TOWN OF ARLINGTON
HAZARD MITIGATION PLAN
2020 UPDATE

Draft Plan

January 21, 2020

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ACKNOWLEDGEMENTS & CREDITS

This plan was prepared for the Town of Arlington 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.

MAPC Officers

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Executive Director:	Marc. D. Draisen

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Project Manager:	Martin Pillsbury
Mapping/GIS Services:	Caitlin Spence

Massachusetts Emergency Management Agency

Director:	Samantha Philips

Department of Conservation and Recreation

Acting Commissioner:	Jim Montgomery

Town of Arlington Local Hazard Mitigation Team

Christine Bongiorno	Director, Health and Human Services
Mike Byrne	Director, Inspectional Services
Wayne Chouinard	Town Engineer, DPW
James Curran	Police Department
Jim Feeney	Acting Director, Facilities
Julie Flaherty	Acting Police Chief
Kevin Kelley	Fire Chief
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Kelly Lynema	Senior Planner, Planning & Comm. Development
Stacey Mulroy	Director, Recreation Department
Michael Rademacher	Director, DPW
Jenny Raitt	Director, Planning & Community Development
Ray Santilli	Assistant Town Manager
Emily Sullivan	Environmental Planner, Planning & Comm. Development
Natasha Waden	Public Health Director, Health and Human Services
Erin Zwirko	Assistant Director, Planning & Comm. Development

Public Meeting Participants and Community Stakeholders

Special thanks to the public meeting participants and community stakeholders who provided feedback for the development of this plan.

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SECTION 1: EXECUTIVE SUMMARY

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

PLANNING PROCESS

Planning for the Hazard Mitigation Plan update was led by the Arlington Local Hazard Mitigation Planning Team, composed of staff from several different town departments (see Table 1). The team was coordinated by Emily Sullivan, Environmental Planner & Conservation Agent from the Department of Planning and Community Development. This team met on March 12, 2019, June 27, 2019, and September 24, 2019 and discussed where the impacts of natural hazards most affect the town, goals for addressing these hazards, updates to the Town's existing mitigation measures, and review of new or revised hazard mitigation measures that would benefit the town in this plan update.

Public participation in this planning process is important for improving awareness of the potential impacts of natural hazards and to build support for the actions the Town takes to mitigate them. The Town's Local Hazard Mitigation Planning Team hosted two public meetings, the first on June 13, 2019 and the second on January 27, 2020 and, the draft plan update was posted on the Town's website for public review. Key town stakeholders and neighboring communities were notified and invited to review the draft plan and submit comments.

RISK ASSESSMENT

The Arlington Hazard Mitigation Plan assesses the potential impacts to the town from flooding, high winds, winter storms, brush fire, geologic hazards, extreme temperatures, and drought. These are shown in the map series in Appendix A.

The Arlington Local Hazard Mitigation Planning Team identified 109 Critical Facilities. These are also shown on the map series and listed in Table 31, identifying which facilities are located within the mapped hazard zones.

Hazards U.S. – Multihazards (HAZUS-MH) is a standardized methodology developed by FEMA that utilizes Geographic Information Systems (GIS) to estimate physical, economic, and social impacts of disasters. The HAZUS-MH analysis for Arlington estimates property damages from Hurricanes of 100-year and 500-year frequencies ($36 million to $152 million), earthquakes of magnitudes 5 and 7 ($858 million to $6.3 billion), and the 1% and 0.2% chance of flooding ($102 to $168 million).

HAZARD MITIGTION GOALS

The Arlington Local Multiple Hazard Community Planning Team endorsed the following hazard mitigation goals at the September 24, 2019 team meeting. The Town added an additional goal focused on incorporating mitigation for climate adaptation and resiliency.

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 Town to develop, review and implement the hazard mitigation plan.

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

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

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

9. Implement multi-benefit climate adaptation and resiliency solutions across town to mitigate hazards and improve resilience.

HAZARD MITIGTION STRATEGY

The Arlington Local Hazard Mitigation Planning Team identified several mitigation measures that would serve to reduce the Town's vulnerability to natural hazard events. Overall, the hazard mitigation strategy recognizes that mitigating hazards for Arlington will be an ongoing process as our understanding of natural hazards and the steps that can be taken to mitigate their damages changes over time. Global climate change and a variety of other factors will impact the Town's vulnerability in the future, and local officials will need to work together across municipal lines and with state and federal agencies in order to understand and address these changes. The Hazard Mitigation Strategy will be incorporated into the Town's other related plans and policies. Implementation will be coordinated with the Town's Municipal Vulnerability Preparedness (MVP) Plan recommendations for action.

PLAN REVIEW AND UPDTATE PROCESS

The process for developing Arlington's Hazard Mitigation Plan 2020 Update is summarized in Table 1.

Table 1: Plan Review and Update Process

Section	Reviews and Updates
Section 3: Public Participation	The Local Hazard Mitigation Planning Team placed an emphasis on public participation for the update of the Hazard Mitigation Plan, discussing strategies to enhance participation opportunities at the first local committee meeting. During plan development, the plan was discussed at two public meetings, the second of which was hosted by the Select Board. The plan was also available on the Town's website for public comment.
Section 4: Risk Assessment	MAPC gathered the most recently available hazard and land use data and met with town staff to identify changes in local hazard areas and development trends. Town staff reviewed critical infrastructure with MAPC staff in order to create an up-to-date list. MAPC also used the most recently available version of HAZUS (Version 4.2) and assessed the potential impacts of flooding using the latest data.
Section 5: Goals	The Hazard Mitigation Goals were reviewed and endorsed by the Arlington Local Hazard Mitigation Planning Team. A goal relating to climate change was added to the original goals from the previous plan.
Section 6: Existing Mitigation Measures	The list of existing mitigation measures was updated to reflect current mitigation activities in the town.
Sections 7 and 8: Hazard Mitigation Strategy	Mitigation measures from the 2012 plan were reviewed and assessed as to whether they were completed, in progress, or deferred. The Local Hazard Mitigation Planning Team determined whether to carry forward measures into the 2020 Plan Update or modify or delete them. The Plan Update's hazard mitigation strategy reflects both new measures and measures carried forward from the 2012 plan. The Local Hazard Mitigation Team prioritized all of these measures based on current conditions and Town priorities.
Section 9: Plan Adoption & Maintenance	This section of the plan was updated with a new on-going plan implementation review and five year update process that will assist the Town in incorporating hazard mitigation issues into other Town planning and regulatory review processes and better prepare the Town for the next comprehensive plan update.

As indicated in Table 36, Arlington made significant progress implementing mitigation measures identified in the 2012 Hazard Mitigation Plan. The Town has completed mapping all storm drains, identified an interim snow dumping location, developed greater flood preparations, developed a GIS-based wetlands mapping capacity, and conducted a hydrologic assessment of Mill Brook flooding. Several mitigation actions are in progress, including improvements to Minuteman Bikeway, open space acquisitions, program to eliminate SSOs, generators at the High School and the Gibbs School, renovation of the DPW building, increased sediment removal from catch basins, and increased resources for tree trimming. Several mitigation measures from the 2012 plan that were not completed will be continued into this plan 2020 update, including addressing flooding in the Mill Brook and Alewife Brook corridors and on Forest Street, Brattle Street, and Grove Street; addressing Sanitary Sewer Overflows; renovate the DPW building, study the feasibility of a stormwater utility or enterprise fund, and identify a new snow permanent dumping location.

Moving forward into the next five year plan implementation period there will be many more opportunities to incorporate hazard mitigation into the Town's decision making processes. As in the past, the Town will document any actions taken within this iteration of the Hazard Mitigation Plan on challenges met and actions successfully adopted as part of the ongoing plan maintenance to be conducted by the Arlington Hazard Mitigation Implementation Team, as described in Section 9, Plan Adoption and Maintenance.

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SECTION 2: INTRODUCTION

PLANNING REQUIREMENTS UNDER THE FEDERAL DISASTER MITIGATION ACT

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

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

The Town of Arlington contracted with the Metropolitan Area Planning Council (MAPC), to assist the Town in updating its local Hazard Mitigation Plan, which was first adopted in 2012. This 2020 plan update will be the Town's first update of its original 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

Since 1991, there have been 28 natural hazard events that triggered federal or state disaster declarations that included Middlesex County. These are listed in Table below. The majority of these events involved flooding, while others were due to hurricanes or nor'easters, and severe winter weather.

