate in well-built buildings; considerable in poorly built buildings

Rating	Seismic Intensity/Effects
VIII	Drivers have trouble steering. Houses that are not bolted down might shift on their foundations. Tall structures such as towers and chimneys might twist and fall. Well-built buildings suffer slight damage. Poorly built structures suffer severe damage. Tree branches break. Hillsides might crack if the ground is wet. Water levels in wells might change.
VIX	Well-built buildings suffer considerable damage. Houses that are not bolted down move off their foundations. Some underground pipes are broken. The ground cracks. Reservoirs suffer serious Damage.
X	Most buildings and their foundations are destroyed. Some bridges are destroyed. Dams are seriously damaged. Large landslides occur. Water is thrown on the banks of canals, rivers, lakes. The ground cracks in large areas. Railroad tracks are bent slightly.
XI	Most buildings collapse. Some bridges are destroyed. Large cracks appear in the ground. Underground pipelines are destroyed. Railroad tracks are badly bent.
XII	Almost everything is destroyed. Objects are thrown into the air. The ground moves in waves or ripples. Large amounts of rock may move.

Source: NSL 2005 (Original Source: FEMA)

Location

Earthquakes are a City-wide hazard. 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.

Previous Occurrences-

There have been no recorded earthquake epicenters within Lynn and no recorded impacts from local earthquake events The City enforces the MA State Building Code which is adequate in ensuring that new construction meets seismic standards. However the City has older un-reinforced, masonry buildings that would potentially be vulnerable in a severe earthquake. The Lynn Fire Department also has two mobile, 5 kW generators and the Lynn Water and Sewer Commission has one mobile generator for pump station backup. Since 2005, the City has upgraded its Emergency Action Plans for dams and made repairs to several dams,.

There have been no new mitigation measures to address earthquake hazards since the 2005 NHM Plan, primarily because of the lower historical risk of a serious earthquake within the eastern Massachusetts region and because most mitigation resources are

directed to flooding and coastal storm related issues. There have been no comments from the community regarding earthquakes. Information on earthquakes in Lynn is included on Map 4 in Appendix B.

The City does not collect data on earthquake events in Lynn and earthquake occurrence are not tracked by County. . The closest earthquake epicenters to occur near Lynn are as follows:

Table 22. Closest Earthquakes to Lynn 1993 - 2014

Location	Date	Magnitude	Depth
1.29 mi from Winthrop Town, MA	4/10/2009	2.3	2.7
1.94 mi from Ipswich, MA	8/3/1975	2.4	5.0
2.30 mi from Dracut, MA	3/28/2014	2.2	0.0
2.52 mi from Newbury, MA	2/20/2013	1.8	5.0
1.78 mi from Merrimac, MA	10/8/2007	1.8	0.7
1.83 mi from Dracut, MA	4/10/2013	2.0	0.0
1.36 mi from North Chelmsford, MA	11/23/1980	2.5	0.0
1.95 mi from Chelmsford, MA	7/28/1993	2.3	1.8
1.96 mi from Littleton Common, MA	10/13/1999	2.7	2.3
1.45 mi from Amesbury Town, MA	1/10/1999	3.1	2.0

Source: USGS

According to the State Hazard Mitigation Plan, New England experiences an average of five earthquakes per year. From 1627 to 1989, 316 earthquakes were recorded in Massachusetts. 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, of magnitude 6.0 to 6.5 in 1727 and 1755. Other notable earthquakes occurred here in 1638 and 1663 (Tufts University). Historical records of some of the more significant earthquakes in the region are shown in Table 23.

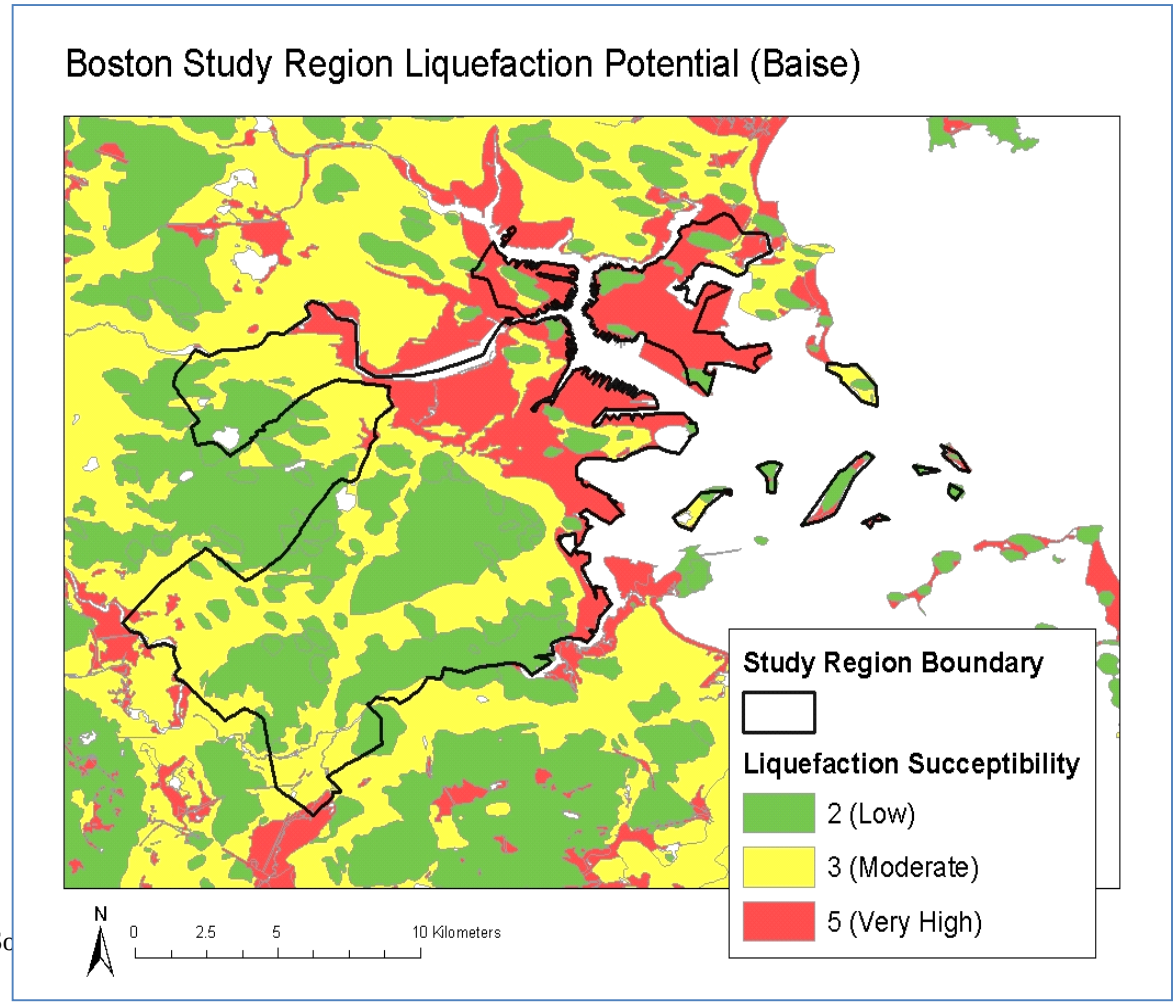
Table 23
Historical Earthquakes in Massachusetts or Surrounding Area, 1727-2012

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

Although New England has not experienced a damaging earthquake since 1755, numerous less powerful earthquakes have been centered in Massachusetts and neighboring states. 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. Development in filled, sandy or clay soils is more vulnerable to earthquake pressures that other soils. The southern portion of Lynn along the coast may be more vulnerable to liquefaction than more upland areas. See Figure 7.

Figure 7 Boston Study Region Liquefaction Potential



So

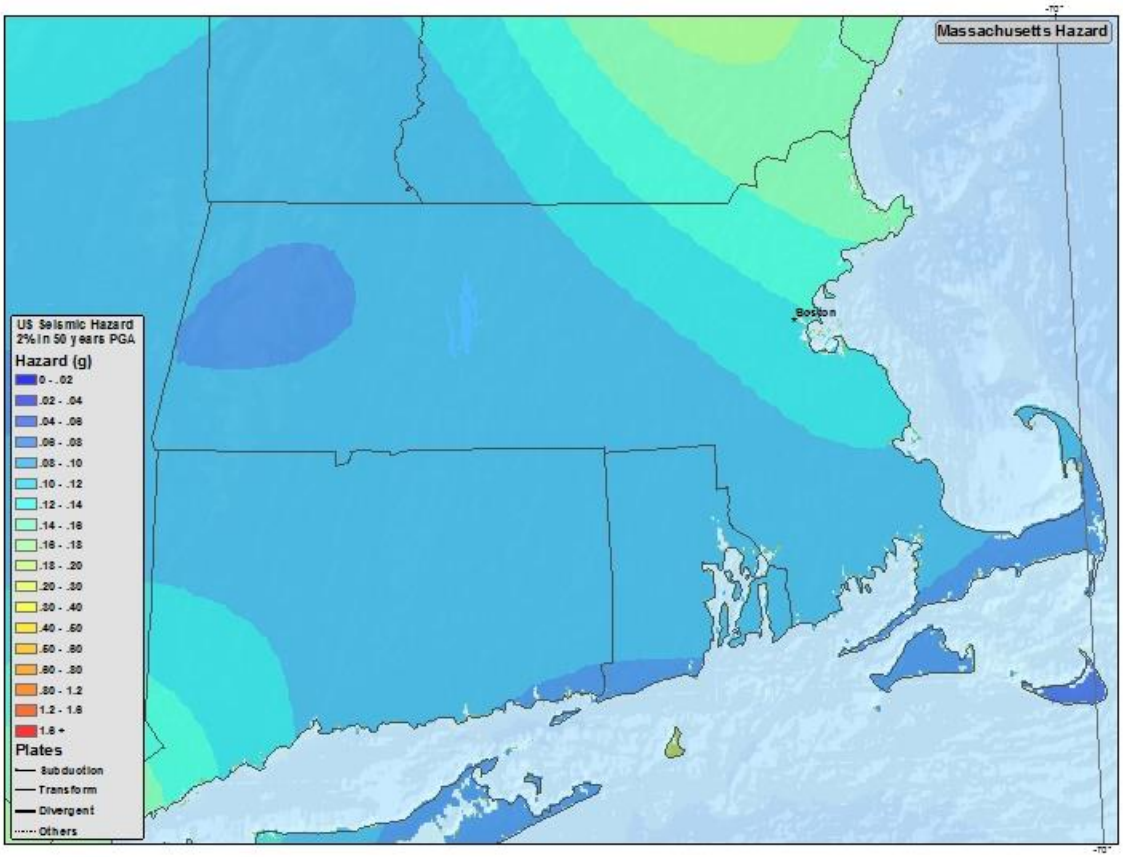
Probability of Future Earthquake Events

Figure 8, the Mass. State Seismic Map, indicates the relative risks for experiencing an earthquake in different areas of the state. Lynn's risk is indicated to be in the .10 - .12

hazard range. The City's frequency of earthquake is projected to be Medium, with events that could occur from once every 10 years to once in 100 years (1% to 10% per year).

The USGS database shows that there is a 2.58% chance of a major earthquake of at least a 5.0 magnitude within 50km of Lynn within the next 50 years. The largest earthquake within 30 miles of Lynn, MA was a 3.1 Magnitude in 1999.

Figure 8 - 2014 Mass. State Seismic Hazard Map



Source: USGS

Landslides

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, such as: erosion by rivers, glaciers, or ocean waves created over steepened slopes; rock and soil slopes weakened through saturation by snowmelt or heavy rains; earthquakes created stresses that make weak slopes fail.

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, glaciers, or ocean waves create 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. USGS scientists also monitor stream flow, noting changes in sediment load carried by rivers and streams that may result from landslides. All of these types of landslides are considered aggregately in USGS mapping of landslides. 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.

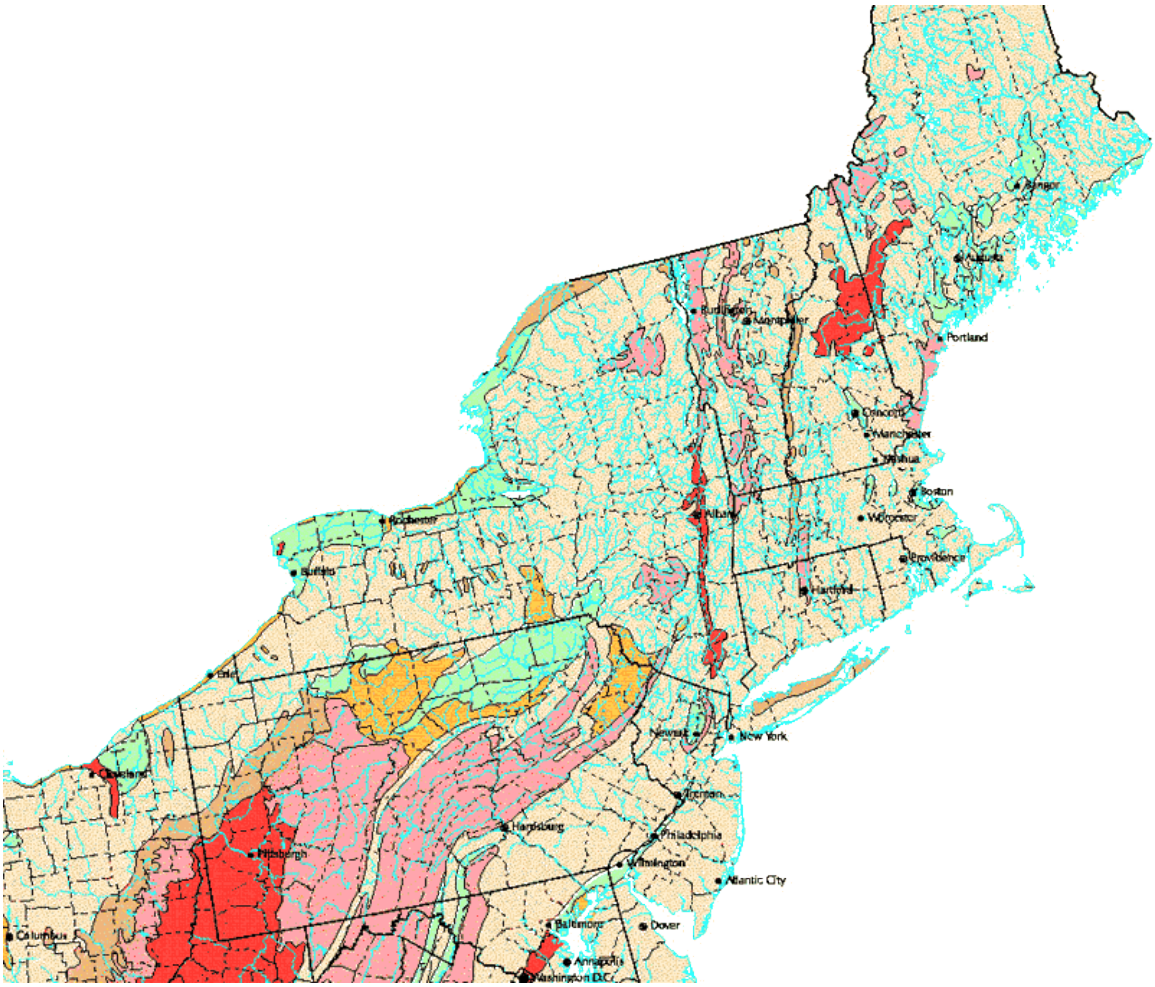
Location

Landslides are considered a City-wide hazard. Based on a review of the USGS landslide website, it was determined that there have been no recorded landslides in Lynn, which is considered to be in a low landslide incidence area except for a western portion of the City which is classified as having a moderate susceptibility but with low incidence . Less than 1.5% of the City area is considered a landslide incidence area, as shown on the Atlantic North East Landslide Incidence map.

The following website concerning landslides in Massachusetts has been researched along with historic occurrences: http://landslides.usgs.gov/learning.The Lynn Hazard Mitigation Community Planning Team did not indicate that landslides pose a significant risk to Lynn and did not take actions regarding this hazard in the 2005 Plan.

See Figure 9, indicating the risk for landslide incidence and susceptibility/incidence for the Northeastern United States, including New England and Lynn. Map 4 in Appendix B shows further information on the incidence of landslide risk for Lynn.

Figure 9. Landslide Overview Map of the Coterminous Eastern United States



Reds= higher risk area Light brown=lower risk

Source: Dorothy H. Radbruch-Hall, Roger B. Colton, William E. Davies, Ivo Lucchitta, Betty A. Skipp, and David J. Varnes, 1982

Previous Occurrences

Lynn does not collect data on landslide occurrences and there was no anecdotal evidence of landslides ever having occurred in Lynn. The best available data was for Essex County. Between 1950 and April 30, 2014, Essex County experienced one landslide event, but suffered no deaths, injuries or property damage from landslides. (NOAA USCS).

Probability of Future Occurrences

Based on past occurrences, landslides in Lynn are of Very Low frequency, events that can occur less frequently than once in 1,000 years (less than 0.1% per year).