Table 2: Previous Federal/State Disaster Declarations

Disaster Name / Date	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

Disaster Name / Date	Type of Assistance	Declared Areas
	Hazard Mitigation Grant Program	Counties of Barnstable, Bristol, Dukes, Essex, Middlesex, Plymouth, Nantucket, Norfolk, Suffolk (10 projects)
March Blizzard (March 1993)	FEMA Public Assistance Project Grants	All 14 Counties
January Blizzard (January 1996)	FEMA Public Assistance Project Grants	All 14 Counties
May Windstorm (May 1996)	State Public Assistance Project Grants	Counties of Plymouth, Norfolk, Bristol
October Flood (October 1996)	FEMA Public Assistance Project Grants	Counties of Essex, Middlesex, Norfolk, Plymouth, Suffolk
	FEMA Individual Household Program	Counties of Essex, Middlesex, Norfolk, Plymouth, Suffolk
	Hazard Mitigation Grant Program	Counties of Essex, Middlesex, Norfolk, Plymouth, Suffolk (36 projects)
(1997)	Community Development Block Grant-HUD	Counties of Essex, Middlesex, Norfolk, Plymouth, Suffolk
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
(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
Snowstorm (March 2001)		Berkshire, Essex, Franklin, Hampshire, Middlesex, Norfolk, Worcester
February Snowstorm (Feb 17-18, 2003)	FEMA Public Assistance Project Grants	Statewide
Snowstorm (December 2003)		Barnstable, Berkshire, Bristol, Essex, Franklin, Hampden, Hampshire, Middlesex, Norfolk, Plymouth, Suffolk, Worcester
Flooding (April 2004)		Essex, Middlesex, Norfolk, Suffolk, Worcester
January Blizzard (January 22-23, 2005)	FEMA Public Assistance Project Grants	Statewide
Hurricane Katrina (August 29, 2005)	FEMA Public Assistance Project Grants	Statewide

Disaster Name / Date	Type of Assistance	Declared Areas
Severe storms and flooding (October 2005)		Statewide
May Rainstorm/ Flood (May 12-23, 2006)	Hazard Mitigation Grant Program	Statewide
April Nor'easter (April 15-27, 2007)	zard Mitigation Grant Program	Statewide
Severe storm and flooding (Dec 2008)		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
Hurricane Earl (September 2010)	FEMA Public Assistance Project Grants	Barnstable, Bristol, Dukes, Essex, Middlesex, Nantucket, Norfolk, Plymouth, Suffolk, and Worcester
Severe winter storm (January 2011)		Berkshire, Essex, Hampden, Hampshire, Norfolk, Plymouth
Tropical Storm Irene (August 27-28, 2011)	FEMA Public Assistance	Barnstable, Berkshire, Bristol, Dukes, Franklin, Hampden, Hampshire, Norfolk, Plymouth
Severe snowstorm and Flooding (February 2013)	FEMA Public Assistance; Hazard Mitigation Grant Program	Statewide
Severe storm and flooding (January 2015)		Barnstable, Bristol, Dukes, Essex, Middlesex, Nantucket, Norfolk, Plymouth, Suffolk, Worcester
Severe storm and flooding (March 2018)		Barnstable, Bristol, Essex, Nantucket, Norfolk, Plymouth
Severe winter storm (March 2018)		Essex, Middlesex, Norfolk, Suffolk, Worcester

Source: MA Hazard Mitigation and Climate Adaptation Plan, 2018

FEMA FUNDED MITIGATION PROJECTS

Town of Arlington has received funding from FEMA for two mitigation projects under FEMA's Hazard Mitigation Grant Program. These projects totaled $3,340,546, with $2,365,514 covered by FEMA grants and $940,032 by local funding. The projects are summarized in Table 3 below.

Table 3: FEMA-Funded Mitigation Projects

Grant Number	Year	Project	Description	Total Cost	Federal Funding	Local Funding
HMGP 1142-36	2001	Drainage Improvement	Upgrading existing drainage systems	$1,130,043	$733,887	$396,156

			Reeds Brook. Project eliminates sections of existing drainage system			
HMGP-1895-32	2010	Colonial Village Drainage Improvements and Fottler Ave Equalization Culvert	Channel improvements and culvert upgrades with inlet control and footbridge designed to protect the Colonial Village	$2,175,503	$1,631,627	$543,876

Source: MEMA Database

COMMUNITY PROFILE

Located west of Cambridge and Somerville, The Town of Arlington is part of the Boston region's Inner Core. Many residents of the town commute to Boston, approximately six miles away, while others are employed in area universities or along the nearby Route 128 corridor. Currently, the town has no manufacturing industry and is predominantly an urban residential community, with an active commercial corridor with a mix of retail, services, and restaurants, primarily along Massachusetts Avenue.

Arlington, founded over 350 years ago, remains proud of its history, even as it has grown into a thoroughly modern community. The birthplace of Uncle Sam, the location of the first public children's library, and the site of most of the fighting when the British marched through it returning from the Old North Bridge at the start of the Revolutionary War, Arlington has preserved many of its historical buildings and even recreated its town common. Once a thriving agriculture and mill town, Arlington's excellent access to metropolitan Boston has made it a very desirable place to live.

The Town operates under the "Standard Form of Representative Town Meeting Government" according to Massachusetts General Laws Chapter 43A. The Town is governed by a five-member Select Board with a Town Manager and a Town Meeting made up of 252 representatives, elected from each of the 21 precincts. The town maintains a website at http://www.town.arlington.ma.us

According to the 2017 American Community Survey estimates, the population was 44,992 people and there were 19,615 housing units.

Table 4: Arlington Characteristics

Population = 44,992 people
- 7.0% are under age 5
- 21.5% are under age 18
- 16.4% are over age 65
- 2.4% live in group quarters
- 9.0% have a disability
- 5.6% of households are limited English-speaking
- 4.2% of workers over 16 have no vehicle available

Number of Housing Units = 19,615
- 39.1% are renter-occupied housing units
- 49% of housing units were built before 1940

Sources: US Census, 2017 American Community Survey

SECTION 3: PLANNING PROCESS & PUBLIC PARTICIPATION

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

PLANNING PROCESS SUMMARY

The six-step planning process outlined below is based on the guidance provided by FEMA's Local Multi-Hazard Mitigation Planning Guidance. Public participation is a central element of this process, which attempts to focus on local problem areas and identify needed mitigation measures based on where gaps occur in the existing mitigation efforts of the municipality. By working on municipal hazard mitigation plans in groups of neighboring cities and towns, MAPC is able to identify regional opportunities for collaboration and facilitate communication between communities. In plan updates, the process described below allows staff to bring the most recent hazard information into the plan, including new hazard occurrence data, changes to a municipality's existing mitigation measures, and progress made on actions identified in previous plans.

Figure 1: Six-Step Planning Process

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. These maps can be found in Appendix A.

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

    - Town of Arlington, Zoning Bylaw (as amended through 2019)
    - Town of Arlington Open Space and Recreation Plan 2015
    - Town of Arlington Municipal Vulnerability Preparedness report, 2018
    - Cambridge Climate Vulnerability Assessment. Part 1. April 2017
    - Center for Disease Control and Prevention, *Natural Disasters and Severe Weather*
    - FEMA, Local Mitigation Plan Review Guide, October 2011
    - FEMA, Flood Insurance Rate Maps for Middlesex County, MA, 2014
    - Gamble, J. L., Hurley, B. J., Schultz, P. A., Jaglom, W. S., Krishnan, N., & Harris, M., *Climate Change and Older Americans,* 2014
    - Massachusetts State Hazard Mitigation and Climate Adaptation Plan, 2018
    - Massachusetts State Hazard Mitigation Plan, 2013
    - Metropolitan Area Planning Council, GIS Lab, Regional Plans and Data
    - Northeast Climate Center UMass Amherst. Mass. Climate Change Projections, 2017
    - Northeast Wildfire Risk Assessment Geospatial Work Group,
    - New England Seismic Network, Boston College Weston Observatory, http://aki.bc.edu/index.htm
    - NOAA National Environmental Information Center
    - Northeast States Emergency Consortium, http://www.nesec.org/
    - USGCRP, I*mpacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment*, 2018
    - USGS, National Water Information System, http://nwis.waterdata.usgs.gov/usa/nwis
    - USGS, Landslide Types and Processes. Fact Sheet 2003-3072
    - US Census, 2010 and American Community Survey 2017, 5-Year Estimates
    - Weston and Sampson, *Mill Brook Evaluation,* 2014

3. **Review Existing Mitigation** – Municipalities in the Boston Metropolitan Region have an active history in hazard mitigation as most have adopted floodplain 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 were be documented.

4. **Develop Mitigation Strategies** – MAPC worked with the local Hazard Mitigation Team 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 Section 7 and Section 8.

5. **Plan Approval & Adoption** – Once a final draft of the plan was complete it was sent to MEMA for the state level review and, following that, to FEMA for review and approval. Typically, once FEMA has approved the plan the agency issues a conditional approval (Approval Pending Adoption), with the condition being adoption of the plan by the municipality. More information on plan adoption can be found in Section 9 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. Section 9 includes more detailed information on plan implementation.

2012 PLAN IMPLEMENTATION & MAINTENANCE

The 2012 Arlington Hazard Mitigation Plan contained a risk assessment of identified hazards for the town and recommended mitigation measures to address the risk and vulnerability from these hazards. Since approval of the plan by FEMA and local adoption, progress has been made on implementation of some of the measures, including locating and mapping all storm drains, identifying an interim snow dumping location, and developing a GIS-based wetlands mapping capacity. Several others are in progress, including improvements to Minuteman Bikeway, open space acquisitions, program to eliminate SSOs, installation of generators at the High School and Gibbs Building, designs for renovation of the DPW building, increased sediment removal from catch basins. The status of mitigation measures from the 2012 plan is discussed in Section 6.

THE LOCAL MULTIPLE HAZARD COMMUNITY PLANNING TEAM

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

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

The Local Hazard Mitigation Planning Team membership is listed below. The team was coordinated by Emily Sullivan, Environmental Planner & Conservation Agent.

Name	Representing
Christine Bongiorno	Director, Health and Human Services
Mike Byrne	Director, Inspectional Services
Wayne Chouinard	Town Engineer, DPW
James Curran	Police Department
Jim Feeney	Acting Director, Facilities
Julie Flaherty	Police Chief
Kevin Kelley	Fire Chief
Adam Kurowski	Director of GIS, IT
Kelly Lynema	Senior Planner, Planning & Community Development
Stacey Mulroy	Acting Director, Recreation Department
Michael Rademacher	Director, DPW
Jenny Raitt	Director, Planning & Community Development
Ray Santilli	Assistant Town Manager
Emily Sullivan	Environmental Planner, Planning & Community Development
Natasha Waden	Public Health Director, Health and Human Services
Erin Zwirko	Assistant Director, Planning & Community Development

The Arlington Redevelopment Board, Zoning Board of Appeals, and the Arlington Conservation Commission are the primary entities responsible for regulating development in the Town. Feedback from these was assured through the participation of Planning and Community Development Department members as well as participation in the public meetings. In addition, MAPC, the State-designated regional planning authority for Arlington, works with all agencies that regulate development in the region, including the listed municipal entities and state agencies, such as MassDOT, DCR, the MBTA, and MWRA.

The Local Hazard Mitigation Planning Team met on the following dates: March 12, 2019, June 27, 2019, and September 24, 2019. The purpose of the meetings was to introduce the Hazard Mitigation planning program, review and update hazard mitigation goals, and to gather information on local hazard mitigation issues and sites or areas related to these. Later meetings focused on verifying information gathered by MAPC staff and discussion of existing mitigation practices, the status of mitigation measures identified in the Town's 2012 hazard mitigation plan, and potential new or revised mitigation measures. The agendas for these meetings are included in Appendix B.

PUBLIC MEETINGS

Public participation in the hazard mitigation planning process is important, both for plan development and for later implementation of the plan. Residents, business owners, and other community members are an excellent source for information on the historic and potential impacts of natural hazard events and particular vulnerabilities the community may face from these hazards. Their participation in this planning process also builds understanding of the concept of hazard mitigation, potentially creating support for mitigation actions taken in the future to implement the plan. To gather this information and educate residents on hazard mitigation, the Town hosted two public meetings, one during the planning process and one after a draft plan was available for review.

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

The public had an opportunity to provide input to the Arlington hazard mitigation planning process at two public meetings. At the first meeting on June 13, 2019, an exercise engaged participants to consider the Town's strengths and the top concerns for natural hazards in Arlington. These are summarized in Appendix C. The draft plan update was presented at the second public meeting at the Arlington Select Board on January 27, 2020. Both meetings were publicized in accordance with the Massachusetts Public Meeting Law. The public meeting notices and meeting agendas can be found in Appendix C.

The draft Arlington Hazard Mitigation Plan 2020 Update was posted on the Town's website for the second public meeting. The meeting was broadcast throughout the Town by the local cable access channel, Arlington Community Media, Inc. Members of the public could access the draft document on the Town website after the public meeting and submit comments.

Table 5: Arlington Public Meetings

Public Meeting #1 June 13, 2019
Owen R. Carrigan
Steve Revilak
Julie Wayman
Kelly Lynema
Tom Ebhrecht
Erin Zwirko
Susan Lees
Emily Sullivan
Public Meeting #2, Select Board Meeting, January 27, 2020

LOCAL STAKEHOLDER INVOLVEMENT

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

- ☐ City of Cambridge
- ☐ City of Medford
- ☐ City of Somerville
- ☐ Town of Belmont
- ☐ Town of Lexington
- ☐ Town of Winchester
- ☐ Arlington Select Board
- ☐ Arlington Redevelopment Board
- ☐ Conservation Commission
- ☐ Zoning Board of Appeals
- ☐ Open Space Committee
- ☐ Disability Commission
- ☐ Municipal Vulnerability Preparedness Committee
- ☐ Envision Arlington
- ☐ Sustainable Arlington
- ☐ Council on Aging
- ☐ Board of Health
- ☐ Town Departments
- ☐ Housing Corporation of Arlington
- ☐ Arlington Housing Authority
- ☐ FoodLink
- ☐ Chamber of Commerce
- ☐
- ☐
- ☐
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CONTINUING PUBLIC PARTICIPATION

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

PLANNING TIMELINE

March 12, 2019	Meeting of the Arlington Local Hazard Mitigation Planning Team
June 13, 2019	First Public Meeting
June 27, 2019	Meeting of the Arlington Local Hazard Mitigation Planning Team
September 24, 2019	Meeting of the Arlington Local Hazard Mitigation Planning Team
January 27, 2020	Second Public Meeting with the Arlington Select Board
TBD	Draft Plan Update submitted to MEMA
TBD	FEMA issued notice of Approval Pending Adoption
TBD	Final Plan Adopted by the Town of Arlington
TBD	FEMA issued formal letter of plan approval

POST PLAN APPROVAL - IMPLEMENTATION TIMELINE

After the plan has been approved by FEMA, the Town will observe the following timeline to implement the plan over the five-year approval period, and prepare for the next plan update.

If the Town wishes to apply for a FEMA grant to prepare the next plan update, due in 2025, a grant application should be submitted approximately two years before this plan expires, in order to allow time for the grant to be approved, and the next plan update to be completed before this plan expires. See Section 9 for more details on plan adoption and maintenance.

Mid-2022	Conduct Mid-Term Plan Survey on Progress
2023	Seek FEMA grant to prepare next plan update
2024	Begin process to update the plan
2025	Submit Draft 2024 Plan Update to MEMA and FEMA
TBD	FEMA approval of 2025 Plan Update

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SECTION 4: RISK ASSESSMENT

The risk assessment analyzes the potential natural hazards that could occur within the Town of Arlington as well as the relationship between those hazards and current land uses, potential future development, and critical infrastructure. Climate change is projected to have significant impacts on many natural hazards. The Town of Arlington completed a Municipal Vulnerability Preparedness community workshop in 2018 (see Appendix F). Information from 2012 Hazard Mitigation Plan was incorporated into the MVP project, and the MVP project informed this 2020 Hazard Mitigation Plan update. This section also includes a vulnerability assessment that estimates the potential damages that could result from certain large-scale natural hazard events such as hurricanes, earthquakes, and floods.

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

OVERVIEW OF HAZARDS AND IMPACTS

Previous state and federal disaster declarations since 1991 are summarized in Table 2. Table 6 below summarizes the hazard risks for the state and the Town of Arlington . This evaluation takes into account the frequency of the hazard, historical records, and variations in land use. The statewide assessment was modified to reflect local conditions in Arlington using the definitions for hazard frequency and severity listed below.