Drought

Drought is a temporary irregularity 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 Water-Supply Paper 2375, National Water Summary 1988-89--Floods and Droughts: Massachusetts Floods and Droughts). See Figure 8**.**

Figure 10. Principal Source and Pattern of Delivery of Moisture into Massachusetts:

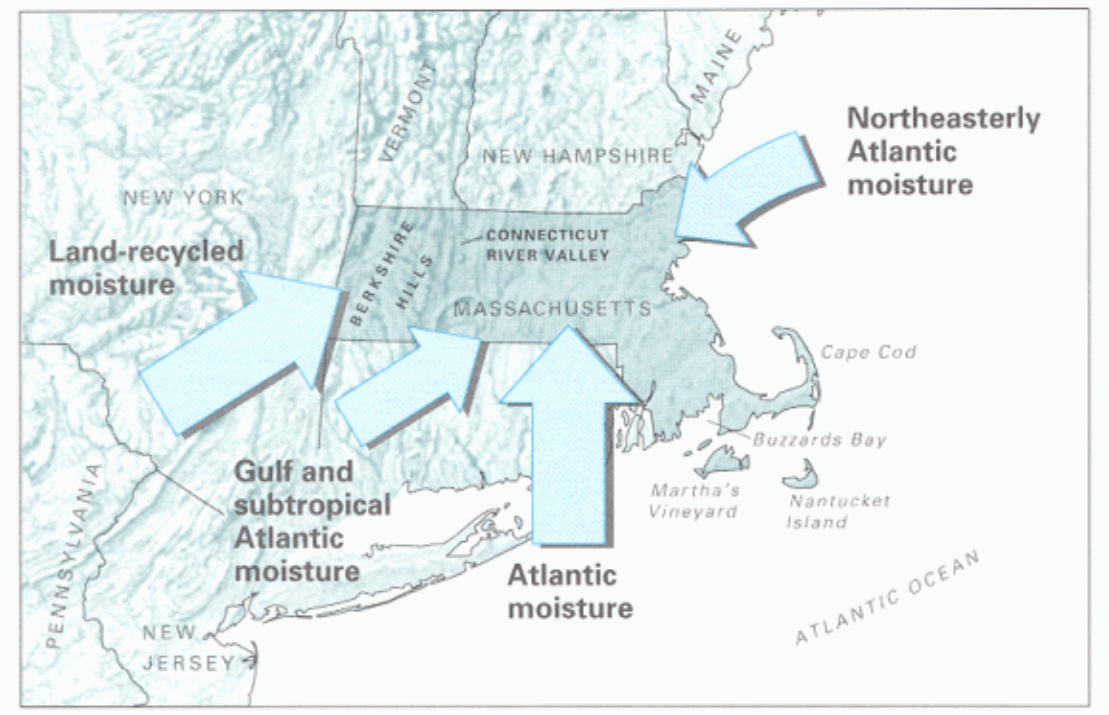


Figure 1. Principal sources and patterns of delivery of moisture into Massachusetts. Size of arrow implies relative contribution of moisture from source shown. (Source: Data from Douglas R. Clark and Andrea Lage, Wisconsin Geological and Natural History Survey.)

Source: U.S. Geological Survey Water-Supply Paper 2375, National Water Summary 1988-89, Floods and Droughts: Massachusetts

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. Lynn is located in the Northeast Region.

Average annual precipitation in Massachusetts is 44 inches per year, with approximately 3 to 4 inch average amounts for each month of the year. Lynn averages 43.77 inches of rain per 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 (generally 1965), the statewide precipitation total of 30 inches was 68 percent of average.

Five levels of drought have been developed to characterize drought severity:

Normal
Advisory
Watch
Warning
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. In practice, the drought level designation has been based upon the condition in which the majority of the drought indices occur. That is, a majority of the indices would need to be triggered in a region in order for a drought designation for that region to move to a more severe level. Drought levels are declared on a regional basis for each of six regions in Massachusetts: Northeast, Southeast, Central, Connecticut River,

Western, Cape Cod and Islands. County by county or watershed-specific determinations may also be made.
Once a drought level of warning and emergency have been reached for the precipitation index, conditions must improve to those of the previous level before a determination is made to reduce the warning or emergency.

A determination of drought level is based on seven indices:

- Standardized Precipitation Index: The Standardized Precipitation Index (SPI) reflects soil moisture and precipitation conditions.
- Crop Moisture Index: The Crop Moisture Index (CMI) reflects short-term soil moisture conditions as used for agriculture.
- Keetch-Byram Drought Index: The Keetch-Byram Drought Index (KBDI) is designed specifically for fire potential assessment. It is a number representing the net effect of evapotranspiration and precipitation in producing cumulative moisture deficiency in deep duff and upper soil layers.
  Source: Res. Paper SE-38. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station. 32pp. Revised 1988.
  Precipitation: The Precipitation Index is a comparison of measured precipitation amounts (in inches) to historic normal precipitation. Cumulative amounts for 3-, 6-, and 12-month periods are factored into the drought determination.
- Groundwater levels: The Groundwater Level Index is based on the number of consecutive months groundwater levels are below normal (lowest 25% of period of record for the respective months).
- Stream flow levels: 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 for the respective months).
- Index Reservoir levels: – The Reservoir Index is based on the water levels of small, medium and large index reservoirs across the state. The reservoir level relative to normal conditions for each month of the year will be considered.

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. Precipitation is a key factor because it is the overall cause of improving conditions. Groundwater levels respond slowly to improving conditions, so they are good indicators of long- term recovery to normal conditions.

A drought emergency will end when the conditions that led to the specific emergency have abated. For example, a critically low reservoir will need to have made a significant recovery, or groundwater wells will need to have returned to normal operating capacities. If an emergency has been declared based on environmental impacts, the emergency will end when these conditions have abated. (Massachusetts Drought Management Plan, 2013). See Table 24 , Mass. Drought Indices: Source: Massachusetts Drought Management Plan, 2013

Table 24. Mass. Drought Indices, Mass. Drought Management Plan- 2013

Drought Level	Standardized Precipitation Index	Crop Moisture Index*	Keetch-Byram Drought Index*	Precipitation	Groundwater	Streamflow	Reservoir***
Normal	3-month > -1.5 **or** 6-month > -1.0 **or** 12-month > -1.0	0.0 to -1.0 slightly dry	< 200	1 month below normal	2 consecutive months below normal**	1 month below normal**	Reservoir levels at or near normal for the time of year
Advisory	3-month = -1.5 to -2.0 **or** 6-month = -1.0 to -1.5 **or** 12-month = -1.0 to –1.5	-1.0 to -1.9 abnormally dry	200-400	2 month cumulative below 65% of normal	3 consecutive months below normal**	At least 2 out of 3 consecutive months below normal**	Small index Reservoirs below normal
Watch	3-month < -2.0 **or** 6-month = -1.5 to -3.0 **or** 12-month = -1.5 to -2.0	-2.0 to –2.9 excessively dry	400-600	1 of the following criteria met: 3 month cum. < 65% **or** 6 month cum. < 70% **or** 12 month cum. < 70%	4-5 consecutive months below normal**	At least 4 out of 5 consecutive months below normal**	Medium index Reservoirs below normal
Warning	6-month < -3.0 **or** 12-month = -2.0 to -2.5	< -2.9 severely dry	600-800	1 of the following criteria met: 3 month cum. < 65% and 6 month cum. <65%, **or** 6 month cum. <65% and 12 month cum. <65%, **or** 3 month cum. <65% and 12 month cum. <65%	6-7 consecutive months below normal**	At least 6 out of 7 consecutive months below normal**	Large index reservoirs below normal
Emergency	12-month < -2.5	<-2.9 severely dry	600-800	Same criteria as Warning and previous month was Warning or	>8 months below normal**	>7 months below normal**	Continuation of previous month's conditions

Notes: The Crop Moisture Index is subject to frequent change. The drought level for this indicator is determined based on the repeated or extended occurrence at a given level.

****** Below normal for groundwater and streamflow are defined as being within the lowest 25th percentile of the period of record.

******* Water suppliers should be consulted to determine if below normal reservoir conditions are due to operational issues.

Location
Drought is a City-wide hazard. Drought did not exist as a natural hazard category within the state hazard mitigation plan when the City completed its first plan in 2005 and the plan does not contain any mitigation actions for drought in the 2005 plan.

Previous Occurrences
Lynn does not collect data relative to drought events. Because drought tends to be more of a regional natural hazard, this plan references state data as the best available data for drought.

For summary purposes, this analysis of drought history in Massachusetts is limited to a statewide analysis. The statewide scale is a composite of six regions of the state: West, Connecticut River, Central, Northeast, Southeast, and Cape Cod and the Islands. Regional composite precipitation values are based on monthly values from six stations, and three stations in the smaller regions (Cape Cod/Islands and West). Because the statewide analysis will result in a muting of more extensive local drought impacts, this Drought History summary will likely underestimate the spatial frequency of droughts (i.e., droughts may occur more frequently in individual regions than depicted in the statewide analysis).

The attached graph indicates incidents of drought levels' occurrence in Massachusetts using the 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.

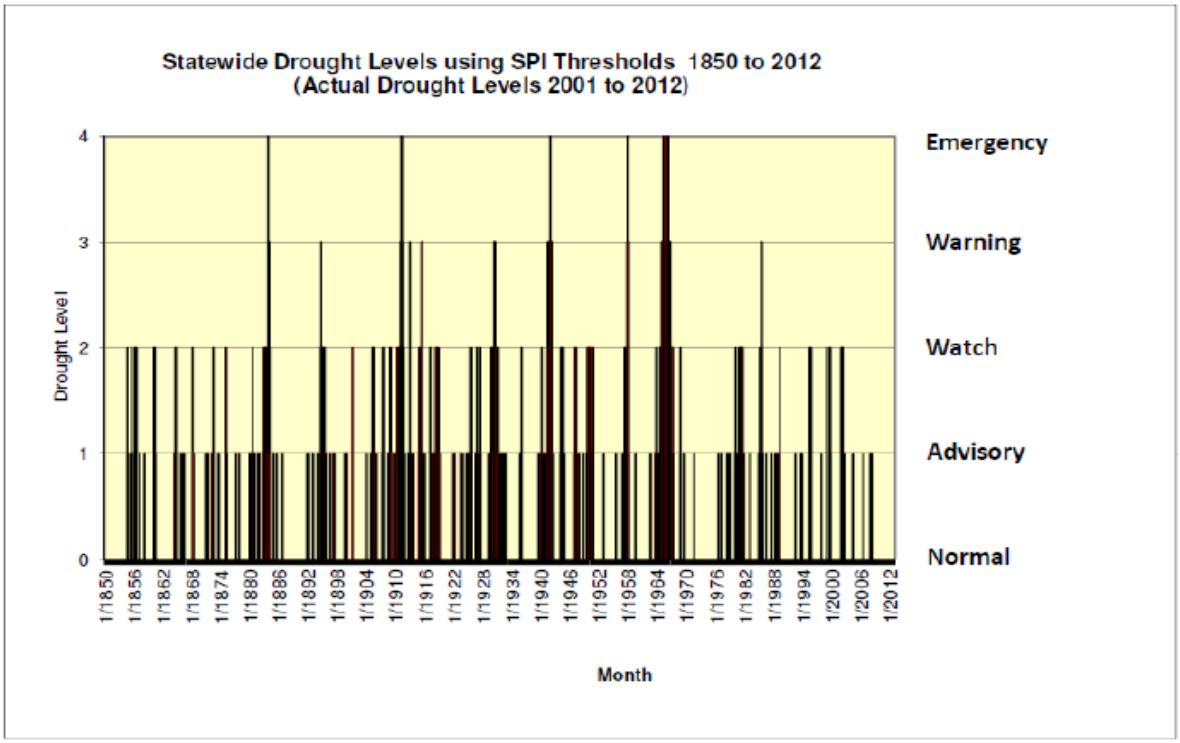
Drought Emergency
Drought emergencies have been reached infrequently, with 5 events occurring in the period between 1850 and 2012: in 1883, 1911, 1941, 1957, and 1965-1966. The 1965-1966 drought period is viewed as the most severe drought to have occurred in modern times in Massachusetts given the period of record for precipitation data 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 would have occurred 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 would have occurred in three to four years per decade between 1850 and 1950. The drought Emergency dominated the 1960s. There were no drought Watches or above in the 1970s. 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 25. Statewide Drought Levels using SPI Thresholds 1850 – 2012



(Source: Mass. State Drought Management Plan 2013)

Table 26. Chronology of Major Droughts in Massachusetts

Flood or drought	Date	Area affected (fig. 2)	Recurrence interval (years)	Remarks
Drought	1929-32	Statewide	10 to >50	Water-supply sources altered in 13 communities. Multistate.
Drought	1939-44	Statewide	15 to >50	More severe in eastern and extreme western Massachusetts. Multistate.
Drought	1957-59	Statewide	5 to 25	Record low water levels in observation wells, northeastern Massachusetts.
Drought	1961-69	Statewide	35 to >50	Water-supply shortages common. Record drought. Multistate.

Drought	1980-83	Statewide	10 to 30	Most severe in Ipswich and Taunton River basins; minimal effect in Nashua River basin. Multistate.
Drought	1985-88	Housatonic River basin	25	Duration and severity as yet 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 and local drought conditions may occur at a different interval than state data indicates, droughts remain primarily regional and state phenomena in Massachusetts. Lynn can expect to experience Emergency Droughts at very close to the same frequency as its region and the state. Emergency Drought conditions over the 162 history of recorded droughts in Massachusetts have generated a Low Frequency natural hazard event, with events that can occur form once in 100 years to once in 1,000 years (0.1% to 1% per year).

Extreme Temperatures

There is no universal definition for extreme temperatures. The term is relative to the usual weather in the region based on climatic averages. Extreme heat, for this climatic region, is usually defined as a period of 3 or more consecutive days above 90 °F, but more generally a prolonged period of excessively hot weather, which may be accompanied by high humidity. Extreme cold, again, is relative to the normal climatic lows in a region.
Temperatures that drop decidedly below normal and wind speeds that increase can cause harmful wind-chill factors. The wind chill is the apparent temperature felt on exposed skin due to the combination of air temperature and wind speed.

Lynn 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 ranges for Massachusetts.

The average temperatures for Massachusetts are: Winter (Dec-Feb) Average = 31.8°F
Summer (Jun-Aug) Average = 71°F

Extreme Cold

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. Lynn-Lowest recorded temperature: The lowest recorded temperature was -9°F in 2004.

Extreme Heat

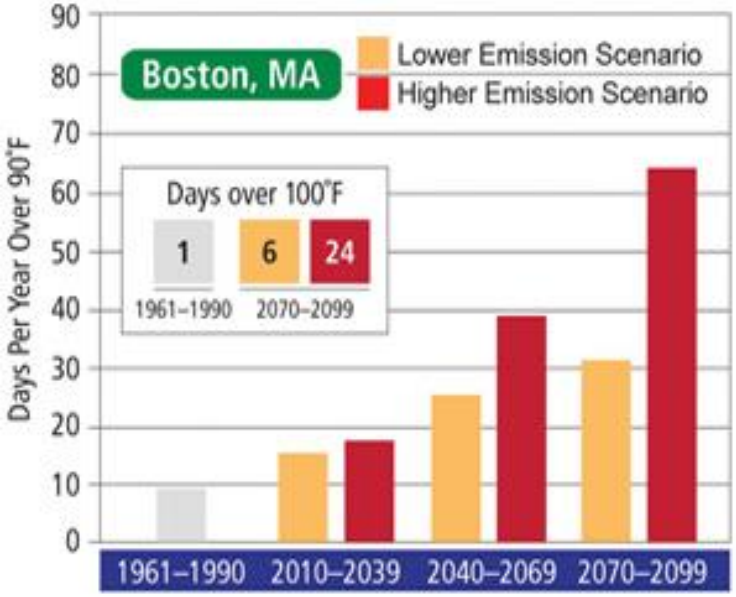
The highest recorded temperature for Lynn was 101°F in 2011.

From 1979-2003, excessive heat exposure caused 8,015 deaths in the United States. During this period, more people in this country died from extreme heat than from hurricanes, lightning, tornados, floods, and earthquakes combined. Because most heat-related deaths occur during the summer, people should be aware of who is at greatest risk and what actions can be taken to prevent a heat-related illness or death. At greater risk are 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. Some behaviors also put people at greater risk: drinking alcohol; taking part in strenuous outdoor physical activities in hot weather; and taking medications that impair the body's ability to regulate its temperature or that inhibit perspiration.

Hot summer days can worsen air pollution, especially in urban areas. In areas of the Northeast that currently face problems with smog, inhabitants are likely to experience more days that fail to meet air quality standards. More frequent heat waves and lower air quality can threaten the health of vulnerable people, including the very young, the elderly, outdoor workers, and those without access to air conditioning or adequate health care. People who live in Northeastern cities are particularly at-risk, since the region is generally not as well adapted to heat as warmer regions of the country. Northeastern cities are likely to experience some of the highest numbers of heat-related illnesses and deaths, compared with the rest of the nation. (Source: EPA)

Boston and nearby Essex County will experience an increase in the number of days over 100°F., depending on whether a higher or lower greenhouse gas emission scenario is met. Source: USGCRP (2009)

Figure 11.Projected Boston Days above 100 degrees F



Location
Extreme temperatures are a City-wide hazard. They did not exist as a natural hazard category within the state hazard mitigation plan when the City completed its first plan in 2005 and the plan does not contain any mitigation actions for drought in the 2005 plan.

Previous Occurrences-Excessive Heat

The City does not collect data on excessive heat occurrences. The best available data was for Essex County, including Lynn. From 1950- April 30, 2014, there has been a total of one excessive heat events in Essex County in 2011, with no reported deaths, injuries or property damage resulting from excessive heat. (NOAA: NCDC)

Previous Occurrences- Extreme Cold
Lynn does not collect data for extreme cold occurrences. The best available data was for Essex County, including Lynn. For the period 1950 – 2014, Essex County experienced no recorded extreme cold/wind chill events. (NOAA: NCDC)

Probability of Future Occurrences- Extreme Temperatures
Extreme temperature events are projected to be Medium Frequency events with both extreme cold and hot weather events happening from between once in ten years to once in 100 years. Due to projected climate change, extreme hot weather events over 100 degrees Fahrenheit may become more frequent and extreme cold weather events less frequent.

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 below shows the acreage and percentage of land in 33 categories. If the five residential categories are aggregated, residential uses make up 41.87 % of the area of the City (3,094 acres). The next highest percentage land use is Forest which comprises 22.32 % with 1649.9 acres.