Table 6: Hazard Risks Summary

Hazard	Frequency		Severity	
	Massachusetts	Arlington	Massachusetts	Arlington
Flooding	High	Medium	Serious to extensive	Serious
Dam failures	Low	Low	Extensive	Extensive
Coastal Hazards	High	N/A	Serious	N/A
Tsunami	Very Low	N/A	Extensive	N/A
Hurricane/Tropical Storm	Medium	Medium	Serious	Serious
Tornadoes	Medium	Low	Serious	Serious
Thunderstorms	High	High	Minor	Minor
Nor'easter	High	High	Minor	Minor
Winter-Blizzard/Snow	High	High	Minor	Minor
Winter-Ice Storms	Medium	Medium	Minor	Minor
Winter Ice Jams	Low	N/A	Serous	N/A
Earthquakes	Very Low	Very Low	Serious	Serious
Landslides	Low	Low	Minor	Minor
Brush fires	Medium	Low	Minor	Minor
Major Urban Fires	Low	N/A	Minor	N/A
Extreme Temperatures	Medium	Medium	Minor	Minor
Drought	Low	Low	Minor	Minor

Source: Massachusetts State Hazard Mitigation Plan, 2013, modified for Arlington

Definitions Used in the Commonwealth of Massachusetts State Hazard Mitigation Plan

Frequency

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

Severity

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

It should be noted that several of the hazards listed in the Massachusetts State Hazard Mitigation plan are not applicable to the Town of Arlington. Due to its inland location away from the coast, coastal hazards and Tsunamis are not applicable to Arlington. Due to the low incidence of wildfires and the lack Wildland Urban Interface in Arlington, major urban fires are also not applicable to this town. In addition, ice jams are not a hazard for the town. The US Army Corps Ice Jam Database shows no record of ice jams in Arlington. All other natural hazards listed above will be addressed in this plan.

FLOOD-RELATED HAZARDS

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

Regionally Significant Storms

There have been a number of major rain storms that have resulted in significant flooding in northeastern Massachusetts over the last fifty years. Significant storms include:

- August 1954
- March 1968
- January 1979
- April 1987
- October 1991
- October 1996
- June 1998
- March 2001
- April 2004
- May 2006
- April 2007
- March 2010
- March 2013
- January 2018
- March 2018

Local data for previous flooding occurrences are not collected by the Town of Arlington. The best available local data is for Middlesex County through the National Environmental Information Center (see Table 7). Middlesex County, which includes the Town of Arlington experienced 65 flood events from 1996 –2019. No deaths or injuries were reported and the total reported property damage in the county was $42 million dollars.

Table 7: Middlesex County Flood Events, 1996 to 2019

Date	Deaths	Injuries	Property Damage ($)
1/29/1996	0	0	0
4/17/1996	0	0	0
9/18/1996	0	0	0
10/21/1996	0	0	0
10/22/1996	0	0	0
3/10/1998	0	0	0
3/11/1998	0	0	0
5/12/1998	0	0	0
6/14/1998	0	0	0
6/15/1998	0	0	0
6/17/1998	0	0	0
4/22/2000	0	0	0
4/23/2000	0	0	0
3/22/2001	0	0	0
3/23/2001	0	0	0
3/31/2001	0	0	0
4/1/2001	0	0	0
4/2/2004	0	0	0
4/15/2004	0	0	0
3/29/2005	0	0	0
10/15/2005	0	0	100,000
10/15/2005	0	0	100,000
10/15/2005	0	0	125,000
5/13/2006	0	0	5,000,000
7/11/2006	0	0	2,000
10/28/2006	0	0	5,000
4/16/2007	0	0	25,000
2/13/2008	0	0	0
5/27/2008	0	0	3,000
6/24/2008	0	0	10,000
6/29/2008	0	0	5,000
8/10/2008	0	0	15,000
8/10/2008	0	0	40,000

Date	Deaths	Injuries	Property Damage ($)
9/6/2008	0	0	15,000
12/12/2008	0	0	20,000
3/14/2010	0	0	26,430,000
3/29/2010	0	0	8,810,000
4/1/2010	0	0	0
8/28/2011	0	0	5,000
10/14/2011	0	0	0
6/8/2012	0	0	0
6/23/2012	0	0	15,000
7/18/2012	0	0	5,000
10/29/2012	0	0	0
6/7/2013	0	0	0
7/1/2013	0	0	0
7/23/2013	0	0	0
9/1/2013	0	0	10,000
3/30/2014	0	0	35,000
7/27/2014	0	0	0
8/31/2014	0	0	0
10/22/2014	0	0	20,000
10/23/2014	0	0	0
12/9/2014	0	0	5,000
12/9/2014	0	0	30,000
5/31/2015	0	0	0
8/4/2015	0	0	0
8/15/2015	0	0	50,000
8/15/2015	0	0	75,000
9/30/2015	0	0	0
4/6/2017	0	0	0
6/27/2017	0	0	1,000
7/12/2017	0	0	1,000,000
7/18/17	0	0	0
8/2/2017	0	0	5,000
10/25/17	0	0	0
10/30/2017	0	0	0
1/12/2018	0	0	0
1/13/2018	0	0	0
4/16/2018	0	0	0
6/25/2018	0		15,000
8/8/2018	0	0	35,000

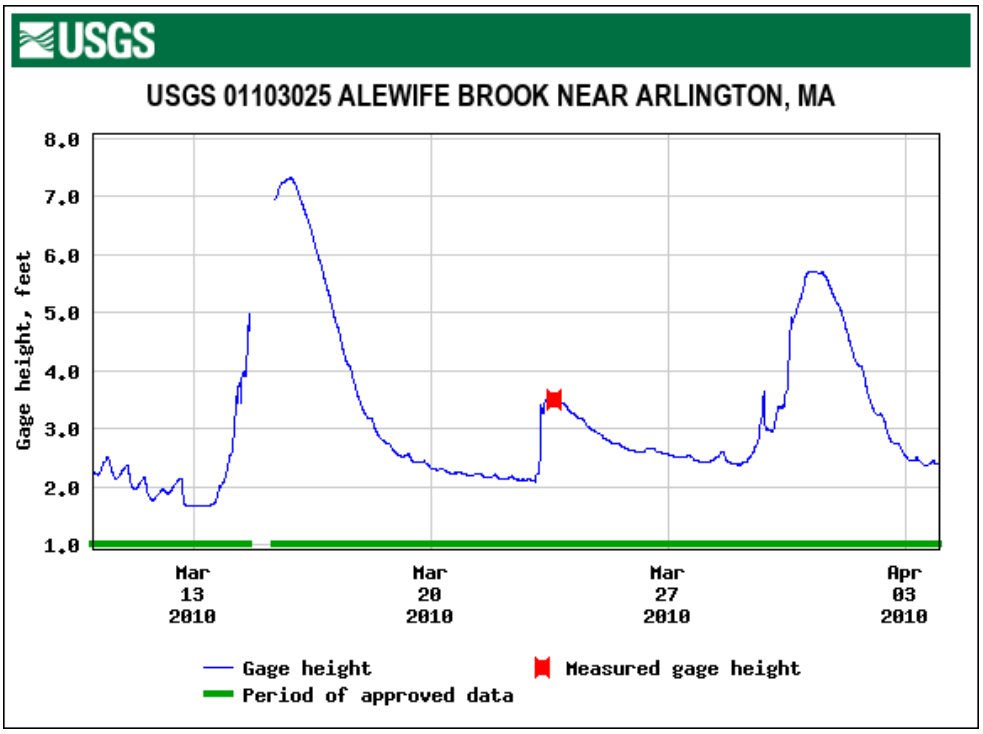
Date	Deaths	Injuries	Property Damage ($)
8/12/2018	0	0	30,000
8/17/2018	0	0	0
10/29/2018	0	0	0
11/3/2018	0	0	0
11/10/2018	0	0	0
7/6/2019	0	0	0
9/2/2019	0	0	300

Source: NOAA, National Environmental Information Center

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

One indication of the extent of flooding is the measured stream discharge at the nearest USGS streamflow gauging station on Alewife Brook. Figure 2 illustrates that 2010 had the highest gage height, with two peaks at over 7 feet in mid-March and nearly 6 feet in early April. Normal gage height at that time of year would be about two to three feet. Of the total $40.1 million in flood damages recorded for Middlesex County from 1996 to 2019, $35.2 million occurred during the March 2010 flooding (Table 3)

Figure 2: USGS Gage Data for Alewife Brook, March 2010



Overview of Town-Wide Flooding

Arlington is located within the Mystic River Watershed, which is one to the most urbanized watersheds in the state. Arlington is partially located within the Charles River Watershed. Local rivers and streams are the predominant source of potential flood waters in Arlington. The Town is bordered or crossed by three primary waterways, the upper Mystic River, Mill Brook, and Alewife Brook. In addition, there are several ponds and lakes that have some potential to cause flooding, including Spy Pond, Lower Mystic Lake, and Upper Mystic Lake. Finally, groundwater sourced flooding of basements is relatively common across many different parts of the Town.

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 A and their definitions are shown below.

Flood Insurance Rate Map Zone Definitions

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

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

Zone X500 (0.2% annual chance): Zone X500 is the flood insurance rate zone that corresponds to the 500-year floodplains that are determined in the Flood Insurance Study (FIS) by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no BFEs (base flood elevations) or depths are shown within this zone.

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

Locally Identified Areas of Flooding

The second source of local flooding information was a review by the local officials on the Arlington Hazard Mitigation Team. The locally identified areas of flooding listed below were identified by the local team 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 restrictions in drainage systems or other local conditions rather than location within a riverine flood zone. The numbers of each site correspond to the sites shown Map 8, "Hazard Areas." The numbers do not reflect priority order.

1) Minuteman Bikeway: During severe storms the Mill Brook jumps the bank here and follows the bike path before flowing back into the creek bed. The stream capacity drops just after the jump- point, which is the likely cause for the flooding. The issue could be addressed through increasing capacity in the stream or perhaps by purposely capturing floodwaters along the bike path.

2) Forest Street: Road flooding at the low point in the underpass under the Minuteman Bikeway.

3) Brattle Street: Road flooding at the low point in the underpass under the Minuteman Bikeway.

4) Colonial Village: Parking lot and first floor of apartments flood. Flooding on the property occurs as frequently as every two years.

5) Grove Street: Flooding in Wellington Park, Dudley St apartments, DPW parking lot.

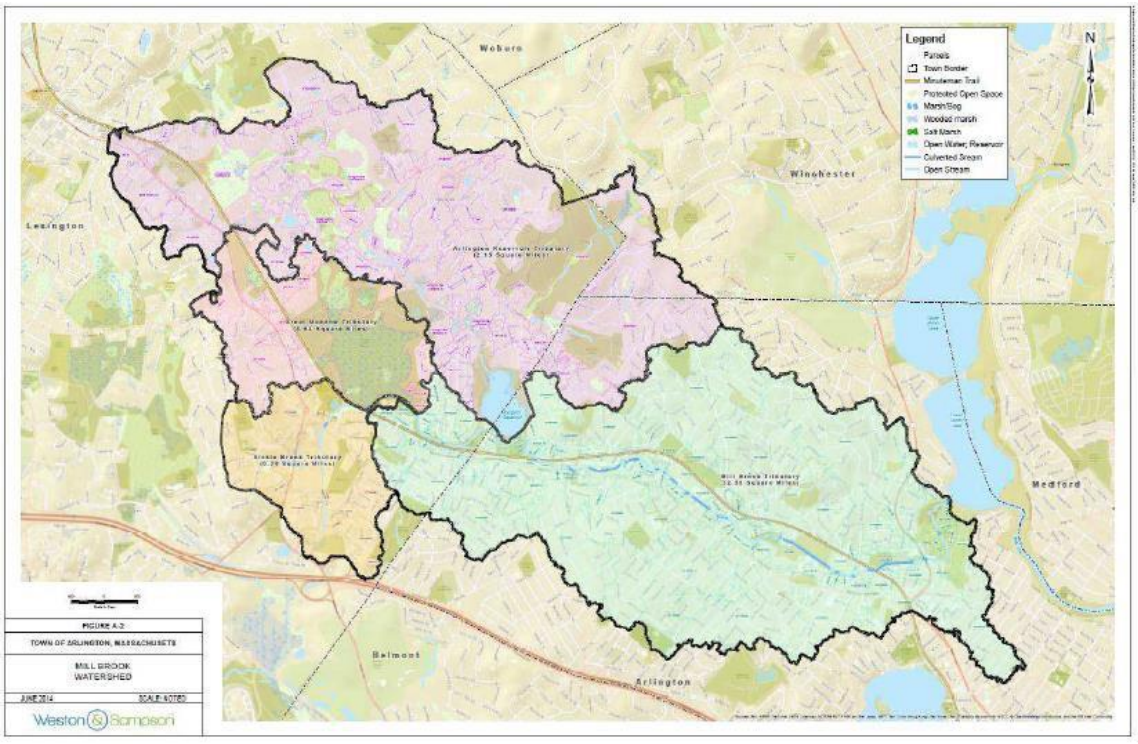
6) Garden Street

7) East Arlington: Extensive flooding from Alewife Brook and tributaries impacts homes.

8) Sunnyside Avenue: Extensive flooding from Alewife Brook impacting homes.

Mill Brook has been the most problematic source of flooding in the town for many years. Under a FEMA Hazard Mitigation Grant (HMGP 1852-32), the Town engaged the firm of Weston and Sampson to conduct a detailed hydrologic and hydraulic analysis of the flooding and evaluate several potential solutions. The Mill Brook flows through town from the Arlington Reservoir on the Lexington town line to the Lower Mystic Lake. The study was conducted in two parts for the upper and lower Mill Brook watershed (see Figure 3).

Figure 3: Upper and Lower Mill Brook Watershed



Source: Weston and Sampson, Mill Brook Evaluation

Flooding problems are most severe in the upper Mill Brook, whose drainage area is upstream of the Arlington Reservoir, mostly in the Town of Lexington (areas on the map in violet, orange, and yellow). The most problematic area is Colonial Village, an apartment complex located immediately downstream of the Arlington Reservoir which has experienced multiple flooding events over many years.

To address this flooding, Weston and Sampson evaluated the installation of an Equalization Culvert and a dam upstream at Fottler Avenue in Lexington, and several other potential storage improvements and flow diversions. The evaluation showed that none of the potential mitigation measures would provide significant reduction of flooding for the 25-year storm at Colonial Village. The report recommends:

1. To abandon the Fottler Avenue Dam construction project as it does not meet the project goals of the FEMA Grant of providing Colonial Village with 25-year flood protection

2. Utilize the existing Mill Brook model to evaluate increasing channel capacity improvement options, and to develop a Mill Brook Capital Improvement Plan for Mill Brook from Colonial Village to Mystic Lake
    - Arlington revised the Mill Brook Corridor Report in 2019 which addresses some of the issues identified in the Weston & Sampson report

The Weston and Sampson report notes "upstream improvements to alleviate flooding at Colonial Village that include providing additional capacity, would require a downstream evaluation of the Lower Mill Brook model to carry improvements downstream as necessary, as increasing capacity of Mill Brook at Colonial Village will exacerbate the existing flooding condition on Lower Mill Brook."

Repetitive Loss Properties

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. There are 32 repetitive loss properties in Arlington, including seven single family residences, two multi-family residences, 22 other residential properties, and one business property (see Table 8). These 32 properties have experienced a total of 78 losses totaling $ 1,087,853. While all these properties have had at least two losses, three of them had 3 losses, three others had 4 losses, and one property had 7 losses. For more information on repetitive losses see http://www.fema.gov/business/nfip/replps.shtm.

The repetitive loss properties are all in various categories of FEMA flood hazard zones. Table 8 shows that 11 properties are in an A00 zone, 8 are in an AE zone, 3 are in a C zone, 2 are in an X zone, and one each are in an A and A05 zone. Many of these properties are in or near the Sunnyside Avenue area, the Colonial Village area, and the Lowell Street area. Most are in the Alewife Brook watershed or the Mill Brook watershed.

Table 8: Arlington Repetitive Loss Properties

Property Type	FEMA Flood Zone	Total Payments	Number of losses
Single Family Res.	C	$ 12,610.98	2
Single Family Res.	A	$ 6,391.49	2
Single Family Res.	B	$ 16,927.03	4

Single Family Res.	AE	$ 9,770.10	2
Single Family Res.	X	$ 7,912.41	2
Single Family Res.	A05	$ 21,464.79	2
Single Family Res.	C	$ 6,168.44	2
Total Single Fam.		**$ 81,245.24**	**16**
2-4 Family Res.	X	$ 17,234.20	2
2-4 Family Res.	C	$ 9,442.16	2
Total 2-4 Fam. Res.		**$ 26,676.36**	**4**
Other Residential	AE	$ 35,006.79	2
Other Residential	AE	$ 36,238.99	4
Other Residential	AE	$ 137,873.91	4
Other Residential	AE	$ 134,552.18	2
Other Residential	AE	$ 33,860.30	3
Other Residential	AE	$ 37,500.21	3
Other Residential	AE	$ 38,525.89	2
Other Residential	AE	$ 29,802.61	2
Other Residential	AE	$ 25,424.83	2
Other Residential	AE	$ 12,357.59	2
Other Residential	AE	$ 50,283.56	3
Other Residential	A00	$ 20,281.37	2
Other Residential	A00	$ 19,321.01	2
Other Residential	A00	$ 19,774.60	2
Other Residential	A00	$ 19,724.10	2
Other Residential	A00	$ 20,723.52	2
Other Residential	A00	$ 20,723.52	2
Other Residential	A00	$ 20,331.86	2
Other Residential	A00	$ 20,275.17	2
Other Residential	A00	$ 20,331.86	2
Other Residential	A00	$ 20,331.86	2
Other Residential	A00	$ 19,586.88	2
Total Other Res.		**$ 792,832.61**	**51**
Business Non-Residential	AE	$ 187,099.75	7
Total Business-Non Res		**$ 187,099.75**	**7**
Grand Total Arlington		**$ 1,087,853.96**	**78**

Source: FEMA Repetitive Loss Database, September 30, 2018

The impacts of flooding on the Town of Arlington can be significant. Potential damages from flooding in the town were estimated using FEMA's HAZUS-MH program. The results, shown in Table 34, indicate potential damages from a 1% Annual Chance Flood (100-year) at $102.38 million and from a 0.2% Annual Chance Flood (500-year) at $167.8 million.