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

Table 27. 2005 Land Use

Land Type	Acres	Percent
Cropland	3.12	0.04
Pasture	0	0
Forest	1649.9	22.32
Wetland	48.79	0.66
Mining	0	0
Open Land	103.79	1.4
Participation Recreation	150.24	2.03
Spectator Recreation	14.72	0.2
Water-based Recreation	6.86	0.09
Multifamily Residential	1483.07	20.07
High Density Residential	1204.93	16.3
Medium Density Residential	376.28	5.09
Low Density Residential	29.34	0.4
Very Low Density Residential	1.00	0.01
Saltwater Wetland	26.11	0.35
Commercial	482.92	6.53
Industrial	482.43	6.53
Urban Open	8.24	0.11
Transportation	45.17	0.61
Waste Disposal	14.08	0.19
Water	470.65	6.37
Cranberry Bog	0	0
Power line	19.94	0.27
Saltwater Beach	38.93	0.53
Golf Course	76.67	1.04
Marina	13.33	0.18
Urban Public	298.83	4.04
Cemetery	201.48	2.73
Orchard	0	0
Nursery	3.73	0.05
Forested Wetland	117.52	1.59
Junkyards	18.36	0.25
Brush land/Succession	0	0
TOTAL	7,390.43	100

Regional Context, Natural Resources and Development

According to the United States Census Bureau, the city has a total area of 13.5 square miles (35 km^2), of which 10.8 square miles (28 km^2) of it is land and 2.7 square miles (7.0 km^2) of it (19.87%) is water. Lynn is located beside Massachusetts Bay and the Atlantic Ocean. Lynn's shoreline is divided in half by the City of Nahant, which divides Lynn Harbor to the south from Nahant Bay to the north. The city lies north of the Saugus River, and is also home to several brooks, as well as several ponds, the largest being Breed's Pond and Walden Pond (which has no relation to a similarly named pond in Concord). More than a quarter of the City's land is covered by the Lynn Woods Reservation, which takes up much of the land in the northwestern part of the city. The city is also home to two beaches, Lynn Beach and King's Beach, both of which lie along Nahant Bay, as well as a boat ramp in Lynn Harbor.

Lynn is located in the southern part of Essex County, and is five miles (8 km) southwest of Salem, ten miles (16 km) northeast of Boston, and twenty-two miles west-southwest of Cape Ann. The city is bordered by Nahant to the south, Swampscott to the east, Salem to the northeast, Peabody to the north, Lynnfield to the northwest, Saugus to the west, and Revere (in Suffolk County) to the southeast. Lynn's water rights extend into Nahant Bay and share Lynn Harbor with Nahant. There is no land connection to Revere; the only connection is the General Edwards Bridge across the Saugus River. Besides its down City district, Lynn is also divided into East Lynn and West Lynn, which are further divided into even smaller areas.

Lynn is loosely segmented into the following neighborhoods:

Central:

- DownCity / Business District
- Central Square

West Lynn:

- Pine Hill
- McDonough Sq./ Barry Park
- Tower Hill / Austin Sq. - Saugus River
- The Brickyard
- The Commons
- Walnut St./Lynnhurst
- Veteran's Village

East Lynn:

- Diamond District / Lynn Shore

- Wyoma Square
- The Highlands
- The Fay Estates
- Ward 1 / Lynnfield St.
- Goldfish PondThe Meadow / Keaney Park (Source: Wikipedia)

The City of Lynn was founded in 1629 as a farming community and maintained its rural character for almost two hundred years until the growth of the shoe manufacturing industry in the 19th century. Lynn was also the birthplace of the Thompson-Houston Electric Company, which would become the General Electric Company. Ad industry grew, housing filled in around the arable land being worked by farmers and the City's several rocky hills. Today the City is one of the most densely populated communities on the North Shore with over 3,500 people per square mile. The two highest density residential areas are in East Lynn next to the central business district and Lynn Commons.

In West Lynn, the northern section is characterized by lower population densities with more single family homes located near the water reservoirs and open space areas including Lynn Woods, Breed Park and Barry Playground. The southern section of West Lynn is more multi-family residential and is located near primary transportation routes including Routes 107 and 1A. The Lynn Waterfront, portions of which are slated for re-development under the new Waterfront Master Plan, is primarily industrial and commercial in nature, with most of the harbor shoreline heavily bulk-headed and listed a state Designated Port Area, designed to protect against the loss of coastal port access for marine and commercial uses. (Source: Lynn Open Space and Recreation Plan, 2005)

Along with waterfront redevelopment, the City has made several rezoning moves to encourage the redevelopment of the central business area Downtown, including reducing parking requirements for residential development.

The Metropolitan Area Planning Council (MAPC) has published two sets of population, housing unit, and employment projections as part of the MetroFuture regional planning process. These projections were created for the 101cities and towns within the MAPC region, as well as 63 additional communities in eastern Massachusetts.

The "Current Trends" projection estimates the number of people, housing units, and jobs likely to exist in each municipality if current patterns of growth and development continued to 2030.The "MetroFuture" projection estimates the number of people and jobs for each of the 164 communities if the recommendations contained in the MetroFuture plan are followed. MetroFuture envisions great changes in the region's development patterns: under MetroFuture, more growth is directed to areas that are already developed, such as City centers and urban areas, and as a result, less open space will be developed and local business districts will be revitalized.

Projections indicate that Lynn would gain population and jobs if the MetroFuture pattern is adopted, as the City is beginning to do with the redevelopment of its central business district and downCity. The City is projected to gain less in population and suffer a decline in total employment if current patterns of development are followed, as is shown in the following table.

	2020	**2030**
Lynn Current Trends Projection-population	94,277	95,931
Lynn MetroFuture Projection-population	99,243	102,265
Lynn Current Trends Projection-total jobs	25,116	24,979
Lynn MetroFuture Projection-total jobs	26,463	26,752

Recent and Potential Future Development

MAPC consulted with City staff to determine areas that have been or are likely to be developed in the future, defined for the purposes of this plan as a five year time horizon. These areas are shown on Map 2, "Potential Development" and are described below. The letter for each site corresponds to the letters on Map 2.

A) Grandview Place: subdivision-complete

B) End Ridge Estates: subdivision-complete

C) Kent Road: subdivision-complete

D) Apple Hills One and Two: subdivision-complete

E) Boulder Heights: subdivision-complete

F) Fox Run Estates: subdivision-complete

G) South Harbor: hotel/retail and condominiums: waterfront redevelopment of the industrial waterfront area that will include a 600 Kw wind turbine to power the waste water treatment plant- conceptual stage

H) Beacon Property: mixed use commercial and residential redevelopment area-conceptual

I) Lynn Housing Authority property: redevelop for mixed use commercial and residential-conceptual

J) Brookline Acres: apartment complex-currently vacant

Regional Development Issue: Lowe's/Wal-Mart development on Highland Avenue in Salem: drainage and traffic impacts in Lynn.

Recent and Future Development in Hazard Areas

Table 28 shows the relationship of these parcels to two of the mapped hazards. This information is provided so that planners can ensure that development proposals comply with flood plain zoning and that careful attention is paid to drainage issues.

Table 28: Relationship of Potential Development to Hazard Areas

ID	Parcel	Landslide risk	Flood Zone
A	Grandview Place: subdivision	Low	No
B	End Ridge Estates	Low	5.4274% in 0.2% Annual Chance
C	Kent Road	Low	No
D	Apple Hills One and Two	Low	No
E	Boulder Heights	Low	No
F	Fox Run Estates	Low	No
G	South Harbor	Moderate	22.9081% in AE 17.9401% in AO 29.046% in VE
H	Beacon Property	Low	33.211% in 0.2% Annual Chance 52.8286% in AE 0.9421% in VE
I	Lynn Housing Authority property	Low	No

Critical Infrastructure in Hazard Areas

Critical infrastructure includes facilities that are important for disaster response and evacuation (such as emergency operations centers, fire stations, water pump stations, etc.) and facilities where additional assistance might be needed during an emergency (such as nursing homes, elderly housing, day care centers, etc.). These facilities are listed in Table 15 and are shown on all of the maps in Appendix B.

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

Explanation of Columns in Table 29

Column 1: ID #: The first column in Table 8 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 as follows:

> **Zones A1-30 and AE**: Special Flood Hazard Areas that are subject to inundation by the base flood, determined using detailed hydraulic analysis. Base Flood Elevations are shown within these zones.
>
> **Zone A** (Also known as Unnumbered A Zones): Special Flood Hazard Areas where, because detailed hydraulic analyses have not been performed, no Base Flood Elevations or depths are shown.
>
> **Zone AO**: Special Flood Hazard Areas that are subject to inundation by types of shallow flooding where average depths are between 1 and 3 feet. These are normally areas prone to shallow sheet flow flooding on sloping terrain.
>
> **Zone VE**, V1-30: Special Flood Hazard Areas along coasts that are subject to inundation by the base flood with additional hazards due to waves with heights of 3 feet or greater. Base Flood Elevations derived from detailed hydraulic analysis are shown within these zones.
>
> **Zone B and X** (shaded): Zones where the land elevation as been determined to be above the Base Flood Elevation, but below the 500 year flood elevation. These zones are not Special Flood Hazard Areas.
>
> **Zones C and X** (unshaded): Zones where the land elevation has been determined to be above both the Base Flood Elevation and the 500 year flood elevation. These zones are not Special Flood Hazard Areas.

Column 6: Locally-Identified Flood Area: The locally identified areas of flooding were identified by City staff as areas where flooding occurs. These areas do not necessarily coincide with the flood zones from the FIRM maps. They may be areas that flood due to inadequate drainage systems or other local conditions rather than location within a flood zone. The numbers correspond to the numbers on Map 8, "Hazard Areas".

Column 8: Hurricane Surge Category: The seventh column indicates whether or not the site is located within a hurricane surge area and the category of hurricane estimated to be necessary to cause inundation of the area. The following explanation of hurricane surge areas was taken from the US Army Corps of Engineers web site:

> "Hurricane storm surge is an abnormal rise in sea level accompanying a hurricane or other intense storm. Along a coastline a hurricane will cause waves on top of the surge. Hurricane Surge is estimated with the use of a computer model called SLOSH. SLOSH stands for Sea Lake and Overland Surge from Hurricanes. The SLOSH models are created and run by the National Hurricane Center. The SLOSH model results are merged with ground elevation data to determine areas that will be subject to flooding from various categories of hurricanes. Hurricane categories are defined by the Saffir-Simpson Scale." See www.sam.usace.army.mil/hesdata/General/hestasks.htm

According to the Saffir-Simpson Scale, the least damaging storm is a Category 1 (winds of 74-95 miles per hour) and the most damaging storm is a Category 5 (winds greater than 155 miles per hour).

Table 29: Relationship of Critical Infrastructure to Hazard Areas							
ID	**NAME**	**TYPE**	**Landslide Risk**	**Within FEMA Flood Zone**	**Within Locally Identified Area of Flooding**	**Average Annual Snow Fall**	**Hurricane Surge Areas (Category #)**
1	Lynn Armory	Armory	Low	No	No	Low	0
2	Briarcliff Lodge	Adult Day Care	Low	No	No	Low	0
3	Ocean Shores	Large Residential Facility	Low	AE	No	Low	3
4	Silsbee Tower	Large Residential Facility	Low	No	No	Low	0
5	Olympia Square Apartments	Large Residential Facility	Low	No	No	Low	0
6	St. Stephens Tower	Large Residential Facility	Low	No	No	Low	0
7	Kings Beach Tower	Large Residential Facility	Low	No	No	Low	0
8	Stadium Condominiums	Large Residential Facility	Low	No	No	Low	0
9	300 Lynnshore Drive	Large Residential Facility	Low	No	No	Low	0
10	Seaport Landing	Large Residential Facility	Low	AO	No	Low	4
11	295 Lynnshore Drive	Large Residential Facility	Low	No	No	Low	0
12	Neptune Towers	Large Residential Facility	Low	No	No	Low	2
13	Neptune Towers	Large Residential Facility	Low	No	No	Low	0
14	Rolfe House	Large Residential Facility	Low	No	No	Low	0
15	Harbor Loft 2	Large Residential Facility	Low	No	No	Low	3
16	The Breakers	Large Residential Facility	Low	No	No	Low	0

Table 29: Relationship of Critical Infrastructure to Hazard Areas							
ID	**NAME**	**TYPE**	**Landslide Risk**	**Within FEMA Flood Zone**	**Within Locally Identified Area of Flooding**	**Average Annual Snow Fall**	**Hurricane Surge Areas (Category #)**
17	Harbor Loft 1	Large Residential Facility	Low	No	No	Low	0
18	Leisure Tower	Large Residential Facility	Low	No	No	Low	0
19	North Shore Comm. College	School	Low	No	No	Low	0
20	St George's Church	Place of Worship	Low	No	No	Low	0
21	Lynn Woods Reservation	Water Resource	Low	No	No	Low	0
22	GAR Hall And Museum	Cultural Resource	Low	No	No	Low	0
23	Lynn Historical Society	Cultural Resource	Low	No	No	Low	0
24	Newall, Lucian House	Cultural Resource	Low	No	No	Low	0
25	High Rock Tower	Cultural Resource	Low	No	No	Low	0
26	Lovejoy, Charles House	Cultural Resource	Low	No	No	Low	0
27	Bank Block	Cultural Resource	Low	No	No	Low	0
28	St Stephen's Church	Place of Worship	Low	No	No	Low	0
29	Central Building	Place of Assembly	Low	No	No	Low	0
30	Lynn Housing Authority – Comm. Center	Municipal Facility	Low	No	No	Low	0

Table 29: Relationship of Critical Infrastructure to Hazard Areas							
ID	**NAME**	**TYPE**	**Landslide Risk**	**Within FEMA Flood Zone**	**Within Locally Identified Area of Flooding**	**Average Annual Snow Fall**	**Hurricane Surge Areas (Category #)**
31	Masonic Hall	Place of Assembly	Low	No	No	Low	0
32	Odd Fellows Hall	Place of Assembly	Low	No	No	Low	0
33	Mary Baker Eddy Historical Home	Cultural Resource	Low	No	No	Low	0
34	Communications Tower - Wayne Alarm	Telecommunications	Low	No	No	Low	0
35	Lynn Head Start Daycare, First Lutheran	Child Care	Low	No	No	Low	0
36	DPW Fueling Station	Municipal Facility	Moderate	No	No	Low	2
37	Project Cope Drug Rehab.	Medical Facility	Low	No	No	Low	0
38	North Shore Medical Center	Housing Authority Residences	Low	No	No	Low	0
39	Meadow Court - Housing Authority	Housing Authority Residences	Low	No	Magnolia Ave	Low	0
40	Tilton Place - Housing Authority	Housing Authority Residences	Low	No	No	Low	0
41	Woodman Street - Housing Authority	Housing Authority Residences	Moderate	No	No	Low	0

Table 29: Relationship of Critical Infrastructure to Hazard Areas							
ID	**NAME**	**TYPE**	**Landslide Risk**	**Within FEMA Flood Zone**	**Within Locally Identified Area of Flooding**	**Average Annual Snow Fall**	**Hurricane Surge Areas (Category #)**
42	Olive Street - Housing Authority	Housing Authority Residences	Low	No	No	Low	0
43	Green Street - Housing Authority	Housing Authority Residences	Low	No	No	Low	0
44	Bond Street - Housing Authority	Housing Authority Residences	Low	No	No	Low	0
45	South Common Street - Housing Authority	Housing Authority Residences	Low	No	No	Low	0
46	Tremont Street - Housing Authority	Housing Authority Residences	Low	No	No	Low	0
47	Essex Street - Housing Authority	Housing Authority Residences	Low	No	No	Low	0
48	Fabens Building	Large Residential Facility	Low	No	No	Low	0
49	St. Mary's Plaza	Large Residential Facility	Low	No	No	Low	0
50	Lynn City Hall	Municipal Office	Low	No	No	Low	0
51	Curwin Circle	Housing Authority Residences	Moderate	No	No	Low	0
52	Emergency Management	Municipal Facility	Low	No	No	Low	0

Table 29: Relationship of Critical Infrastructure to Hazard Areas							
ID	**NAME**	**TYPE**	**Landslide Risk**	**Within FEMA Flood Zone**	**Within Locally Identified Area of Flooding**	**Average Annual Snow Fall**	**Hurricane Surge Areas (Category #)**
53	Solimine Funeral Home	Mortuary	Low	No	No	Low	0
54	Fire Station Engine 11	Fire Station	Low	No	No	Low	0
55	Fire Station Engine 10	Fire Station	Low	No	No	Low	0
56	Fire Station Engine 7	Fire Station	Low	No	No	Low	0
57	Fire Station Engine 5	Fire Station	Low	No	No	Low	0
58	Fire Station Engine 5	Fire Station	Low	No	No	Low	0
59	Fire Station Engine 9	Fire Station	Moderate	No	No	Low	0
60	Fire Station Engine 1	Fire Station	Low	No	No	Low	0
61	Fire Station Engine 3 / Fire Headquarters	Fire Station	Low	No	No	Low	0
62	Gannon Golf Course Fueling Station	Hazardous Materials	Low	No	No	Low	0
63	Kings Lynn	Large Residential Facility	Moderate	No	No	Low	0
64	Lynn Water Treatment Plant	Hazardous Materials	Low	No	No	Low	0
65	C.L. Hathaway	Hazardous Materials	Moderate	AE	No	Low	2

Table 29: Relationship of Critical Infrastructure to Hazard Areas							
ID	**NAME**	**TYPE**	**Landslide Risk**	**Within FEMA Flood Zone**	**Within Locally Identified Area of Flooding**	**Average Annual Snow Fall**	**Hurricane Surge Areas (Category #)**
66	All Welding Supplies Inc	Hazardous Materials	Low	No	No	Low	2
67	Garelick Farms - Lynn	Hazardous Materials	Moderate	No	No	Low	2
68	Old Neighborhood Foods	Hazardous Materials	Moderate	No	No	Low	4
69	National Grid Gas	Hazardous Materials	Low	AE	No	Low	2
70	National Grid 8 Substations	Hazardous Materials	Low	No	No	Low	0
71	General Electric Aircraft Engines	Hazardous Materials	Moderate	No	No	Low	2
72	Multi-service Center	Social Services	Low	No	No	Low	0
73	Public Library	Library	Low	No	No	Low	0
74	Bay Ridge Hospital	Medical Facility	Low	No	No	Low	0
75	DCR Skating Rink	Mortuary	Low	No	No	Low	2
76	Parker Memorial	Mortuary	Low	No	No	Low	0
77	Solimine Funeral Home	Mortuary	Low	No	No	Low	0
78	Cuffe-McGinn Funeral	Mortuary	Low	No	No	Low	0
79	Goodrich Funeral Home	Mortuary	Low	No	No	Low	0

Table 29: Relationship of Critical Infrastructure to Hazard Areas							
ID	**NAME**	**TYPE**	**Landslide Risk**	**Within FEMA Flood Zone**	**Within Locally Identified Area of Flooding**	**Average Annual Snow Fall**	**Hurricane Surge Areas (Category #)**
80	Lynn District Court	Municipal Office	Low	No	No	Low	0
81	Phillips Manor	Medical Facility	Low	No	No	Low	0
82	Atlantic Rest Home	Special Needs	Low	No	No	Low	0
83	Lynn Shore Rest Home	Nursing home	Low	No	No	Low	0
84	Abbott House	Nursing Home	Low	No	No	Low	0
85	Lynn Home For Elderly Persons	Elderly Housing	Low	No	No	Low	0
86	Lifecare	Medical Facility	Low	No	No	Low	0
87	Manning Field	Recreation	Low	No	No	Low	0
88	Lynn Police Headquarters	Police Station	Low	No	No	Low	0
89	United States Postal Service	Hazardous Materials	Low	No	No	Low	0
90	Fraser Field	Recreation	Low	No	No	Low	0
91	Barry Park	Recreation	Moderate	No	No	Low	4
92	Salvation Army	Armory	Low	No	No	Low	0
93	Fecteau-Leary Middle School	School	Low	No	No	Low	0
94	Connery School Annex	School - Special Needs	Low	No	No	Low	0
95	LVTI Annex/ School Dept Headquarters	Municipal Office	Low	No	No	Low	0

Table 29: Relationship of Critical Infrastructure to Hazard Areas

ID	NAME	TYPE	Landslide Risk	Within FEMA Flood Zone	Within Locally Identified Area of Flooding	Average Annual Snow Fall	Hurricane Surge Areas (Category #)
96	Connery School	School - Special Needs	Low	No	No	Low	0
97	Lynn Woods School	School - Special Needs	Low	No	No	Low	0
98	Sacred Heart Elementary School	School	Moderate	No	No	Low	4
99	Catholic Charities Child Care	Child Care	Low	No	No	Low	0
100	Lynn Head Start (Temple)	Child Care / Place of Worship	Low	No	No	Low	0
101	Ford Annex	Special Needs	Moderate	No	No	Low	2
102	Lynn School Dept Office	Municipal Facility	Low	No	No	Low	0
103	St Mary Regional Jr/Sr High School	School	Low	No	No	Low	0
104	Ford School	School - Special Needs	Low	No	No	Low	0
105	Washington Community Elementary School	School	Low	No	No	Low	0
106	A Drewicz Elementary School	School	Moderate	No	No	Low	0

Table 29: Relationship of Critical Infrastructure to Hazard Areas							
ID	**NAME**	**TYPE**	**Landslide Risk**	**Within FEMA Flood Zone**	**Within Locally Identified Area of Flooding**	**Average Annual Snow Fall**	**Hurricane Surge Areas (Category #)**
107	E J Harrington Elementary School	School	Low	No	No	Low	0
108	Cobbet Elementary School	School	Low	No	No	Low	0
109	Brickett Elementary School	School	Low	No	No	Low	0
110	Catholic Charities Second Chance School	School	Low	No	No	Low	0
111	Community Partnership Program	Child Care	Low	No	No	Low	0
112	Greater Bethlehem Temple	Place of Worship	Low	No	No	Low	0
113	Joi Day Care	Child Care	Low	No	No	Low	0
114	Lincoln-Thomson Elementary School	School	Moderate	No	No	Low	0
115	Classical High School	School	Moderate	No	No	Low	0
116	Julia F Callahan Elementary	School	Moderate	No	No	Low	0

Table 29: Relationship of Critical Infrastructure to Hazard Areas							
ID	**NAME**	**TYPE**	**Landslide Risk**	**Within FEMA Flood Zone**	**Within Locally Identified Area of Flooding**	**Average Annual Snow Fall**	**Hurricane Surge Areas (Category #)**
117	William R Fallon Elementary School (vacant)	Municipal Facility	Low	No	No	Low	0
118	Tracy Elementary School	School	Low	No	No	Low	0
119	Breed Middle School	School	Moderate	0.2 PCT ANNUAL CHANCE FLOOD HAZARD	No	Low	0
120	Sewell-Anderson Elementary School	School	Low	No	No	Low	0
121	Thurgood Marshall Middle School	School	Low	No	No	Low	0
122	Ingalls Elementary School	School	Low	No	No	Low	0
123	Lynn English High School	School	Low	No	No	Low	0
124	Hood Elementary School	School	Low	No	No	Low	0

Table 29: Relationship of Critical Infrastructure to Hazard Areas							
ID	**NAME**	**TYPE**	**Landslide Risk**	**Within FEMA Flood Zone**	**Within Locally Identified Area of Flooding**	**Average Annual Snow Fall**	**Hurricane Surge Areas (Category #)**
125	Aborn Elementary School	School	Low	No	No	Low	0
126	St Pius V Elementary	School	Low	No	No	Low	0
127	Pickering Middle School	School	Low	No	No	Low	0
128	Edward A Sisson	School	Low	No	No	Low	0
129	Lynn Vocational Technical High School	School	Low	No	No	Low	0
130	North Shore Christian Elementary School	School	Low	No	No	Low	0
131	Capt William G Shoemaker Elementary School	School	Low	No	No	Low	0
132	Zion Baptist Church	Place of Worship	Low	No	No	Low	0
133	YMCA Childcare	Child Care	Low	No	No	Low	0
134	Hollis Road Sewer Lift Station	Sewer Pumping Station	Low	No	No	Low	0

Table 29: Relationship of Critical Infrastructure to Hazard Areas

ID	NAME	TYPE	Landslide Risk	Within FEMA Flood Zone	Within Locally Identified Area of Flooding	Average Annual Snow Fall	Hurricane Surge Areas (Category #)
135	Joel Circle Sewer Lift Station	Sewer Pumping Station	Low	No	No	Low	0
136	Log Cabin Road Sewer Lift Station	Sewer Pumping Station	Low	No	No	Low	0
137	Transfaglia Road Sewer Lift Station	Sewer Pumping Station	Moderate	No	No	Low	0
138	Sanderson Ave Sewer Lift Station	Sewer Pumping Station	Low	No	No	Low	0
139	Reed Street Sewer Lift Station	Sewer Pumping Station	Moderate	No	No	Low	2
140	Camden Street Sewer Lift Station	Sewer Pumping Station	Moderate	AE	No	Low	2
141	Washington Street Sewer Lift Station	Sewer Pumping Station	Low	No	No	Low	4
142	Hanson Street Pump Sewer Lift Station	Sewer Pumping Station	Moderate	AO	No	Low	2
143	Sewer Lift Station	Sewer Pumping Station	Low	AE	No	Low	2

Table 29: Relationship of Critical Infrastructure to Hazard Areas							
ID	**NAME**	**TYPE**	**Landslide Risk**	**Within FEMA Flood Zone**	**Within Locally Identified Area of Flooding**	**Average Annual Snow Fall**	**Hurricane Surge Areas (Category #)**
144	Lakeview Ave Sewer Lift Station	Sewer Pumping Station	Low	No	No	Low	0
145	Bridge No. 6 Substation	Power Substation	Moderate	No	Bridge Street at Boston Street and Strawberry Brook	Low	4
146	Lynn Shore Drive Seawall	Flood Protection	Low	VE	No	Low	0
147	Transfaglia Road Stormwater Lift Station	Sewer Pumping Station	Moderate	No	No	Low	0
148	Linton Road Stormwater Lift Station	Sewer Pumping Station	Low	No	No	Low	0
149	Lynn Traffic Control Point	Traffic Control Point	Low	No	No	Low	0
150	Lynn Traffic Control Point	Traffic Control Point	Low	No	No	Low	0
151	Lynn Traffic Control Point	Traffic Control Point	Low	No	No	Low	0
152	Lynn Traffic Control Point	Traffic Control Point	Low	No	No	Low	0
153	Lynn Traffic Control Point	Traffic Control Point	Low	No	No	Low	0
154	Lynn Traffic Control Point	Traffic Control Point	Low	No	No	Low	0

Table 29: Relationship of Critical Infrastructure to Hazard Areas							
ID	**NAME**	**TYPE**	**Landslide Risk**	**Within FEMA Flood Zone**	**Within Locally Identified Area of Flooding**	**Average Annual Snow Fall**	**Hurricane Surge Areas (Category #)**
155	Lynn Traffic Control Point	Traffic Control Point	Low	No	No	Low	2
156	Lynn Traffic Control Point	Traffic Control Point	Moderate	No	No	Low	0
157	Lynn Traffic Control Point	Traffic Control Point	Low	No	No	Low	0
158	Fire Alarm Dispatch Center	Telecommunications	Low	No	No	Low	0
159	Verizon Telephone	Communications	Low	No	No	Low	0
160	Hyberia	Telecommunications	Low	No	No	Low	0
161	Railroad	Transportation Facility	Low	No	Alley Street	Low	0
162	MBTA Bus Terminal	Transportation Facility	Moderate	No	No	Low	2
163	Commuter Rail Station	Transportation Facility	Low	No	No	Low	4
164	Tennessee Gas Pipeline	Gas Line	Moderate	No	No	Low	0
165	330 Scangas Nominee Trust	Hazardous Materials	Low	AE	No	Low	2
166	Lynn Waste Water Treatment Plant	Sewer Treatment Facility	Moderate	No	No	Low	3
167	First Lutheran Church	Place of Worship	Low	No	No	Low	0

Table 29: Relationship of Critical Infrastructure to Hazard Areas							
ID	**NAME**	**TYPE**	**Landslide Risk**	**Within FEMA Flood Zone**	**Within Locally Identified Area of Flooding**	**Average Annual Snow Fall**	**Hurricane Surge Areas (Category #)**
168	Grace United Methodist Church of Lynn	Place of Worship	Low	No	No	Low	0
169	Austin Square Baptist Church	Place of Worship	Moderate	No	No	Low	0
170	Bethlehem Temple	Place of Worship	Low	No	No	Low	0
171	St Mary's Church	Place of Worship	Low	No	No	Low	0
172	Washington Street Baptist Church	Place of Worship	Low	No	No	Low	0
173	St Josephs Church	Place of Worship	Low	No	No	Low	0
174	Christ Church United Methodist	Place of Worship	Low	No	No	Low	0
175	Sacred Heart	Place of Worship	Moderate	No	No	Low	4
176	Walgreens	Pharmacy	Moderate	No	No	Low	0
177	Walgreens	Pharmacy	Low	No	No	Low	0
178	Walgreens	Pharmacy	Low	No	No	Low	0
179	CVS	Pharmacy	Low	No	No	Low	0
180	CVS	Pharmacy	Low	0.2 PCT ANNUAL CHANCE FLOOD HAZARD	No	Low	0

Table 29: Relationship of Critical Infrastructure to Hazard Areas							
ID	**NAME**	**TYPE**	**Landslide Risk**	**Within FEMA Flood Zone**	**Within Locally Identified Area of Flooding**	**Average Annual Snow Fall**	**Hurricane Surge Areas (Category #)**
181	Stop & Shop	Grocery Store/ Pharmacy	Low	No	No	Low	0
182	Johnny's Food Master	Grocery Store	Low	0.2 PCT ANNUAL CHANCE FLOOD HAZARD	No	Low	0
183	Shaw's Super Market	Grocery Store/ Pharmacy	Low	No	No	Low	0
184	Mary Ellen Drive Water Tank	Water Storage Tank	Low	No	No	Low	0
185	Pinehill Water Tank	Water Storage Tank	Low	No	No	Low	0
186	Seaport Landing Marina	Recreation/ Residences	No	VE	No	High	0
187	Lynn Yacht Club	Recreation	Low	AE	No	Low	1
188	Volunteer Yacht Club	Recreation	Low	VE	No	Low	1
189	Lynn EDIC Pier	Recreation	No	VE	No	High	0
190	General Edwards Bridge	Bridge	No	AE	No	High	0
191	Dam	Dam	Low	No	No	Low	0
192	Dam /Pump Station	Dam	Low	No	No	Low	0

Table 29: Relationship of Critical Infrastructure to Hazard Areas							
ID	**NAME**	**TYPE**	**Landslide Risk**	**Within FEMA Flood Zone**	**Within Locally Identified Area of Flooding**	**Average Annual Snow Fall**	**Hurricane Surge Areas (Category #)**
193	Pine Grove Cemetery Fueling Facility	Hazardous Material	Low	0.2 PCT ANNUAL CHANCE FLOOD HAZARD	No	Low	0
194	National Grid Power Station	Power Station	Low	AE	No	Low	2
195	Fox Hill Bridge	Bridge	No	AE	No	High	0
196	Floating Bridge	Bridge	Low	No	No	Low	0
197	Gear Plant Heliport	Heliport	Moderate	No	No	Low	2
198	EOC	EOC	Low	No	Johnson Street	Low	0
199	Quinn Road Water Tank	Water Tank	Low	No	No	Low	0
200	Dibble Road Water Tank	Water Tank	Low	No	No	Low	0
201	Lynn Water and Sewer Commission Headquarters	Municipal Facility	Low	No	No	Low	0
202	Juvenile Court	Government Facility	Low	No	No	Low	0
203	Holy Family Catholic Church	Place of Worship	Low	No	No	Low	0
204	East Baptist Church	Place of Worship	Low	No	No	Low	0
205	Church	Place of Worship	Low	No	No	Low	0
206	Mosque	Place of Worship	Low	No	No	Low	0

Table 29: Relationship of Critical Infrastructure to Hazard Areas							
ID	**NAME**	**TYPE**	**Landslide Risk**	**Within FEMA Flood Zone**	**Within Locally Identified Area of Flooding**	**Average Annual Snow Fall**	**Hurricane Surge Areas (Category #)**
207	Haitian Church	Place of Worship	Low	No	No	Low	0
208	Church	Place of Worship	Low	No	Johnson Street	Low	0
209	Church	Place of Worship	Low	No	No	Low	0
210	Church	Place of Worship	Low	No	No	Low	0
211	church	Place of Worship	Low	No	No	Low	0
212	St Theresa House	Low Income Housing	Low	No	No	Low	0
213	Low Service Reservoir	Water Resource	Low	0.2 PCT ANNUAL CHANCE FLOOD HAZARD	No	Low	0
214	Low Service Pumping St	Water Pumping Station	Moderate	No	No	Low	0
215	Saugus River Diversion Dam	Dam	Low	No	No	High	0
216	KIPP Academy Lynn Charter School	School	Low	No	No	Low	0
217	Habit Management (Methadone) Treatment Center	Medical Facility	Moderate	No	No	Low	2
218	Elliott Community Health Center	Medical Facility	Low	No	No	Low	0

Table 29: Relationship of Critical Infrastructure to Hazard Areas							
ID	**NAME**	**TYPE**	**Landslide Risk**	**Within FEMA Flood Zone**	**Within Locally Identified Area of Flooding**	**Average Annual Snow Fall**	**Hurricane Surge Areas (Category #)**
219	VA Clinic/ Doctors offices	Medical Facility	Low	No	No	Low	0
220	Rite-Aid	Pharmacy	Low	0.2 PCT ANNUAL CHANCE FLOOD HAZARD	No	Low	0
221	Rite-Aid	Pharmacy	Low	No	No	Low	0
222	CVS	Pharmacy	Low	No	No	Low	0
223	Richmond Pharmacy	Pharmacy	Low	No	No	Low	0
224	Eaton Apothecary	Pharmacy	Low	No	No	Low	0
225	Flag Pharmacy	Pharmacy	Low	No	No	Low	0
226	Pharmacy - Market Square	Pharmacy	Low	No	No	Low	0
227	Price Rite of Lynn	Grocery	Low	No	No	Low	2
228	Compare Supermarket	Grocery	Low	No	No	Low	0
229	Lynn Community Health Center	Medical Facilty	Low	No	No	Low	0
230	East Lynn Post Office	Government Facility	Low	No	No	Low	0
231	West Lynn Post Office	Government Facility	Moderate	No	No	Low	0

Table 29: Relationship of Critical Infrastructure to Hazard Areas							
ID	**NAME**	**TYPE**	**Landslide Risk**	**Within FEMA Flood Zone**	**Within Locally Identified Area of Flooding**	**Average Annual Snow Fall**	**Hurricane Surge Areas (Category #)**
232	Atlantic Ambulance	Medical Services	Low	No	No	Low	0
233	Atlantic Ambulance	Medical Services	Low	No	No	Low	0
234	Atlantic Ambulance	Medical Services	Low	0.2 PCT ANNUAL CHANCE FLOOD HAZARD	No	Low	0
235	Action Ambulance	Medical Services	Low	No	No	Low	0
236	Walden Pond outlet Dam	Dam	Low	No	No	Low	0
237	Birch Pond Dam	Dam	Low	No	No	Low	0
238	Lantern Rock Dike #4	Water Feature	Low	No	No	Low	0
239	Comcast	Communication	Low	0.2 PCT ANNUAL CHANCE FLOOD HAZARD	No	Low	0
240	Lynn Community Cable	Communication	Moderate	No	No	Low	4
241	Knight of Columbus	Place of Assembly	Low	No	No	Low	0

Table 29: Relationship of Critical Infrastructure to Hazard Areas							
ID	**NAME**	**TYPE**	**Landslide Risk**	**Within FEMA Flood Zone**	**Within Locally Identified Area of Flooding**	**Average Annual Snow Fall**	**Hurricane Surge Areas (Category #)**
242	Knights of Pythias	Place of Assembly	Low	No	No	Low	0
243	Community Brotherhood	Place of Assembly	Low	No	No	Low	0
244	St Michaels House	Place of Assembly	Moderate	No	Lower Western Interceptor Sewer/Drain Line	Low	2
245	Franco American	Place of Assembly	Low	No	No	Low	0
246	Connery-Post 6	Place of Assembly	Low	No	No	Low	0
247	North Shore Animal Hospital	Medical Facility	Low	No	No	Low	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. Please note that Census data is incorporated into the HAZUS program and cannot be modified by an end user. Up until January 1, 2015, the HAZUS program used 2000 Census data.
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 City of Scituate, 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 only 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. If interested, communities can build a more accurate database and further test disaster scenarios.