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

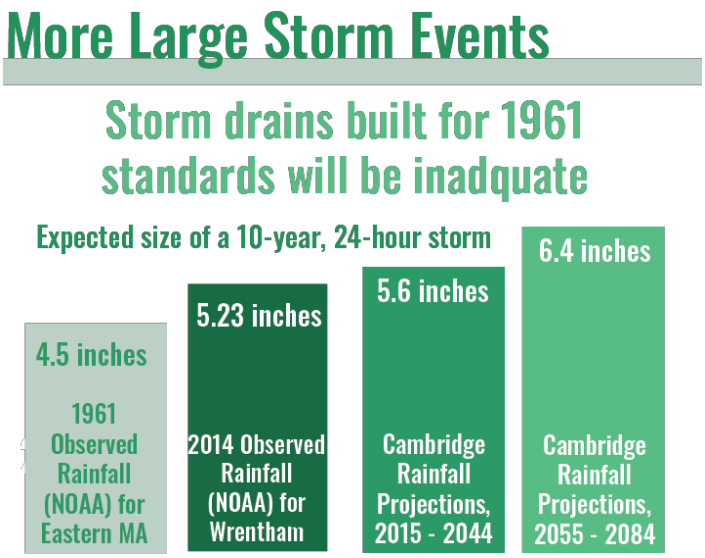
Flooding and Climate Change

With climate change, scientists project an increase in severity and frequency of precipitation events. Because of its location in the urbanized Mystic River watershed, extreme precipitation events and changing precipitation patterns could increase the frequency and severity of flooding in Arlington and other communities in the watershed.

Annual precipitation in Massachusetts has already increased by approximately 10% in the fifty-year period from 1960 to 2010 (MA Climate Change Adaptation Report 2011). Moreover, for the Northeast US, according to the U.S. National Climate Assessment, 2014, there was a 71% increase in the amount of rain that falls in the top 1% of storm events for the period 1958-2012.

Precipitation frequency estimates, which are used to derive stormwater design standards, were published in 196l by the U.S. Commerce Department in a document known as TP-40 (Technical Paper 40). The National Oceanic and Atmospheric Administration (NOAA Atlas 14) has recently published updated estimates. In the future, based on projections developed for the neighboring City of Cambridge, Arlington will likely experience more frequent and intense precipitation events, including an increase in the standard "design storm" from historic levels of 4.5 inches to 6.4 inches by the late 21st century (Figure 4). According to data on ResilientMA.org, by mid- to late century, the region can anticipate 9-10 days with precipitation events with greater than one inch of rain, and an increase in total annual precipitation from 46 to 50 inches.

Figure 4: Design Storm Trends and Projections for the 10-year, 24-hour Storm



Cambridge Climate Vulnerability Assessment. Part 1. April 2017

Dams and Dam Failure

Dam failure can occur as a result of structural failure, independent of a hazard event, or as the result of the impacts of a hazard event such as flooding associated with storms or an earthquake. In the event of a dam failure, the energy of the water stored behind even a small dam can cause loss of life and property damage if there are people or buildings downstream. The number of injuries or 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 MA Department of Conservation and Recreation (DCR) Office of Dam Safety maintains an inventory of dams in Massachusetts. There are two dams in the Town of Arlington, the Upper Mystic Lake Dam and the Arlington Reservoir Dam. These are listed in Table 9, from the DCR dam inventory, and described below.

Table 9: DCR Inventory of Dams in Arlington

Dam Name	Dam #	Owner	Hazard Potential
Upper Mystic Lake Dam	MA00769	MA Dept. of Conservation & Recreation	Significant
Arlington Reservoir Dam	MA00771	Town of Arlington, Department of Public Works	High

Source: MA Dept. of Conservation and Recreation Dam Inventory

DCR provides a classification of dam hazards as summarized below. It should be noted that the hazard potential rating does not refer to the condition of a dam or its likelihood of breaching, but to the potential level of hazard due to the dam's location and the downstream area that could be affected should a breach occur. According to data provided by DCR, one of the dams in Arlington, the Upper Mystic Lake Dam (owned by DCR) is classified as "significant" hazard potential, and the other, Arlington Reservoir Dam (owned by the Town) is considered "high" hazard potential.

DCR Dam Hazard Classification

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

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

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

Upper Mystic Lake Dam – The Upper Mystic Lake Dam is owned and operated by the Massachusetts Department of Conservation and Recreation (DCR) and divides the Upper and Lower Mystic Lakes on Arlington's northeastern boundary. In 2007-2008 the state conducted a Dam Safety Inspection resulting in an overall condition rating of Poor. Inadequate spillway capacity, erosion, and poorly functioning controls were amongst the findings that resulted in this rating. DCR has moved forward with plans to repair and improve the dam and work has already begun. An inundation map was prepared in order to understand the potential impacts of a dam failure, showing the potential for extensive flooding in the floodplain areas of the Mystic River and Alewife Brook with some of the greatest impacts in the East Arlington area. Completion of the repair work will significantly address the potential risk of dam failure.

Arlington Reservoir Dam – The Arlington Reservoir Dam is owned and operated by the Town of Arlington through the Department of Public Works and is located on the Town's boundary with Lexington (see Figure 5). While the reservoir is no longer used for water supply, the dam continues to be used to maintain the water level for recreational uses. The water level is raised and lowered seasonally and in anticipation of large storm events to help mitigate downstream flooding in Mill Brook. The impoundment size ranges from 19.8 acres in the winter to 28 acres in the summer.

The Town of Arlington has prepared and regularly updates an Emergency Action Plan (EAP) for this dam, as required by state regulations (302 CMR 10.11). The 2017 update reports that the dam was inspected by Weston and Sampson in 2013. The dam was reported in satisfactory condition with no major dam safety deficiencies.

Figure 5: Arlington Reservoir

Source: Arlington Reservoir Dam Emergency Action Plan

The EAP includes a dam break analysis utilizing the National Weather Service computer model "DAMBRK," which is designed to predict wave formation and downstream progression due to a dam failure. The EAP finds that, "although an unlikely event, the sudden release of water due to breaching of the Arlington Reservoir Dam may cause significant flooding in Mill Brook. Mill Brook has been confined to a narrow, man-made channel for the majority of its length from the dam to Lower Mystic Lake. The resultant flooding would fill the low valley along Mill Brook and the flood wave would propagate over 3 miles downstream to its confluence with the Lower Mystic Lake. The DAMBRK model indicates the floodwave is greatly dissipated by the time it reaches Lower Mystic Lake."

Dam failure is a highly infrequent occurrence in Massachusetts, but a severe incident could result in loss of lives and property damage. Since 1984, three dams have failed in or very near to Massachusetts, but a dam failure has never been recorded in the Town of Arlington.

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

Dams and Climate Change

Climate change could further increase the risk of dam failure in several ways. Changing precipitation patterns could alter the flow behavior of a river where the dam was not designed to support, more intense of frequent precipitation events could alter the discharge rates creating greater structural stress to the dam and increasing scouring, erosion, and loss of flood storage capacity in nearby spillways or floodplain wetlands.

WIND-RELATED HAZARDS

Wind-related hazards include hurricanes and tornadoes as well as high winds during severe rainstorms and thunderstorms. As with most communities, falling trees that result in downed power lines and power outages are an issue in Arlington. Information on wind-related hazards can be found on Map 5 in Appendix A.

Hurricanes and Tropical Storms

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

Since 1900, Massachusetts has experienced approximately 32 tropical storms, nine Category 1 hurricanes, five Category 2 hurricanes, and one Category 3 hurricane. Significant hurricanes since 1938 are summarized in Table 6.