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 .01% and .005% 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 City, bringing the strongest winds and greatest damage potential.

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

Table 30. Estimated Damages from Hurricanes

	100-year	**500-year**
Building Characteristics		
Estimated total number of buildings	18,124	18,124
Estimated total building replacement value (Year 2002 $) (Millions of Dollars)	$5,481	$5,481
Building Damages		
# of buildings sustaining minor damage	1,847	6,244
# of buildings sustaining moderate damage	308	2,746
# of buildings sustaining severe damage	14	404
# of buildings destroyed	2	213
Population Needs		
# of households displaced	207	1,724
# of people seeking public shelter	63	504
Debris		
Building debris generated (tons)	12,920.4	61,464.48
Tree debris generated (tons)	4,539.6	18,359.52
# of truckloads to clear building debris	516	2,472
Value of Damages (Thousands of dollars)		
Total property damage	$62,187.10	$421,226.60
Total losses due to business interruption	$8,695.37	$64,891.20

Estimated Damages from Earthquakes

Methodology Used

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

Table 31
Estimated Damages from Earthquakes

	Magnitude 5.0	**Magnitude 7.0**
Building Characteristics		
Estimated total number of buildings	18,000	18,000
Estimated total building replacement value (Year 2002 $) (Millions of dollars)	$5,481	$5,481
Building Damages		
# of buildings sustaining slight damage	2,970	2,220
# of buildings sustaining moderate damage	929	6,437
# of buildings sustaining extensive damage	142	5,081
# of buildings completely damaged	18	4,021
Population Needs		
# of households displaced	335	14,460
# of people seeking public shelter	96	4,117
Debris		
Building debris generated (tons)	0	1.00 million
Value of Damages (Millions of dollars)		
Total property damage	$279.95	$3,554.30
Total losses due to business interruption	$16.97	$443.43

Estimated Damages from Flooding

Methodology Used

MAPC did not use HAZUS-MH to estimate flood damages in Lynn. In addition to technical difficulties with the software, the riverine module is not a reliable indicator of flooding in areas where inadequate drainage systems contribute to flooding even when those structures are not within a mapped flood zone. In lieu of using HAZUS, MAPC developed a methodology to give a rough approximation of flood damages.

Lynn is 10.8 square miles or 6,912 acres. Approximately 128 acres have been identified by local officials as areas of flooding. This amounts to 1.85 % of the land area in Lynn. The number of structures in each flood area was estimated by applying the percentage of the total land area to the number of structures (18,124) in Lynn; the same number of structures used by HAZUS for the hurricane and earthquake calculations. HAZUS uses a value of $302,417 per structure for the building replacement value. This was used to calculate the total building replacement value in each of the flood areas. The calculations were done for a low estimate of 10% building damages and a high estimate of 50% as suggested in the FEMA September 2002 publication, "State and Local Mitigation Planning how-to guides" (Page 4-13). The range of estimates for flood damages is $9,526,136- $47,630,677. These calculations are not based solely on location within the floodplain or a particular type of storm (i.e. 100 year flood).

Table 32- Estimated Damages from Flooding

ID	Flood Hazard Area	Approximate Area in Acres	% of Total Land Area	# of Struc-tures	Replacement Value	Low Damage Estimate	High Damage Estimate
1	Surfside Road	15.2070	0.22	40	$12,096,680	$1,209,668	$6,048,340
2	Valley Road	5.9559	0.0806	15	$4,536,255	$453,626	$2,268,126
3	Lower Western Interceptor Sewer/Drain Line	51.1447	0.6920	125	$37,802,125	$3,782,125	$18,901,062
4	Bridge Street at Boston Street and Strawberry Brook	8.5305	0.1154	21	$6,350,757	$635,076	$3,175,379
5	Flax Pond at Maple Street	10.6996	0.1448	26	$7,862,842	$786,284	$3,931,421
6	Magnolia Ave	7.3823	0.0999	18	$5,443,506	$544,351	$2,721,753
7	Cedar Pond	10.2066	0.1381	25	$7,560,425	$756,043	$3,780,213
8	Bridge Road outlet	6.6202	0.0896	20	$6,048,347	$604,835	$3,024,174
9	Alley Street	8.2300	0.1114	13	$3,931,421	$393,142	$1,965,711
10	Johnson Street	5.2412	0.0709	16	$4,838,672	$483,867	$2,419,336
11	Silsbee Street	3.4257	0.0463	8	$2,419,336	$241,937	$1,209,668
18	Coolidge Road	5.6204	0.0760	14	$4,233,838	$423,384	$2,116,919
	Totals	128.26	1.73543	315	$95,261,355	$9,526,136	$47,630,677

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V. HAZARD MITIGATION GOALS

The Lynn Local Multiple Hazard Community Planning Team met on March 9, 2011. At that meeting, the team reviewed and discussed the goals from the 2005 Hazard Mitigation Plan for the City of Lynn. The goals were modified and updated.

The following nine goals were endorsed by the Committee for the 2016 update of the Lynn Hazard Mitigation Plan:

1. Promote cost-effective hazard mitigation actions that protect and promote public health and safety from all hazards with a particular emphasis on reducing damage to repetitive and severe repetitive loss properties.

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

3. Ensure that critical infrastructure sites are protected from natural hazards.

4. Protect the City's ability to respond to various natural hazard events.

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

6. Increase coordination and cooperation between City departments in implementing sound hazard mitigation planning and sustainable development.

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VI. EXISTING MITIGATION MEASURES

Existing Multi-Hazard Mitigation Measures

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.

Communications Equipment – The City has its own Emergency Operations Center located at the Lynn Police facility. The City is installing a Reverse 911 system in 2012.

Emergency Power Generators – Emergency power generators are in place in the three certified emergency shelters- the Lynn Classical High School, Lynn English High School and the Lynn Vocational High School. All but three fire stations have backup emergency generators.

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

Southern Essex Regional Emergency Management Planning Committee (REPC) – Lynn is a member of the Southern Essex REPC which also includes the communities of Beverly, Danvers, Essex, Gloucester, Manchester-by-the-Sea, Marblehead, Nahant, Peabody, Rockport, Salem, and Swampscott.

The mission of an LEPC can be summarized as follows:

- A response plan must be written for responding to a hazardous material incident with the jurisdiction(s). It must also be reviewed annually.
- Emergency responders (police, fire, emergency medical services, public works, etc.) must be trained to levels indicated in the plan. At a minimum, first responders must be trained to the awareness level.
- The emergency response plan must be exercised at least once a year.
- The committee must create a system to collect, store, and respond to public requests.

Existing Flood Hazard Mitigation Measures

Overview of Mitigation Measures – Background: The most severe winter storm in recent history, the Great Blizzard of 1978 heavily impacted the Lynn, Revere, and Saugus coastal areas. It damaged 25% of Revere's homes, left 3,000 people homeless, and flooded over 3,000 buildings in the Lynn, Revere, Saugus and Malden area. The storm's

impacts led these communities to request the Army Corps of Engineers to develop and implement the Saugus River and Tributaries Flood Damage Reduction Project, which was completed by 1989. Included in the plans recommendations and since installed, were dikes and a pooling area for Revere Beach, floodgates for the Saugus River (located just south of the entrance to Lynn Harbor), and a series of dikes, walls and revetments along Lynn Harbor.

As demonstrated by the Saugus River Flood Damage Reduction Project, mitigating flood hazards is more than a local issue amongst the densely developed communities of the North Shore, such as Lynn. The drainage systems that serve these communities are a complex system of storm drains, tide gates, roadway drainage structures, pump stations and other facilities owned and operated by a wide array of agencies including the City of Lynn, 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.

Combined Sewer Separation: During heavy flows to the treatment plant, the plant is not able to pump as much water which results in wet well flooding in the lower areas of the collection system. There is an on-going sewer separation program and the program has successfully remediated more than half of the City's combined sewer and drain lines, primarily in East Lynn.

National Flood Insurance Program (NFIP) – Lynn participates in the NFIP with 397 policies in force as of May 31, 2014. FEMA maintains a database on flood insurance policies and claims. This database can be found on the FEMA website at http://www.fema.gov/business/nfip/statistics/pcstat.shtm

The following information is provided for the City of Lynn:

Flood insurance policies in force (as of October 3, 2013)	397
Coverage amount of flood insurance policies	94,597,700
Premiums paid	281,279
Total losses (all losses submitted regardless of the status)	159
Closed losses (Losses that have been paid)	128
Open losses (Losses that have not been paid in full)	0
CWOP losses (Losses that have been closed without payment)	31
Total payments (Total amount paid on losses)	$1,110,609.01

The City complies with the NFIP by enforcing floodplain regulations, Section 14.3 of the Lynn Zoning Ordinance, maintaining up-to-date floodplain maps, and providing information to property owners and builders regarding floodplains and building requirements.

Since the 2005 Hazard Mitigation Plan, policies in force have increased by 117 and total losses have increased by 52. The total payments increased by $451,307.

Public Services Operations/Maintenance Activities – The Lynn Water and Sewer Commission actively maintains the City's storm drain system. The following specific activities serve to maintain the capability of the drainage system through the reduction of sediment and litter build up and proper maintenance and repair.

- *Street sweeping* – Street sweeping is done by both Lynn and contracted out, conducted nine times annually, with streets swept twice per year or as needed.

- *Catch basin cleaning* –2,000 catch basins; each basin is cleaned every year with clogged basins cleaned as needed. Lynn has replaced several dysfunctional catch basins with new deep-sump basins over the last 10 years.

- *Roadway treatments* – Calcium Chloride is used for snow/ice treatment.

- *Drainage maintenance*- 60 % of the City's catch basins and drain lines are now digitally mapped. The LWSC tracks and records all catch basin maintenance. The Engineering Department inspects streets and drainage systems once construction is completed. Private covenants for private, off-street drainage facilities are required. Routine maintenance and systematic replacement of drainage infrastructure part of the Lynn Water and Sewer Commission's annual operating budget.

2010 Open Space and Recreation Plan- The Lynn Open Space and Recreation Plan, lists actions that can could help prevent flooding and reduce stormwater runoff through the following targeted actions from 2010 – 2015

- Identify, conserve and utilize open space areas along the Saugus River;
- Begin re-forestation of fire-damaged areas within the Lynn Woods Reservation;
- Continue the revitalization of downCity urban green spaces, such as adding pervious traffic islands and landscaped, pervious parking areas.

Flood Plain Regulations - Section 14.3 of the Lynn Zoning Ordinance, adopted by Lynn on May 8, 2012, establishes a Floodplain district within the City, establishing areas of special flood hazards subject to a one percent chance or greater of flooding in any given year. These areas may be designated as Zone A, AO, AH, A1-30, AE, A99, V1-30 or V. This Floodplain District includes all of the Zones designated as special flood hazard areas and as designated on the City of Lynn, Massachusetts Essex County Flood Insurance

Rate Map (FIRM) issued by the Federal Emergency Management Agency (FEMA) for the administration
of the National Flood Insurance Program, dated July 16, 2014. *Lynnshore Drive Seawall* - Development along Lynnshore Drive is protected by a seawall owned by the State Department of Conservation and Recreation.

Wetland Ordinance- Chapter 16.04 of the Lynn Code of Ordinances: The City follows MGL Chapter 131 Section 40 *MA Wetlands Protection Act,* as well as state wetland regulations.

Dam safety regulations- Lynn Water and Sewer Commission Dam Safety Report – The LWSC inspected all of its dams and dikes in 2003 and submitted a report to the DEM Office of Dam Safety. This report identified all rehabilitation work required at each dam. The Walden Pond dams were rehabilitated in 1999-2000 and the Hawkes Pond dams were rehabilitated in 1997-1998. Birch Pond Dam, Breeds Pond Dam at Lantern Rock and Breeds Pond Outlet Dam have all been rehabilitated since 2005. The city's *Comprehensive Emergency Management Plan* (CEMP) also addresses dam safety.

Existing Wind Hazard Mitigation Measures

CEMP – The Lynn Comprehensive Emergency Management Plan contains a section on hurricanes. It lists five generic mitigation measures:

- Develop and disseminate emergency public information and instructions concerning hurricane preparedness and safety.
- Community leaders should ensure that Lynn is enrolled in the National Flood Insurance Program.
- Develop and enforce local building codes to enhance structural resistance to high winds and flooding. Build new construction in areas that are not vulnerable to direct hurricane effects.
- Review National Flood Insurance Rate Maps and Hurricane Evacuation Maps for possible impact on the community.
- Maintain plans for managing all hurricane emergency response activities.

The Lynn CEMP outlines three generic mitigation measures for tornadoes.

- Develop and disseminate emergency public information and instructions concerning tornado safety, especially guidance regarding in-home protection and evacuation procedures, and locations of public shelters.
- Strict adherence should be paid to building code regulations for all new construction.
- Maintain plans for managing tornado response activities. Refer to the non-institutionalized, special needs and transportation resources listed in the Resource Manual.

Massachusetts State Building Code – The City 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.

Tree-trimming program – The City contracts out some of its work to trim and remove trees as needed and grind stumps. National Grid maintains its power line corridors, and the DPW maintains the rest of the City's trees. 25% of the City's trees have been inventoried but the City would like to complete the inventory.

Additional mitigation measures in place include:

- The City has placed zoning height restrictions on the height of wind energy turbines.
- Lynn now has backup power generators at key public facilities and utility sites.
- The City places power lines underground during new construction to avoid storm damage.

Existing Winter Hazard Mitigation Measures

Snow disposal – Regular plowing and snow/ice removal. Calcium chloride is used primarily for road treatments. Sand is very rarely used as it creates siltation and clean up problems. The DPW works to clear roads as requested or in an emergency for the Fire and Police Departments.

Existing Brush Fire Hazard Mitigation Measures

Burn Permits – The City fire department does not allow outdoor burning.

Fire Response-Lynn responds to a brush fire or marsh fire in the same manner as other fire calls. It does not have a dedicated Forestry Division.

Subdivision/Development Review – The Fire Department participates in the review of new subdivisions and development projects.

Existing Geologic Hazard Mitigation Measures

Massachusetts State Building Code – The City enforces the State Building Code. It contains a section on designing for earthquake loads (780 CMR 1612.0). Section 1612.1 states that the purpose of these provisions is "to minimize the hazard to life to occupants of all buildings and non-building structures, to increase the expected performance of higher occupancy structures as compared to ordinary structures, and to improve the capability of essential facilities to function during and after an earthquake". This section

goes on to state that, due to the complexity of seismic design, the criteria presented are the minimum considered to be "prudent and economically justified" for the protection of life safety. The code also states that absolute safety and prevention of damage, even in an earthquake event with a reasonable probability of occurrence, cannot be achieved economically for most buildings.

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

In the event of an earthquake and fires caused by it, 100 % of Lynn is served by fire hydrants. The Emergency Management Department has two mobile, 5Kw generators in case of power loss and the Lynn Water and Sewer Commission has one.

Table 33- Lynn Existing Mitigation Measures

Type of Existing Mitigation Measures	Area Covered	Effectiveness/ Enforcement	Improvements/ Changes Needed
MULTIPLE HAZARDS			
Comprehensive Emergency Management Plan (CEMP)	City-wide.	Emphasis is on emergency response.	None. Plan is up to date.
Communications Equipment: • Member of NERAC and NEMWIC • DFS Mobile backup • Police station is emergency operations center	City-wide.	Effective	Complete Reverse 911 installation. Evacuation/intersection sign-boards.
Massachusetts State Building Code	City-wide.	Effective for new construction.	None
Hazardous Facilities Emergency Response Plans	City-wide.	Emergency response.	All plans up to date for Lynn Water Treatment Plant, General Electric, C.L. Hathaway, LWSC Wastewater Treatment Plant, Blossom Street LNG Tank, Garelick Farms
Emergency Power Generators	Lynn English, Lynn Tech, Lynn Classical, DPW, City Hall, six of nine fire stations	Effective.	Upgrade generators as needed; provide generators at additional locations; provide alternative fuel sources and generator power source flexibility. New fixed generator needed at three fire stations and LWSC facility.
Participation in the Southern Essex Emergency Management Planning Committee	City-wide	A forum for cooperation on natural and manmade disasters.	None

Type of Existing Mitigation Measures	Area Covered	Effectiveness/ Enforcement	Improvements/ Changes Needed
FLOOD HAZARDS/DAMS			
LWSC Capital Improvements Program	City-wide	The City has made extensive drainage infrastructure upgrades under its Capital Improvements Program since 2005.	Additional resources are needed to implement further upgrades, particularly for CSO separation work.
Participation in the National Flood Insurance Program (NFIP)	Areas identified on the FIRM maps	There are 397 policies in force.	Encourage all eligible homeowners to obtain insurance; add more public outreach about program availability and new FIRM maps.
Public education on stormwater and flooding		website	Update for wetlands and new FIRM maps when available.
City Engineering Department inspects all streets and drainage systems once construction is completed.	City Wide	Effective	None
Public Services Operations/Maintenance	City-wide	Effective	Complete digital mapping of drainage and sewer system.
2010 Open Space Plan	City Wide	Effective	Target land acquisitions along the Saugus River for flood water storage, damage prevention and habitat protection.
Wetlands Regulation-follows MA Wetlands Protection Act	City-wide	Effective	None
Site Plan Review	City-wide	Somewhat Effective	Consider referencing MA Stormwater Management Standards.
Planned Unit Development	City-wide	Effective	Consider referencing MA Stormwater Management Standards.

Type of Existing Mitigation Measures	**Area Covered**	**Effectiveness/ Enforcement**	**Improvements/ Changes Needed**
Subdivision Rules and Regulations	City-wide	Somewhat Effective.	Consider referencing MA Stormwater Management Standards.
Lynn Water and Sewer Commission Dam Safety Report – The LWSC inspected all of its dams and dikes in 2003 and submitted a report to the DEM Office of Dam Safety. This report identified all rehabilitation work required at each dam. Birch Pond Dam, Breeds Pond at Lantern Rock and Breeds Pond Outlet Dam have all been rehabilitated since 2005. The Walden Pond dams were rehabilitated in 1999-2000 and the Hawkes Pond dams were rehabilitated in 1997-1998.	City-wide	Effective	Rehabilitate and upgrade dams as needed. Replace headwall at Foster's Pond Dam.
Comprehensive Emergency Management Plan (CEMP): addresses dam safety	City-wide	Effective	CEMP is up to date: None.
Permits required for construction: state law requires permit for the construction of any dam.	City-wide	Effective	None
WIND HAZARDS			
CEMP	City-wide	Effective	None
The Massachusetts State Building Code	City-wide	Effective for most situations except severe storms.	None
Tree trimming program and power line corridor maintenance.	City-wide	Satisfactory	Complete tree inventory.

Type of Existing Mitigation Measures	Area Covered	Effectiveness/ Enforcement	Improvements/ Changes Needed
Limits wind turbine height	City-wide	Effective	None
Backup generator capacity in place at key public facilities.	City-wide	Effective	Update existing generators as needed and add fixed generator capacity to three fire stations.
Lynn Emergency Planning Website- Hurricane Preparedness	City-wide	Effective	None
WINTER HAZARDS			
Snow Removal	City-wide	Somewhat Effective	None
Lynn Emergency Preparedness Website- Snow and Ice Safety	City-side	Effective	None
FIRE-RELATED HAZARDS			
Outdoor burning is not allowed.	City-wide.	Effective.	Need two All Terrain Vehicles for brush fire access and equipment mobility.
Water availability: 100 % of City is served by hydrants; tanker truck agreements in place with surrounding communities; authority to take water from surface supplies.	City-wide.	Effective.	None.
Development Review	City-wide.	Effective.	None.
Public Education	City-wide	Effective.	None.
GEOLOGIC HAZARDS			
The Massachusetts State Building Code	City-wide.	Effective.	None.
Mobile generators and light pole for power/light backup	City-wide	Effective.	None.

VII. MITIGATION MEASURES FROM THE 2005 PLAN

Review and Update Process

At a meeting of the Lynn Hazard Mitigation Committee, City staff reviewed the potential mitigation measures identified in the 2005 North Shore Regional Pre-Disaster Mitigation Plan Lynn Annex 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 Lynn 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 City to take action on the measure.

Table 34- Potential Mitigation Measures from the 2005 Plan

Mitigation Measure	Priority	Implementation Responsibility	Time Frame	2014 Status
Continue with Combined Sewer Overflow separation project.	High	LWSC	Years 1-5	East Lynn phase is complete and the project is complete.
Camden Street/Little River drainage improvements.	High	LWSC	Years 1-3	Completed 2006.
Undertake dam rehabilitation work as identified in the 2003 inspections: Birch Pond, Breeds Pond, at Lantern Rock, Breeds Pond Outlet Dam.	High	LWSC	Years 1-3	All three dams have repaired and a maintenance plan put into place.
Install new pump station on Linton Road.	High	LWSC	Years 1-3	Completed 2006.
Map inundation areas for dams.	High	LWSC	Years 1-3	This project has been completed as of 2009.
Complete Valley Road drainage project.	Medium	LWSC	Years 2-4	Not completed: targeted for NHM grant.
Foster Pond dam	Medium	LWSC,	Years	Not completed:

Mitigation Measure	Priority	Implementation Responsibility	Time Frame	2014 Status
upgrade.		Swampscott DPW	2-4	target to complete with Valley Road project.
Brush Fire equipment upgrades.	Low	Fire Department	Years 2-4	Not completed due to budget constraints: still needed.
Complete the City tree inventory.	Low	DPW	Years 3-5	95% complete.
Undertake a tree trimming program.	Low	DPW	Years 3-5	Completed.

Lynn has made considerable progress on implementing mitigation measures identified in the 2005 Hazard Mitigation Plan. Many of the measures identified in that plan are now considered on-going aspects of the regular work of City staff from the department head level to the regular work of Public Works staff. Individual projects have been incorporated into the City's capital improvement plan and the City continues to seek FEMA grant funding to implement the home elevation program. Moving forward into the next five year plan implementation period there will be many more opportunities to incorporate hazard mitigation into the City's decision making processes.

Lynn will be increasing its integration of natural hazard mitigation into its community planning processes by building on priority mitigation actions included in this update of its original plan. The City will begin to actively incorporate new hazard mitigation actions into its all of its land use, environmental, capital, and transportation planning efforts, building on the following core principles of sound hazard mitigation planning:

- Building on this plan update to continue assessing and mapping community risk;
- Creating local support for integration of natural hazard mitigation planning by increasing its hazard education and risk awareness outreach and education efforts;
- Integrating mitigation into local planning studies, bylaws and regulations;
- Incentivizing hazard mitigation best practices.

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 and human-made hazards through long-term strategies. These long-term strategies include planning, policy changes, programs, 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 in a local area. There is a third level of mitigation which is regional; involving a state, regional, or federal agency or an issue that involves numerous municipalities across a wide area of the metropolitan region.

Regional Partners

In many communities, 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 City of Lynn, the Department of Conservation and Recreation (DCR), and Massachusetts Department of Transportation (MDOT). 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 where cooperation with these other agencies may be necessary. Implementation of these recommendations will require that all parties work together to develop solutions.

Inter-Community Considerations

Fosters Pond Dam in Swampscott drains into Lynn and if it failed, would pose a problem in Lynn.

The Lynn Woods Reservation is owned by the City of Lynn and encompasses 2,200 acres in Lynn, Lynnfield and Saugus. The reservation contains several ponds and dams and is also a regional concern due to wildfires.

Hawes Pond dam in Saugus is of regional concern because a dam failure could impact commuters on Route 1.

Walden Pond Dam (and a portion of the pond) is in Saugus.

The Lynn LEPC felt that a possible regional mitigation measure would be the joint purchase of fire equipment or other specialized equipment that a single community would not be able to afford.

Sea Level Rise and Shoreline Environment – The coastal shoreline of the North Shore area is a dynamic environment where forces of sea-level rise, erosion and deposition of are constantly at work changing the shoreline profile. This process disregards municipal

boundaries as sand and other materials are moved along the coast. Shoreline protection measures such as sea walls, jetties, and others have an impact on this process with the potential of building up materials in some areas while stripping it away from others. In Lynn, a shoreline issue of regional concern is the need for additional storm water and storm surge storage capacity

Municipalities along the North Shore should work to understand how these processes and others associated with sea level rise and storm surge are at work locally and consider mutually beneficial means of protecting their shore side communities from the impacts of storm damage and sea-level rise. Lynn should consider participating within a regional sea level rise action work group to help plan for and address sea level rise, storm surge and related climate adaptation issues on a regional basis.

Proposed Hazard Mitigation Measures

Changes in Mitigation Priorities from 2005 Plan

Mitigation measures in the 2005 Hazard Mitigation Plan were assigned a priority of high, medium or low by the local Hazard Mitigation Planning Committee for that plan. Each mitigation measure from the 2005 plan that has been retained in this plan update has been marked with an asterisk (*) and a note made if the priority level has changed according to the prioritization process in this plan update.

High Priority Mitigation Measures

Flooding, Drainage Infrastructure and Dams

- Upgrade drainage system on Surfside Road. This area is heavily impacted by high tides, storm surge and sea level rise. The drainage system for this area needs to be raised and a pump station installed.

- Install wave attenuator at Seaport Landing facility.

- * Upgrade Valley Road culvert. Previously Medium Priority. The Valley Road culvert is undersized for the amount of stormwater flow it handles during high precipitation events. It backs up and causes localized flooding.

- Lower Western Interceptor: mitigate low elevation issue and tidal backup. The combined sewer overflow system (CSO) in place in Lynn creates a capacity problem in the drainage system. When there are heavy flows to the treatment plant, the plant is not able to pump as much water and the wet wells flood in the lower areas of the collection system. This situation is being alleviated by sewer separation which will eventually cost in the range of $50 -54 million. The City would like to conduct a study on how to best mitigate the low elevation, tidal

backup and inflow and infiltration problems that create the wet well flooding issues.

- Install Ipswich River pumps station levee. The Ipswich River waters provides drinking water to 350,000 people and thousands of businesses in 14 communities, including Beverly, Danvers, Hamilton, Ipswich, Lynn, Lynnfield, Middleton, North Reading, Peabody, Salem, Topsfield, Wenham and Wilmington. The Lynn Water and Sewer Commission makes permitted withdrawals from the Ipswich and needs to install the levee around the pump station to protect it from river flooding events.

- Finish digital mapping of city drainage system.

- *Upgrade the Foster Pond Dam headwall in conjunction with Swampscott DPW. Previously Medium Priority- There is flooding in the eastern part of the City from Foster's Pond in Swampscott. The design of the grate at the headwall is inadequate and it gets blocked with debris. The City of Lynn has offered to replace the grate.

Measures to Ensure Compliance with NFIP and Mitigate for Coastal Hazards/Tsunami

- The City should participate in the FEMA Community Rating System (CRS) program to lower flood hazard risk, raise community awareness and quality for lower flood hazard insurance premiums. . See information at: http://ma.stormsmart.org/home/community-rating-system-crs-primer/

- Floodplain District Management: Update this district to remain consistent with FEMA guidelines and floodplain mapping. See more information on model bylaw development for MA coastal floodplains at: http://ma.stormsmart.org/2010/11/05/great-model-bylaw-for-managing-coastal-floodplain-development/

- Floodplain Mapping: Maintain up to date maps of local FEMA identified floodplains. The effective date for the current FIRM map is 7/16/2014.

- Acquisition of Vacant Flood Prone Lands: Acquire priority open space parcels in floodplain areas in order to maintain flood storage and water infiltration capacity. The 2010 Lynn Open Space and Recreation Plan includes the acquisition of land along the Saugus River as one its goals.

Multi Hazards

- Emergency Power Generators: Upgrade all emergency power generators in emergency shelters and critical facilities as needed; provide alternative fuel sources and generator power source flexibility. Upgrading fixed generators at three Lynn fire stations and the LWSC facility are top public safety priorities.

    - Install new diesel, fixed location generator at the Reservoir Pumping Station. Purchase new light tower

    - Upgrade LWSC handheld radios and repeater station.

    - Purchase two electronic signboards.

- Assess and Map Community Risk through the following actions:
    - Develop and maintain a database to track community vulnerability to known hazards.
    - Establish a process to coordinate with regional, state and Federal agencies to maintain up-to-date hazard data, maps and assessments.
    - Identify the most at-risk critical facilities and evaluate potential mitigation techniques.

- Integrate Mitigation into Local Planning through the following actions:
    - Incorporate risk assessment and hazard mitigation principles into local capital improvement, master, and open space planning efforts.
    - Incorporate a stand-alone element for hazard mitigation into the local development, redevelopment and subdivision review process.
    - Determining and enforcing acceptable land uses to alleviate the risk of damage by limiting exposure in such hazard areas.
    - Involve citizens in all comprehensive planning activities that identify and mitigate hazards.

- Incentivize Hazard Mitigation through the following actions:
    - Waive permit fees for home construction or reconstruction related to mitigation.
    - Use tax abatements, public subsidies, and other incentives to encourage private mitigation practices.

- Increase Hazard Education and Risk Awareness through the following actions:
    - Include hazard mitigation and preparedness measures on the Town's website.
    - Host an annual public hazards workshop for Town residents, with speakers from MEMA, FEMA and private industry (such as insurance) on natural hazards and mitigation.

Fire Related Hazards

- Purchase new 4x4 fire truck, pump and forestry hose.

- Purchase two new ATV's for brush fire access and equipment hauling.

- Encourage single-family residences to have fire plans and practice evacuation.

- Encourage Fire Department to notify new business applications to ensure that appropriate fire plans and egress plans have been developed.

- Develop and maintain a database to track the location of any wildfire hazard event.
- Include the consideration of wildfire risk and mitigation in any comprehensive, capital, emergency response or open space planning efforts.
- Perform arson prevention cleanup activities in areas of abandoned or collapsed structures, accumulated trash or debris, and any area where spills or dumping may have occurred.
- Routinely inspect the functionality of fire hydrants.

Winter Storms

- The City shares a large percentage of its snow and ice road clearing duties with MA DOT. Lynn would like to better coordinate with MA DOT to ensure mutual enforcement of winter no-parking ordinances during storm events and prompt sidewalk snow removal following storm events.

- Lynn should consider partnering with MEMA and FEMA to design and implement a winter storm preparedness program that reduces the risk to life, property and utility systems.

- Develop partnerships with utility providers to document known hazards

- Protect buildings and infrastructure by retrofitting public buildings to withstand snow loads and prevent roof collapse.

- Using snow fences or "living snow fences" e.g. rows of trees or shrubs, to limit blowing and drifting snow over critical roadway segments.

- Identifying specific at-risk populations that may be exceptionally vulnerable in the event of long-term power outages.

Medium Priority Mitigation Measures

Flooding, Drainage Infrastructure and Dams

- Install upgraded drainage outlet at Flax Pond.

- Upgrade the Magnolia Avenue sewer line to eliminate inflow and infiltration.

- Upgrade drainage at Cedar Pond outlet.

- Upgrade drainage at Floating Bridge Pond outlet.

- Upgrade Johnson street drainage to eliminate Combined Sewer Overflow events during heavy precipitation events.

- Create a climate change preparedness strategy with adaptation goals and actions.

Wind Related Hazards

- Update and implement the tree maintenance program with additional funding. Distribute information to property owners to reduce risk of tree failure to life, property and utility systems; identify potentially hazardous trees in critical areas; increase tree program staffing as possible to identify and remove hazardous trees.

Winter Storms

- Participate in a regional Sea Level Rise Action Work Group with neighboring coastal communities to draft and implement regional preparedness actions for winter storms, storm surge and associated sea level rise coastal hazards. This can be done in association with participating in the Community Rating System program.

Lower Priority Mitigation Measures

Geologic Related Hazards

- Public and Commercial Building Assessments: Develop an inventory and assess the earthquake vulnerability of all public and commercial buildings.

- Develop and implement a structural retrofitting program that prioritizes actions on the Town's older, un-reinforced masonry buildings.

- Earthquakes and Landslides: Provide public information to encourage the reduction of structural and non-structural earthquake and landslide hazards in homes, schools, businesses and government offices.
    - Assess slopes that potentially vulnerable to landslide during an earthquake.
    - Provide information to government and building and school facility managers and teachers on securing bookcases, filing cabinets, light fixtures, and other objects that can cause injuries and block exits.
    - Encourage business owners, teachers and facility managers to to refer to FEMA's guide book: "Reducing the Risks of Nonstructural Earthquake Damage".

- Encourage homeowners and renters to use "Is Your Home Protected from Earthquake Disaster? A Homeowner's Guide to Earthquake Retrofit".

Flooding and Drainage Infrastructure

- Develop a City-base wetlands mapping capacity that would include an all local wetlands delineations data base

- Create and implement wetlands, flooding, and stormwater education and outreach program for Lynn residents that incorporate new NFIP map and program information.

Drought

Promote drought tolerant landscape design through measures such as:

- Incorporating drought tolerant native species into development landscape regulations.
- Using permeable driveways and surfaces to promote groundwater infiltration and reduce stormwater runoff.

Extreme Temperatures

- Green Buildings and Parking areas to reduce urban heat island impacts: plant trees to shade buildings, parking areas and public ways; encourage the use of green roofs or cool roofing products to reflect sun and heat away from a building.

- Create a database to track vulnerable, at-risk people in the community such as the elderly and homeless.

Prioritization of Mitigation Activities

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

Prioritization occurred through discussion with the local committee and through subsequent review by committee members and public comment. Priority setting was based on local knowledge of the hazard areas, including impacts of hazard events and the extent of the area impacted and the relation of a given mitigation measure to the City's identified goals. In addition, through the discussion, the local committee also took into

consideration factors such as the number of homes and businesses affected, whether or not road closures occurred and what impact closures had on delivery of emergency services and the local economy, anticipated project costs, whether the City currently had the technical and administrative capability to carry out the mitigation measures, whether any environmental constraints existed, and whether Lynn would be able to justify the costs relative to the anticipated benefits.

Table 35 below demonstrates the prioritization. For each mitigation measure, the geographic extent of the potential benefiting area is identified, an overall benefit in terms of High, Medium or Low is estimated, a cost in terms of High (greater than $50,000), Medium ($10,000 to $49,000), or Low (less than $10,000 or staff time) is identified, and based on these factors, each mitigation measure is categorized as High, Medium or Low. The level of benefit created by a project was based on an estimate of the number of homes, businesses, or people served by the mitigation action and an estimate of the costs or damages avoided via implementation of the mitigation measure.