A hurricane or storm track is the line that delineates the path of the eye of a hurricane or tropical storm. In 1861 a tropical storm track passed through western Arlington; since then there have been no tropical storm or hurricanes recorded to have tracked through the Town. However, the Town can experience the impacts of the wind and rain of hurricanes and tropical storms regardless of whether the storm track passes through the town. The hazard mapping indicates that the 100-year wind speed in Arlington is 110 miles per hour (see Appendix A).

Table 10: Hurricane Records for Massachusetts, 1938-2019

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

Source: National Oceanic and Atmospheric Administration

Hurricane intensity is measured according to the Saffir/Simpson scale, which categorizes hurricane intensity linearly based upon maximum sustained winds, barometric pressure, and storm surge potential. These are combined to estimate potential damage. Table 11 provides an overview of the wind speeds, surges, and range of damage caused by different hurricane categories:

Table 11: Saffir/Simpson Scale

Scale No. (Category)	Winds (mph)	Surge (feet)	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: National Oceanic and Atmospheric Administration

Hurricanes typically have regional impacts beyond their immediate tracks. Falling trees and branches are a significant problem because they can result in power outages when they fall on power lines or block traffic and emergency routes. Hurricanes are a town-wide hazard in Arlington. Potential hurricane damages to Arlington have been estimated using HAZUS-MH. Total damages (building and business interruption) are estimated at $35.7 million for a 100-year hurricane and $151.9 million for 500-year hurricane. Other potential impacts, including displaced households, sheltering needs, and debris generation, are detailed in Table 32.

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

Hurricanes and Climate Change

Climate models suggest that hurricanes will become more intense as warmer ocean waters provide more fuel for the storms. In addition, rainfall amounts associated with hurricanes are predicted to increase because warmer air can hold more water vapor.

Tornadoes

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

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

Tornado damage severity is measured by the Fujita Tornado Scale, in which wind speed is not measured directly but rather estimated from the amount of damage. As of February 1, 2007, the National Weather Service began rating tornados using the Enhanced Fujita-scale (EF-scale), which

allows surveyors to create more precise assessments of tornado severity. The Fujita Scale and Enhanced Fujita (EF)-scales are summarized in Table 12 below.

Table 12: Fujita Scale and Enhanced Fujita Scale

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

Source: Massachusetts State Hazard Mitigation Plan, 2013

The frequency of tornadoes in eastern Massachusetts is low; on average, there are six tornadoes that touchdown somewhere in the Northeast region every year. The strongest tornado in Massachusetts history was the Worcester Tornado in 1953 (NESEC). Remains from the Worcester tornado reached 75 miles across Massachusetts. The most recent tornado events in Massachusetts were in Springfield in 2011 and in Revere in 2014. The Springfield tornado caused significant damage and resulted in four deaths in June of 2011. The Revere tornado touched down in Chelsea just south of Route 16, moved north into Revere's business district along Broadway, and ended near the intersection of Routes 1 and 60. The path was approximately two miles long and 3/8 mile wide, with wind speeds up to 120 miles per hour. Approximately 65 homes had substantial damages and 13 homes and businesses were rendered uninhabitable. In August of 2018 an EF1 tornado hit the town center of Webster, destroying at least two buildings and damaging others

There have been no recorded tornadoes in the Town of Arlington. Since 1955 there have been 18 tornadoes in surrounding Middlesex County recorded by the Tornado History Project. Two of these were F3 tornados, and four were F2. These 18 tornadoes resulted in a total of one fatality and six injuries and $38.8 million in damages, as summarized in Table 13.

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

Although tornadoes are a potential town-wide hazard in Arlington, tornado impacts are relatively localized compared to Nor'easters and hurricanes. Damages from any tornado in Arlington would greatly depend on the track of the tornado. Generally, the more densely developed corridor along Massachusetts Avenue would likely be subject to more damage in the event of a tornado.

Table 13: Tornado Records for Middlesex County

Date	Fujita	Fatalities	Injuries	Width	Length	Damage
10/24/1955	1	0	0	10	0.1	$500-$5000
6/19/1957	1	0	0	17	1	$5K-$50K
6/19/1957	1	0	0	100	0.5	$50-$500
7/11/1958	2	0	0	17	1.5	$50K-$500K
8/25/1958	2	0	0	50	1	$500-$5000
7/3/1961	0	0	0	10	0.5	$5K-$50K
7/18/1963	1	0	0	50	1	$5K-$50K
8/28/1965	2	0	0	10	2	$50K-$500K
7/11/1970	1	0	0	50	0.1	$5K-$50K
10/3/1970	3	1	0	60	35.4	$50K-$500K
7/1/1971	1	0	1	10	25.2	$5K-$50K
11/7/1971	1	0	0	10	0.1	$50-$500
7/21/1972	2	0	4	37	7.6	$500K-$5M
9/29/1974	3	0	1	33	0.1	$50K-$500K
7/18/1983	0	0	0	20	0.4	$50-$500
9/27/1985	1	0	0	40	0.1	$50-$500
8/7/1986	1	0	0	73	4	$50K-$500K
8/22/2016	1	0	0	400	.85	$10

Source: The Tornado History Project

Based on the record of previous occurrences since 1955, tornado events in Arlington are a low frequency event as defined by the Massachusetts State Hazard Mitigation Plan. This hazard may occur from once in 50 years to once in 100 years (1% to 2% per year).

Tornadoes and Climate Change

According to the *Massachusetts State Hazard Mitigation and Climate Adaptation Plan*, it is possible that severe thunderstorms which can include tornadoes may increase in frequency and intensity. However, scientists have less confidence in the models that seek to project future changes in tornado activity at this time.

Nor'easters

A northeast coastal storm, known as a nor'easter, is typically a large counter-clockwise wind circulation around a low-pressure center. Featuring strong northeasterly winds blowing in from the ocean over coastal areas, nor'easters are relatively common in the winter months in New England occurring one to two times a year. The storm radius of a nor'easter can be as much as 1,000 miles and these storms feature sustained winds of 10 to 40 mph with gusts of up to 70 mph. These storms are accompanied by heavy rain or snow, depending on temperatures. Previous occurrences of nor'easters include the following shown in Table 14, which were listed in the Massachusetts State Hazard Mitigation Plan from 2013 or have occurred since.

Table 14: Nor'easter Events for Massachusetts, 1978 to 2019

Date	Nor'easter Event
February 1978	Blizzard of 1978
October 1991	Severe Coastal Storm ("Perfect Storm")
December 1992	Great Nor'easter of 1992
January 2005	Blizzard/Nor'easter
October 2005	Coastal Storm/Nor'easter
April 2007	Severe Storms, Inland & Coastal Flooding/Nor'easter
January 2011	Winter Storm/Nor'easter
October 2011	Severe Storm/Nor'easter
February 2013	Blizzard of 2013
January 2015	Blizzard of 2015
March 2015	March 2015 Nor'easters
January 2018	January 2018
March 2018	March 2018

Many of the historic flood events identified in the previous section were precipitated by nor'easters, including the "Perfect Storm" event in 1991. The recent blizzards in winter 2018, as well as those in December 2010, February 2013, and January 2015, were large nor'easters that caused significant snowfall amounts in Arlington. Four nor'easters in the winter of 2018 had significant and cumulative impacts on Massachusetts with high winds, flooding, fallen trees and electricity loss.

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

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

Based on the record of previous occurrences, nor'easters in Arlington are high frequency events as defined by the 2013 Massachusetts State Hazard Mitigation Plan. This hazard may occur more frequently than once in 5 years (greater than 20% per year).

Nor'easters and Climate Change

As with hurricanes, warmer ocean water and air will provide more fuel for storms. According to the SHMCAP it appears that Atlantic coast nor'easters are increasing in frequency and intensity.

Severe Thunderstorms

While less severe than the other types of storms discussed, thunderstorms can lead to localized damage and represent a hazard risk for communities. A thunderstorm typically features lightning, strong winds, and rain and/or hail. Thunderstorms sometime give rise to tornados. On average, these storms are only around 15 miles in diameter and last for about 30 minutes. A severe

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

The best available data on previous occurrences of thunderstorms in Arlington is for Middlesex County through the National Centers for Environmental Information. Between the years 2006 and 2019, records indicate 83 thunderstorm events in Middlesex County (Table 15). These storms resulted in a total of $1,691,050 in property damages. There were no injuries or deaths reported.