For Table 35, the following symbols apply to indicate degree of Hazard Mitigation Alternative Acceptability:

- Acceptable
- Somewhat Acceptable

TABLE 35- EVALUATION OF PRIORITY HAZARDS MITIGATION ALTERNATIVES									
	PROJECTS ALTERNATIVE	**Socially Acceptable**	**Technically Feasible**	**Administratively Possible**	**Politically Acceptable**	**Legal**	**Economically Sound**	**Environmentally Sound**	**Cost Range**
High Priority Alternatives-Flooding									
Flooding	Surfside Road drain lines	•	•	•	•	•	•	•	High
Flooding	**Install wave attenuator at Seaport Landing Facility**	•	•	•	•	•	•	•	High
Flooding	**Valley Road: upgrade culvert and screen debris**	•	•	•	•	•	•	•	High
Flooding	**Lower Western Interceptor: study on how to mitigate low elevation issue and tidal backup**	•	•	•	•	•	•	•	High
Flooding	**Ipswich River Pump Station levee**	•	•	•	•	•	•	•	High
Flooding	**Finish digital mapping of drainage system**	•	•	•	•	•	•	•	High
Flooding	**Finish digital drainage system mapping**	•	•	•	•	•	•	•	High
Flooding	**Foster Pond dam headwall**	•	•	•	•	•	•	•	High

TABLE 35- EVALUATION OF PRIORITY HAZARDS MITIGATION ALTERNATIVES									
	PROJECTS ALTERNATIVE	**Socially Acceptable**	**Technically Feasible**	**Administratively Possible**	**Politically Acceptable**	**Legal**	**Economically Sound**	**Environmentally Sound**	**Cost Range**
Flooding	**Use FEMA Community Rating System**	•	•	•	•	•	•	•	Medium
	Floodplain District Management: Update this district to remain consistent with FEMA guidelines and floodplain mapping as needed.	•	•	•	•	•	•	•	Moderate
		•	•	•	•	•	•	•	Moderate
Flooding	**Maintain up to date FIRM maps and update as needed.**	•	•	•	•	•	•	•	Low
Flooding	**Purchase vacant flood prone lands with focus on Saugus River Flooding floodplain**	•	•	•	•	•	•	•	Moderate
High Priority Alternatives-Multi Hazard									
Multi Hazard	Update or install new fixed generators	•	•	•	•	•	•	•	Moderate

TABLE 35- EVALUATION OF PRIORITY HAZARDS MITIGATION ALTERNATIVES

	PROJECTS ALTERNATIVE	Socially Acceptable	Technically Feasible	Administratively Possible	Politically Acceptable	Legal	Economically Sound	Environmentally Sound	Cost Range
Multi Hazard	Purchase new light tower	•	•	•	•	•	•	•	Low
Multi Hazard	Purchase two electronic signboards	•	•	•	•	•	•	•	Low
Multi Hazard	Upgrade LWSC communications	•	•	•	•	•	•	•	Moderate
Multi Hazard	Assess and map community risk	•	•	•	•	•	•	•	Moderate
Multi Hazard	Integrate mitigation into local planning	•	•	•	•	•	•	•	High
Multi Hazard	Incentivize hazard mitigation	•	•	•	•	•	•	•	Moderate
Multi Hazard	Increase hazard education and risk awareness	•	•	•	•	•	•	•	Low
High Priority Alternatives- Fire Related									
Brush Fires	Purchase new brush fire truck and equipment	•	•	•	•	•	•	•	Moderate
Urban Fires	Fire plans and	•	•	•	•	•	•	•	Low

TABLE 35- EVALUATION OF PRIORITY HAZARDS MITIGATION ALTERNATIVES									
	PROJECTS ALTERNATIVE	**Socially Acceptable**	**Technically Feasible**	**Administratively Possible**	**Politically Acceptable**	**Legal**	**Economically Sound**	**Environmentally Sound**	**Cost Range**
	evacuation routes for single family homes								
Urban Fires	Fire and egress plans for new business	•	•	•	•	•	•	•	Low
Brush Fires	Purchase two ATV's for brush fire fighting and hauling	•	•	•	•	•	•	•	Moderate
Brush Fires	Develop wildfire data base	•	•	•	•	•	•	•	Low
Brush Fires	Include wildfire risk in planning	•	•	•	•	•	•	•	Low
Urban/brushfires	Arson cleanup and prevention	•	•	•	•	•	•	•	Low
Urban/brushfires	Routine inspection of fire hydrants	•	•	•	•	•	•	•	Low
High Priority Alternatives-Winter Storms									
Winter Storms	Coordinated parking and snow removal program	•	•	•	•	•	•	•	Low
Winter Storms	Partner with utilities to document known hazards	•	•	•	•	•	•	•	Low
Winter Storms	Retrofit public buildings to withstand snow loads	•	•	•	○	•	○	•	High

TABLE 35- EVALUATION OF PRIORITY HAZARDS MITIGATION ALTERNATIVES

	PROJECTS ALTERNATIVE	Socially Acceptable	Technically Feasible	Administratively Possible	Politically Acceptable	Legal	Economically Sound	Environmentally Sound	Cost Range
Winter Storms	Use snow fences to limit blowing snow	•	•	•	•	•	•	•	High
Winter Storms	ID at risk populations vulnerable to long term power outages	•	•	•	•	•	•	•	Low
Medium Priority Alternatives-Flooding									
Flooding	Upgrade Flax Pond outlet	•	•	•	•	•	•	•	High
Flooding	Upgrade Magnolia Avenue sewer line for I and I problems	•	•	•	•	•	•	•	High
Flooding	Upgrade Cedar Pond outlet	•	•	•	•	•	•	•	High
Flooding	Upgrade Johnson Street for CSO problems	•	•	•	•	•	•	•	High
Flooding	Climate change strategy	•	•	•	•	•	•	•	Moderate
Medium Priority Alternatives-Wind Related									
Wind Related	Increase tree maintenance program	•	•	•	•	•	•	•	Moderate

TABLE 35- EVALUATION OF PRIORITY HAZARDS MITIGATION ALTERNATIVES

	PROJECTS ALTERNATIVE	Socially Acceptable	Technically Feasible	Administratively Possible	Politically Acceptable	Legal	Economically Sound	Environmentally Sound	Cost Range
Medium Priority Alternatives- Winter Storms									
Winter Storms	Regional Sea Level Rise Action Group	•	•	•	•	•	•	•	Low
Winter Storms	Consider partnering with MEMA and FEMA to design and implement a winter storm preparedness program	•	•	•	•	•	•	•	Low
Lower Priority Alternatives- Geologic									
Geologic	Develop an inventory and assess earthquake vulnerability of public and commercial buildings	•	•	•	•	•	•	•	Moderate
	Develop and implement a structural retrofitting program for earthquake vulnerable buildings	•	•	•	○	•	○	•	High

TABLE 35- EVALUATION OF PRIORITY HAZARDS MITIGATION ALTERNATIVES									
	PROJECTS ALTERNATIVE	**Socially Acceptable**	**Technically Feasible**	**Administratively Possible**	**Politically Acceptable**	**Legal**	**Economically Sound**	**Environmentally Sound**	**Cost Range**
Geologic	Provide public information to reduce nonstructural and structural risks	•	•	•	•	•	•	•	Low
Lower Priority Alternatives- Flooding									
Flooding	Wetlands delineation and database	•	•	•	•	•	•	•	Moderate
Flooding	Dredge Washburn Avenue outfall and chokepoint	•	•	•	•	•	•	•	Moderate
Flooding	Outreach program	•	•	•	•	•	•	•	Low
Drought	Promote drought tolerant land design measures	•	•	•	•	•	•	•	Low
Extreme Temps.	Implement Green Building and Parking BMPs	•	•	•	•	•	•	•	Moderate
Extreme Temps	Create database to track at risk populations for	•	•	•	•	•	•	•	Low

TABLE 35- EVALUATION OF PRIORITY HAZARDS MITIGATION ALTERNATIVES									
	PROJECTS ALTERNATIVE	**Socially Acceptable**	**Technically Feasible**	**Administratively Possible**	**Politically Acceptable**	**Legal**	**Economically Sound**	**Environmentally Sound**	**Cost Range**
	extreme temps.								

Introduction to Mitigation Measures Table

Priority – The designation of high, medium, or low priority was done at the meeting of the Local Multiple Hazard Community Planning Team meeting. The designations reflect discussion and a general consensus developed at the meeting but could change as conditions in the community change. In determining project priorities, the local team considered potential benefits and project costs.

Hazard Area – Each mitigation measure is intended to address one or more of the natural hazard potentially impacting Lynn, such as Flooding, Wind, Fire, and Earthquake. Where the proposed measure is intended to address a specific locally identified area of concern, this area is identified as well.

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. . Hazards marked with an asterisk (*) can be used as either a stand-alone recommendation or can be performed within the comprehensive hazard assessment, mitigation, hazard mitigation incentives and hazard education and risk awareness recommendations made under the Multi-Hazard hazard heading.

Measure Type – There are six different types of pre-disaster mitigation measures identified by FEMA for which a community may apply for Hazard Mitigation funding.

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

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

Potential Funding Sources – This column attempts to identify the most likely sources of funding for a specific measure. The information on potential funding sources in this table is preliminary and varies depending on a number of factors. These factors include whether or not a mitigation measure has been studied, evaluated or designed, or if it is still in the conceptual stages. MEMA and DCR assisted MAPC in reviewing the potential eligibility for hazard mitigation funding. Each grant program and agency has

specific eligibility requirements that would need to be taken into consideration. In most instances, the measure will require a number of different funding sources. Identification of a potential funding source in this table does not guarantee that a project will be eligible for, or selected for funding. Upon adoption of this plan, the local committee responsible for its implementation should begin to explore the funding sources in more detail.

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

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

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

United States Department of Agriculture – The USDA has programs by which communities can get grants for firefighting needs. See the link below for some example.

http://www.rurdev.usda.gov/rd/newsroom/2002/cfg.html

Abbreviations Used in Table 36

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

ACOE = Army Corps of Engineers.

MHD = Massachusetts Highway Department.

EOT = Executive Office of Transportation.

DCR = Department of Conservation and Recreation

DHS/EOPS = Department of Homeland Security/Emergency Operations

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

LWSC= Lynn Water and Sewer Commission

Table 36 - Potential Mitigation Measures						
Hazard Area	**Mitigation Measures**	**Measure Type**	**Implementation Responsibility**	**Time Frame**	**Estimated Cost**	**Potential Funding Sources**
High Priority Mitigation Measures						
Flooding	**Surfside Road: upgrade drain lines**	**Structural Projects**	**LWSC**	**2014-2016**	**$250,000**	**Bonding/PDM**
Flooding	**Install wave attenuator at Seaport Landing Facility**	**Structural Projects**	**OECD**	**2014-2016**	**$500,000**	**Bonding**
Flooding	**Valley Road: upgrade culvert and screen debris**	**Structural Projects**	**LWSC**	**2014-2016**	**$400,000**	**DPW budget**
Flooding	**Foster Pond dam headwall**	**Structural Projects**	**LWSC**	**2014- 2016**	**$300,000**	**Bonding/PDM**
Flooding	**Lower Western Interceptor: mitigate low elevation issue and tidal backup study**	**Structural Projects**	**LWSC**	**2014-2017**	**$250,000**	**Bonding/PDM**
Flooding	**Participate in the FEMA Community**	**Prevention**	**Building Division, Planning and**	**2014- 2019**	**$20,000 annually**	**General budget/MPTA**

Table 36 - Potential Mitigation Measures						
Hazard Area	**Mitigation Measures**	**Measure Type**	**Implementation Responsibility**	**Time Frame**	**Estimated Cost**	**Potential Funding Sources**
	Rating System (CRS) program		**Conservation Commission**			
Flooding	**Ipswich River Pump Station levee**	**Structural**	**LWSC**	**2014-2019**	**$250,000**	**LWSC/PDM**
Flooding	**Finish digital mapping of drainage system**	**Prevention**	**LWSC**	**2014-2019**	**$350,000**	**LWSC**
Flooding	**Continue to update floodplain district as district as needed to be consistent with FEMA guidelines.**	**Prevention**	**Building Division**	**2014- 2019**	**$$25,000 per year**	**General fund**
Flooding	**Purchase**	Natural	**Planning/**	**2014-2018**	**Parcels could**	**PDM/Bondin**

Table 36 - Potential Mitigation Measures						
Hazard Area	**Mitigation Measures**	**Measure Type**	**Implementation Responsibility**	**Time Frame**	**Estimated Cost**	**Potential Funding Sources**
	vacant flood prone lands with focus on Saugus River Flooding floodplain	Resource Protection	**Conservation Commission**		**range in cost from $100,000 to $5 million**	**g/Private Land Trust not yet identified**
Flooding	***Plan for storm surge events.**	Prevention	**Planning/Conservation Commission**	**2014-2017**	**$25,000**	**General fund, MPTA**
Flooding	***Limit development in V-Zones.**	Prevention	**Planning/Conservation Commission**	**2014-2017**	**$25,000**	**General fund, MPTA**
Flooding	***Adopt coastal A-Zones.**	Prevention	**Planning/Conservation Commission**	**2014-2017**	**$25,000**	**General fund, MPTA**
Multi-hazards						
Multi-hazards	**Upgrade fixed, emergency power generators: 3 Fire Stations, LWSC**	**Emergency Services Protection**	**Fire/LWSC**	**2014-2019**	**$100,000**	**General fund**
Multi-hazards	**Purchase new light tower**	**Emergency Services Protection**	**LWSC**	**2014-2019**	**$20,000**	**General fund**
Multi-hazards	**Purchase two electronic**	**Emergency Services**	**Fire/Police**	**2014-2019**	**$35,000**	**General fund**

Table 36 - Potential Mitigation Measures						
Hazard Area	**Mitigation Measures**	**Measure Type**	**Implementation Responsibility**	**Time Frame**	**Estimated Cost**	**Potential Funding Sources**
	signboards	**Protection**				
Multi-hazards	**Upgrade and LWSC handheld radios and repeater station**	**Emergency Services Protection**	**LWSC**	**2014-2019**	**$75,000**	**General fund**
Multi-hazard	**Assess and map community risk**	**Prevention**	**Planning/Conservation Commission**	**2014-2016**	**$50,000**	**General fund, MPTA/PDM**
Multi-hazard	**Integrate mitigation into local planning**	**Prevention**	**Planning/Conservation Commission**	**2016-2019**	**$100,000**	**General fund/MPTA/ PDM**
Multi-hazard	**Incentivize hazard mitigation**	**Prevention**	**Planning/Conservation Commission**	**2016-2019**	**$25,000**	**General fund/MPTA/ PDM**
Multi-hazard	**Increase hazard education and risk awareness**	**Public Education and Awareness**	**Planning/Conservation Commission/DPW**	**2014-2019**	**$10,000 per year staff time**	**DPW budget, general fund**
Fire Related Hazards						
Brush Fires	**Purchase new 4x4 fire truck, pump and**	**Emergency Services Protection**	**Fire**	**2014-2017**	**$125,000**	**General fund**

Table 36 - Potential Mitigation Measures						
Hazard Area	**Mitigation Measures**	**Measure Type**	**Implementation Responsibility**	**Time Frame**	**Estimated Cost**	**Potential Funding Sources**
	forestry hose					
Brush Fires	**Purchase two ATV's**	**Emergency Services Protection**	**Fire**	**2014-2017**	**$20,000**	**General fund**
Urban Fires	**Fire plans and evacuation routes for single family homes**	**Public Information**	**Fire**	**2017-2019**	**$2,500 per year staff time**	**General fund**
Urban Fires	**Fire and egress plans for new business**	**Public Information**	**Fire**	**2014-2019**	**$2,500 per year staff time**	**General fund**
Wildfires	*** Develop and maintain a wildfire database**	**Prevention**	**Fire/EMD**	**2015-2016**	**$10,000**	**General fund**
Wildfires	***Include wildfire risk and mitigation in comprehensive planning**	**Prevention**	**Planning**	**2014- 2019**	**$5,000**	**General fund**
Wildfires/Urban	**Perform arson prevention activities**	**Natural Resource Management**	**Fire**	**2014 - 2019**	**$2,000 per year**	**Fire Dept. budget**
Wildfires/Urban	**Inspect fire**	**Emergency**	**Fire**	**2014- 2019**	**$2,000 per**	**Fire Dept.**

Table 36 - Potential Mitigation Measures

Hazard Area	Mitigation Measures	Measure Type	Implementation Responsibility	Time Frame	Estimated Cost	Potential Funding Sources
	hydrants on a routine basis	**Services Protection**			**year**	**budget**
Winter Storms						
Winter Storms	**Coordinated snow removal and parking program**	**Emergency Services Protection**	**DPW/Police/ DCR/MA DOT**	**20142019**	**Staff cost estimated to be $10,000/year**	**DPW budget/ DCR/ MA DOT**
Winter Storms	**Winter Storm Preparedness**	**Prevention**	**DPW/FEMA/ MEMA**	**2014-2019**	**$5,000/year staff time**	**DPW budget/DCR**
Winter Storms	**Partner with utility to document hazard areas**	**Prevention**	**DPW/Utilities**	**2014-2019**	**$2,500/year staff time**	**DPW budget/ Utilities**
Winter Storms	**Retrofit at-risk critical, public building roofs to withstand snow loads**	**Emergency Services Protection**	**DPW**	**2017-2019**	**$250,000**	**General fund**
Winter Storms	**Construct snow fences**	**Structural Project**	**DPW**	**2017-2019**	**$150,000**	**General fund**
Winter Storms	***ID populations vulnerable to long term power outage**	**Prevention**	**Planning**	**2017-2019**	**$2,000 staff time**	**General fund, MPTA**
Medium Priority Mitigation Measures						

Table 36 - Potential Mitigation Measures						
Hazard Area	**Mitigation Measures**	**Measure Type**	**Implementation Responsibility**	**Time Frame**	**Estimated Cost**	**Potential Funding Sources**
Flooding	**Flax Pond @Maple St: upgraded outlet**	**Structural Project**	**LWSC**	**2014- 2019**	**$350,000**	**Bonding/PDM**
Flooding	**Magnolia Ave: upgrade sewer- eliminate I &I**	**Structural Project**	**LWSC**	**2014-2019**	**$300,000**	**Bonding/PDM**
Flooding	**Cedar Pond**	**Structural Project**	**LWSC**	**2016-2019**	**$500,000**	**Lynn/FEMA**
Flooding	**Floating Bridge Pond Outlet**	**Structural Project**	**LWSC**	**2014- 2019**	**$250,000**	**Bonding/PDM**
Flooding	**Johnson Street: CSO backup**	**Structural Project**	**LWSC**	**2014- 2019**	**$800,000**	**Bonding/PDM**
Flooding						
Flooding	**Master/ Drainage Plan Climate Adaptation Update**	**Prevention**	**Planning**	**2014-2019**	**$50,000**	**General fund**
Wind Related						
Wind Related	**Update tree maintenance program**	**Emergency Services**	**DPW**	**2014-2019**	**$15,000/year staff time**	**General fund**
Winter Storms						
Winter Storms	***Regional Sea**	**Prevention**	**Planning/DPW/**	**2014- 2019**	**$5,000 per**	**General fund**

Table 36 - Potential Mitigation Measures						
Hazard Area	**Mitigation Measures**	**Measure Type**	**Implementation Responsibility**	**Time Frame**	**Estimated Cost**	**Potential Funding Sources**
	Level Rise Action Work Group		**Conservation Commission**		**year staff time**	
Lower Priority Mitigation Measures						
Geologic	***Develop an inventory and assess the earthquake vulnerability of all public and commercial buildings.**	**Prevention**	**Fire/Planning/EMD**	**2014-2016**	**$20,000**	**General fund/MPTA**
Geologic	**Implement a structural retrofit program for town's priority at risk buildings**	**Structural**	**Fire/DPW/EMD**	**2017- 2019**	**$1,000,000**	**General fund**
Geologic	***Provide public information to reduce nonstructural and structural landslide and earthquakes**	**Public Information**	**Planning**	**2014-2019**	**$2,500 per year staff time**	**General fund/MPTA**

Table 36 - Potential Mitigation Measures						
Hazard Area	**Mitigation Measures**	**Measure Type**	**Implementation Responsibility**	**Time Frame**	**Estimated Cost**	**Potential Funding Sources**
Flooding	**Wetlands and wetlands delineations database**	**Natural Resource Protection**	**Planning/ Conservation Commission**	**2014- 2019**	**$20,000**	**General fund /DCR**
Flooding	***Wetlands and Stormwater Outreach program**	**Natural Resource Protection/Prevention**	**Conservation Commission**	**2014-2019**	**$2,500 per year staff time**	**General fund**
Drought						
	***Incorporate drought tolerant species into regulations**	**Prevention**	**Planning**	**2017-2019**	**$5,000**	**General fund**
	***Require permeable driveways and surfaces to promote infiltration and reduce runoff**	**Prevention**	**Planning**	**2017-2019**	**$10,000**	**General fund**
Extreme Temps						
	***Require Green Building and parking best**	**Prevention**	**Planning**	**2014- 2019**	**$10,000**	**General fund**

Table 36 - Potential Mitigation Measures						
Hazard Area	**Mitigation Measures**	**Measure Type**	**Implementation Responsibility**	**Time Frame**	**Estimated Cost**	**Potential Funding Sources**
	practices					
	***Create and maintain a data base to track those vulnerable to extreme temperatures**	**Prevention**	**Planning/EMD**	**2014- 2019**	**$2,000 per year**	**General fund**

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IX. PLAN ADOPTION AND MAINTENANCE

Plan Adoption

The Lynn Hazard Mitigation Plan 2016 Update was adopted by the City Council on June 21, 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

MAPC worked with the Lynn Hazard Mitigation Planning Team to prepare this plan. This group will continue to meet on an as-needed basis to function as the Local Hazard Mitigation Implementation Group, with the Lynn Emergency Management Director as coordinator. Additional members could be added to the local implementation group from businesses, non-profits, and institutions. The public will be invited to all meetings in accordance with the Massachusetts Open Meeting Law. MAPC will strongly encourage Lynn to advertise the meetings in newspaper ads, post the meetings at the local library and on the City's website.

Implementation Schedule

Bi-Annual Survey on Progress– The coordinator of the Hazard Mitigation Implementation Team will prepare and distribute a biannual survey in years two and four 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. MAPC will send an annual reminder to each Local Hazard Mitigation Team contact person to check their hazard mitigation planning schedule and to conduct their bi-annual survey if in year two or four of their plan.

This information will be used to prepare a report or addendum to the local hazard mitigation plan. The Hazard Mitigation Implementation Team will have primary responsibility for tracking progress and updating the plan.

Develop a Year Four Update – During the fourth year after initial plan adoption, the coordinator of the Hazard Mitigation Implementation Team will convene the team to begin to prepare for an update of the plan, which will be required by the end of year five in order to maintain approved plan status with FEMA. The team will use the information from the year four biannual review to identify the needs and priorities for the plan update. MAPC will send an annual reminder to each Local Hazard Mitigation Team contact person to check their hazard mitigation planning schedule and to conduct their four year update if in year four of their plan

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 City's approved plan status and its eligibility for FEMA mitigation grants. Because of the time required to secure a planning grant, prepare an updated plan, and complete the approval and adoption of an updated plan, the local Hazard Mitigation Planning Team should begin the process by the end of Year 3. This will help the City avoid a lapse in its approved plan status and grant eligibility when the current plan expires.

At this point, 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 update of the Lynn Hazard Mitigation Plan 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 Lynn Hazard Mitigation Plan by FEMA, the Local Hazard Mitigation Implementation 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. . Discussions will focus on how recommendations in the approved NHM plan can be integrated into the City's capital improvement planning program, master planning process, zoning, wetlands, and stormwater or subdivision regulations.

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

- Fire / Emergency Management
- Police
- Public Services / Highway
- Engineering
- Planning and Community Development
- Conservation
- Parks and Recreation
- 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.

Acting to Increase Hazard Mitigation Awareness and Planning into Lynn's Planning and Community Development Process

The City has incorporated several high priority mitigation actions into its plan update in order to help raise awareness of the increasing threat posed by natural hazards, integrate mitigation planning into local plans and bylaws and find ways to help offset the costs associated with hazard mitigation actions.

Those actions include the following broader objectives as cornerstones, followed by specific mitigation actions to implement them:

Building a Knowledge Platform

The City will build on this plan update to begin creating local databases to track known hazards, working with regional, state and federal partners such as MAPC, MEMA and FEMA to help it get started and maintain and up-to date hazard data, maps and assessments with as much local information as possible. Creating this information will help Lynn identify its most at-risk facilities and vulnerable populations and help it select the most effective mitigation techniques.

Integration

Once a data framework has been started and relationships with regional, state and federal partners have begun to be established, the City will be ready to present its case to City residents and businesses on the need to incorporate hazard mitigation planning into all phases of the City's operational and planning departments, including the following integration actions:

- Incorporating risk assessment and hazard mitigation principles into local capital improvement, master, and open space planning efforts.
- Incorporating a stand-alone element for hazard mitigation into the local zoning and subdivision review process.
- Adopting and enforcing acceptable land uses to alleviate the risk of damage by limiting exposure in hazard areas.

Outreach and Education

Accomplishing this integration successfully will mean the City will need to begin to reach out to its residents early and in a consistent manner to present updated and relevant hazard information, building trust over time with area residents and businesses on the vital need to address hazard mitigation planning.

Two actions within this plan update are for the City to place its latest Hazard Mitigation Plan, members of the Local Hazard Mitigation Implementation Team and meeting notices, links to MEMA and FEMA and other relevant agencies, mitigation funding incentives for homeowners and business owners, helpful hazard mitigation links and "tips" on a Hazard Mitigation web page of the City's website. Another action is to hold annually, at minimum, a Natural Hazard Awareness Public Workshop with presentation of City and regional hazard information, highlights from the City's current Hazard Plan, and either academic, agency or another community's Hazard Mitigation Implementation Team on hand as speakers. The workshop should feature plenty of time for discussion and questions on local projects, costs, funding and lessons learned.

Incentives for Hazard Mitigation

Finding ways to help reduce the cost of hazard mitigation will be critical to the City successfully adopting hazard mitigation measures. Impact fees for new development are not legal within Massachusetts, although the Zoning Reform Act now being debated by the Legislature has a clause that would allow it. Waiving permit fees, tax abatements, public subsidies and other funding must considered or made available.

StormSmart Coasts is a "resource for coastal decision makers looking for the latest and best information on how to protect their communities from weather and climate hazards", and can be extremely helpful to Lynn in all phases of learning and implementing effective natural hazard mitigation planning.

See : http://ma.stormsmart.org/.

X. LIST OF REFERENCES

In addition to the specific reports listed below and sources noted in the text, much of the technical information for this plan came from meetings with City department heads and staff.

FEMA Local Multi-Hazard Mitigation Planning Guidance, July 1, 2008

North Shore Regional Multi Hazard Mitigation Plan: Lynn Annex, December, 2005

Saugus River and Tributaries Flood Damage Reduction Project, US Army Corps of Engineers, 1989

City of Lynn General Ordinances

City of Lynn Zoning Ordinance

City of Lynn, Subdivision Control Regulations

Lynn Water and Sewer Capital Improvement Program 2012- 2015

City of Lynn, Comprehensive Emergency Management Plan

2010 Lynn Open Space and Recreation Plan

Lynn Waterfront Master Plan Report, September, 2007

Commonwealth of Massachusetts, MacConnell Land Use Statistics, 2005

Metropolitan Area Planning Council, Geographic Information Systems Lab

Metropolitan Area Planning Council, Regional Plans and Data

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APPENDIX A
MEETING AGENDAS

Don Boyce
Director

Richard Sullivan
COMMISSIONER

Marc D. Draisen
Executive Director

The Commonwealth of Massachusetts

DEVAL PATRICK, GOVERNOR

Massachusetts Emergency Management Agency
400 WORCESTER ROAD, FRAMINGHAM, MA 01702-5399 508-820-2000 FAX 508-820-1404

Department of Conservation and Recreation
251 CAUSEWAY STREET, SUITE 600-900, BOSTON, MA 02114-2104 617-626-1250 FAX 617-626-1351

Metropolitan Area Planning Council
60 TEMPLE PLACE, 6TH FLOOR, BOSTON, MA 02111 617-451-2770 FAX 617-482-7185

North Shore Hazard Mitigation Planning Team

First Meeting

Monday, February 8, 10:00 AM

Saugus Public Safety Building
2nd Floor Training Room
27 Hamilton Street, Saugus, MA
(Map & directions attached)

NORTH SHORE Hazard Mitigation Planning TEAM

Lynn
Lynn
Nahant
Lynn
Lynn
Salem
Saugus
Swampscott
Lynn

AGENDA

10:00 WELCOME & INTRODUCTIONS

10:05 OVERVIEW OF HAZARD MITIGATION PLANNING & GRANTS

- State Hazard Mitigation Plan & FEMA Grants–Sarah White, MEMA
- Regional & Local Mitigation Plans - Martin Pillsbury, MAPC

10:20 UPDATING THE NORTH SHORE HAZARD MITIGATION PLAN

- FEMA Requirements & Grant Eligibility
- Review of Scope of Work & Schedule –MAPC
- Questions & Discussion – Local issues & Priorities

10:50 GETTING STARTED: MAPPING AND CRITICAL FACILITIES DATABASE FOR THE NORTH SHORE PLAN UPDATE

- Susan Brunton, GIS Analyst, MAPC

11:15 NEXT STEPS / ADJOURN

If you have any questions please contact Martin Pillsbury at MAPC:
617-451-2770, ext. 2012 or **mpillsbury@mapc.org**

Lynn Predisaster Mitigation Renewal Planning Meeting
March 15, 2011
Lynn City Hall
10 – 12
Agenda

1. Welcome and Introductions

2. Project Overview (*Sam Cleaves, MAPC*)

3. Survey Handout and Ortho Map Markup of Hazardous Areas/ Conversation:

   What has changed from 2005 PDM Plan?

   Review past Areas of Concern and Potential Areas of Development, Priority Projects

   Plan Update:

   - What floods? How often? Any new mitigation studies done? What mitigation measures have been done or planned for? High or low priority?

   - Other hazards: Brush fires, dams, earthquake, high winds? What areas? Dam studies available?

   - Map known future development areas? Type, size, status of permitting

4. Review Draft Project Goals: See over

5. Discuss Project Outreach: See over

6. Review mitigation projects: community actions and new priority projects/costs

7. Next Steps: Follow up with individuals as needed, continue information gathering, set priority mitigation projects and costs, maximize community collaboration on projects

---

Project Overview - MAPC received a grant to prepare natural hazards *Pre-Disaster Mitigation Plan* for the communities of Beverly, Lynn, Nahant, Lynn, Lynn, Salem, Saugus, Swampscott and Lynn. MAPC is working with the nine 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.

Public Participation Options

1. Presentation by City/City staff to local groups.
2. MAPC presents at public meetings – existing board or commissions
3. Post on City/City website with a set public review period.
4. Distribute to specified organizations or boards/commissions for their review.
5. Create a summary document and distribute in community

Draft Sample 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 the business community, major institutions and non-profits to work with the City/City 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 City staff and the public about hazard mitigation.

Second Lynn Team Meeting Agenda May 10, 2012

Hello Everyone

I would like to set up a meeting to review the Hazard Mitigation Plan for Lynn on Thurs May 10th at 10:00-11:30 AM in room 302 at City Hall. Sam Cleaves from MAPC, who is preparing our Hazard Mitigation Plan, will attend the meeting as well.

Sam will send out the project list prior to the meeting.

Here is an agenda for the meeting:

10:00 Welcome & Purpose

10:10 Review Hazard Mitigation Project Priority List
Adjustments, cost, and timelines

11:10 Plan Implementation

11:30 Adjourn

Please let me know if you are able to attend.

Tom

Lt. Thomas Hines
Office of Emergency Management
Lynn Fire Department
725 Western Ave
Lynn, MA 01905
Bus: 781-593-1234
Cell: 781-389-2447
thines@lynnma.gov

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APPENDIX B
HAZARD MAPPING

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

The map series consists of four panels with two maps each.

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

Full sized PDF's of the Lynn maps can be downloaded from the MAPC File Transfer Protocol (FTP) website:

ftp://ftp.mapc.org/Hazard_Mitigation_Plans/maps/Lynn/

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: Potential Development – This map shows potential future developments, and critical infrastructure sites. MAPC consulted with City staff to determine areas that were likely to be developed or redeveloped in the future.

Map 3: Flood Zones – The map of flood zones used the latest FEMA NFIP Flood Zones as its source, dated July 16, 2014 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 municipally owned and protected open space

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. 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 and open space. 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.

APPENDIX C
DOCUMENTATION OF PUBLIC PARTICIPATION AND COMMENTS RECEIVED

LYNN PLANNING BOARD

ROOM 401 – CITY HALL

LYNN, MASSACHUSETTS

(781) 598-4000, EXTENSION 6816

RECEIVED
CITY CLERK'S OFFICE

2011 SEP -7 P 2:27

LYNN, MASS

September 7, 2011

Mrs. Mary Audley
City Clerk
City Hall
Lynn, MA 01901

Dear Mrs. Audley:

A meeting of the Lynn Planning Board will be held on Tuesday, September 13, 2011, at 6:30 p.m., Room 302, Lynn City Hall.

The Agenda includes a presentation of Natural Hazard Mitigation Measures.

Sincerely,

Judith Lewin-Callahan
Recording Secretary

CITY OF LYNN, MASSACHUSETTS

LYNN CITY COUNCIL
2012-2013

Ward One	Wayne A. Lozzi
Ward Two	William R. Trahant, Jr.
Ward Three	Darren P. Cyr
Ward Four	Richard C. Colucci
Ward Five	Brendan P. Crighton
Ward Six	Peter L. Capano
Ward Seven	Richard J. Ford

At-Large	Buzzy Barton
At-Large	Daniel F. Cahill
At-Large	Hong L. Nel
At-Large	John Timothy Phelan
City Clerk	Mary F. Audley

John Timothy Phelan President
Richard J. Ford Vice-President

MEETINGS SCHEDULED FOR THE WEEK BEGINNING FEBRUARY 26, 2012:

Tuesday, February 28, 2012:

RECEIVED
CITY CLERK'S OFFICE
2012 FEB 24 P 12:26
LYNN, MASS

Public Safety Committee, 6:45 P.M., Room 402
Discussion re: Presentation by the Metropolitan Area Planning Council re: FEMA Natural Hazard Mitigation Plan for the City of Lynn, and Other Business.

License Committee, 7:15 P.M., Room 402
Discussion re: Minor Licenses, and Other Business.

Finance Committee, 7:45 P.M., Room 408
Discussion re: Financial Transfers and Other Business.

CITY COUNCIL MEETING, 8:00 P.M., COUNCIL CHAMBERS
City Council Agenda

/tcy

Lynn City Council Office, Telephone (781) 598-4000, Ext. 6740
3 City Hall Square, Lynn, MA 01901 Fax (781) 477-7126

Public Comment Received

Cleaves, Sam

From: Don Walker [dwalker@lynnma.gov]
Sent: Monday, May 14, 2012 2:28 PM
To: Cleaves, Sam
Subject: Hazard Mitigation Plan

5/15/12

Hi Sam, I reviewed the draft Lynn NHM Actions Chart that you prepared. Under "Implementation Responsibility" I noticed that you were citing departments. As such, for the Seaport Landing facility you may want to list the Office of Economic and Community Development (OECD) as the entity. Also, a more accurate estimated cost for a wave attenuater might be $500,000. Please contact me if you have any questions.

Thanks Sam!

Don

1

APPENDIX D
DOCUMENTATION OF PLAN ADOPTION

(To be completed after FEMA approval)

CITY OF LYNN

In City Council JUNE 14, 2016

RESOLUTION

Whereas, the City of Lynn established a Committee to prepare the City of Lynn Hazard Mitigation Plan 2016 Update, and

Whereas, the City of Lynn Hazard Mitigation Plan 2016 Update contains several potential future projects to mitigate potential impacts from natural hazards in the City of Lynn and

Whereas, duly-noticed public meetings were held by the Planning Board on September 23, 2011 and by the Lynn City Council on February 26, 2012 and

Whereas, the City of Lynn authorizes responsible departments and/or agencies to execute their responsibilities demonstrated in the plan, and

Now, Therefore be it Resolved that the City of Lynn City Council adopts the City of Lynn Hazard Mitigation Plan 2016 Update, in accordance with MGL, C.40, S4 or the Charter and Ordinances of the City of Lynn.

HAZARD MITIGATION PLAN
RESOLUTION

Offered by Councilor BARTON

In City Council

Date: JUNE 14, 2016

Date Adopted:

Councilor	YES	NO
Barton	X	
Cahill	X	
Capano	X	
Chakoutis	AB	
Colucci	X	
Cyr	X	
LaPierre	X	
Lozzi	AB	
Net	X	
Trahant	AB	
Walsh	AB	
TOTAL	7	0

Janet L. Rowe
Assistant City Clerk

Judith Flanagan Kennedy
Mayor

6-21-16
Date Approved

In City Council

Immediate Reconsideration

Notice of Reconsideration

Councillor	YES	NO
Barton	☐	☐
Cahill	☐	☐
Capano	☐	☐
Chakoutis	☐	☐
Colucci	☐	☐
Cyr	☐	☐
LaPierre	☐	☐
Lozzi	☐	☐
Net	☐	☐
Trahant	☐	☐
Walsh	☐	☐

Referred to Law Dept, ISD, State Delegation

Date: June 17, 2016

EMERGENCY PREAMBLE

WHEREAS, A Special Emergency exists involving the peace, health and safety of the people or their property in the City of Lynn

WHEREAS, An emergency exists involving the Order Attached *-Therefore be it voted by the Lynn City Council that the Foregoing constitutes an Emergency*

A TRUE COPY ATTEST:
Mary F Audley
CITY CLERK