Table 15: Middlesex County Thunderstorm Events, 2006 to 2019

Date	Type	Magnitude	Deaths	Injuries	Damage ($)
4/1/2006	Thunderstorm Wind	50	0	0	8000
5/21/2006	Thunderstorm Wind	61	0	0	95000
6/23/2006	Thunderstorm Wind	50	0	0	30000
7/11/2006	Thunderstorm Wind	50	0	0	10000
7/21/2006	Thunderstorm Wind	50	0	0	35000
7/28/2006	Thunderstorm Wind	50	0	0	15000
8/2/2006	Thunderstorm Wind	50	0	0	15000
5/16/2007	Thunderstorm Wind	50	0	0	0
6/27/2007	Thunderstorm Wind	50	0	0	0
7/6/2007	Thunderstorm Wind	50	0	0	0
7/9/2007	Thunderstorm Wind	50	0	0	0
7/15/2007	Thunderstorm Wind	50	0	0	0
7/28/2007	Thunderstorm Wind	50	0	0	0
7/29/2007	Thunderstorm Wind	50	0	0	0
8/17/2007	Thunderstorm Wind	50	0	0	0
9/8/2007	Thunderstorm Wind	50	0	0	25000
5/27/2008	Thunderstorm Wind	50	0	0	8000
6/10/2008	Thunderstorm Wind	50	0	0	20000
6/23/2008	Thunderstorm Wind	50	0	0	5000
6/24/2008	Thunderstorm Wind	50	0	0	5000
6/27/2008	Thunderstorm Wind	50	0	0	5000
6/29/2008	Thunderstorm Wind	50	0	0	10000
7/1/2008	Thunderstorm Wind	50	0	0	20000
7/2/2008	Thunderstorm Wind	50	0	0	5000
7/3/2008	Thunderstorm Wind	50	0	0	15000
7/19/2008	Thunderstorm Wind	50	0	0	8000
7/20/2008	Thunderstorm Wind	50	0	0	5000
7/27/2008	Thunderstorm Wind	50	0	0	5000
8/3/2008	Thunderstorm Wind	50	0	0	5000
8/7/2008	Thunderstorm Wind	50	0	0	5000
9/9/2008	Thunderstorm Wind	50	0	0	8000
5/9/2009	Thunderstorm Wind	50	0	0	2000
5/24/2009	Thunderstorm Wind	50	0	0	15000
7/7/2009	Thunderstorm Wind	50	0	0	1000
7/8/2009	Thunderstorm Wind	50	0	0	20000
7/26/2009	Thunderstorm Wind	50	0	0	15000
7/31/2009	Thunderstorm Wind	50	0	0	30000
5/4/2010	Thunderstorm Wind	50	0	0	30000
6/1/2010	Thunderstorm Wind	50	0	0	5000
6/3/2010	Thunderstorm Wind	50	0	0	20000
6/5/2010	Thunderstorm Wind	50	0	0	40000
6/6/2010	Thunderstorm Wind	50	0	0	100000
6/24/2010	Thunderstorm Wind	50	0	0	30000
7/12/2010	Thunderstorm Wind	50	0	0	50000
7/19/2010	Thunderstorm Wind	50	0	0	25000
6/1/2011	Thunderstorm Wind	50	0	0	5000
6/9/2011	Thunderstorm Wind	50	0	0	15000
8/2/2011	Thunderstorm Wind	50	0	0	1000

Date	Type	Magnitude	Deaths	Injuries	Damage ($)
8/19/2011	Thunderstorm Wind	50	0	0	15000
6/8/2012	Thunderstorm Wind	50	0	0	25000
6/23/2012	Thunderstorm Wind	45	0	0	5000
7/4/2012	Thunderstorm Wind	50	0	0	10000
7/18/2012	Thunderstorm Wind	70	0	0	350000
9/7/2012	Thunderstorm Wind	50	0	0	10000
9/8/2012	Thunderstorm Wind	40	0	0	3000
6/17/2013	Thunderstorm Wind	50	0	0	25000
6/18/2013	Thunderstorm Wind	45	0	0	10000
6/24/2013	Thunderstorm Wind	45	0	0	3000
7/23/2013	Thunderstorm Wind	50	0	0	20000
7/29/2013	Thunderstorm Wind	50	0	0	5000
7/3/2014	Thunderstorm Wind	50	0	0	75000
7/7/2014	Thunderstorm Wind	87	0	0	100000
7/15/2014	Thunderstorm Wind	50	0	0	25000
7/28/2014	Thunderstorm Wind	50	0	0	50000
9/6/2014	Thunderstorm Wind	50	0	0	15000
5/28/2015	Thunderstorm Wind	45	0	0	5000
8/4/2015	Thunderstorm Wind	50	0	0	40000
8/15/2015	Thunderstorm Wind	50	0	0	25000
2/25/2016	Thunderstorm Wind	50	0	0	30000
3/17/2016	Thunderstorm Wind	45	0	0	5000
7/22/2016	Thunderstorm Wind	50	0	0	14,000
7/23/2016	Thunderstorm Wind	50	0	0	0
8/22/2016	Thunderstorm Wind	50	0	0	0
9/11/2016	Thunderstorm Wind	50	0	0	10,000
5/18/2017	Thunderstorm Wind	50	0	0	0
6/13/2017	Thunderstorm Wind	52	0	0	0
6/23/2017	Thunderstorm Wind	52	0	0	1000
6/27/2017	Thunderstorm Wind	50	0	0	0
7/12/2017	Thunderstorm Wind	50	0	0	0
8/2/2017	Thunderstorm Wind	50	0	0	0
9/6/2017	Thunderstorm Wind	50	0	0	0
5/15/2018	Thunderstorm Wind	40	0	0	0
6/18/2018	Thunderstorm Wind	50	0	0	0
6/25/2018	Thunderstorm Wind	43	0	0	0
7/17/2018	Thunderstorm Wind	50	0	0	3000
7/26/2018	Thunderstorm Wind	50	0	0	5000
8/7/2018	Thunderstorm Wind	50	0	0	3000
8/17/2018	Thunderstorm Wind	50	0	0	4000
9/6/2018	Thunderstorm Wind	50	0	0	2000
10/23/2018	Thunderstorm Wind	46	0	0	10,000
6/30/2019	Thunderstorm Wind	50	0	0	800
7/17/2019	Thunderstorm Wind	50	0	0	7250
7/31/2019	Thunderstorm Wind	50	0	0	2500
8/7/2019	Thunderstorm Wind	50	0	0	800
9/4/2019	Thunderstorm Wind	55	0	0	26700

*Magnitude refers to maximum wind speed (mph)
Source: NOAA, National Environmental Information Center

Severe thunderstorms are a town-wide hazard for Arlington. The Town's vulnerability to severe thunderstorms is similar to that of nor'easters. High winds can cause falling trees and power outages, as well as obstruction of key routes and emergency access. Heavy precipitation may also cause localized flooding, both riverine and urban drainage related.

Based on the record of previous occurrences, severe thunderstorms in Arlington are high frequency events as defined by the Massachusetts State Hazard Mitigation Plan. This hazard may occur more frequently than once in 5 years (greater than 20% per year).

Thunderstorms and Climate Change

As noted previously, the intensity of rainfall events has increased significantly, and those trends are expected to continue. The *Massachusetts State Hazard Mitigation and Climate Adaptation Plan* does not specifically address whether climate will affect the intensity or frequency of thunderstorms.

WINTER-RELATED HAZARDS

Winter storms, including blizzards, heavy snow, and ice storms, are the most common and most familiar of the region's hazards that affect large geographic areas. The majority of blizzards and ice storms in the region cause more inconvenience than they do serious property damage, injuries, or deaths. However, periodically, a storm will occur which is a true disaster, and necessitates intense large-scale emergency response. The Blizzard of 1978 is the most outstanding example of this.

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 four inches of snowfall within a 12 hour period. Winter Storms are often associated with a Nor'easter event, a large counter-clockwise wind circulation around a low-pressure center often resulting in heavy snow, high winds, and rain.

Blizzards and Heavy Snow Events

A blizzard is a winter snowstorm 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.

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 in Table 16 below:

Table 16: NESIS Categories

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+	Extreme

Source: Massachusetts State Hazard Mitigation Plan, 2013

The most significant winter storm in recent history was the "Blizzard of 1978," which resulted in over three feet of snowfall and multiple day closures of roadways, businesses, and schools. Blizzards and severe winter storms have occurred in the following years as shown in Table 17.

Table 17: Severe Winter Storm Records for Massachusetts

Severe Winter Storm Event	Date
Blizzard of 1978	February 1978
Blizzard	March 1993
Blizzard	January 1996
Severe Snow Storm	March 2001
Severe Snow Storm	December 2003
Severe Snow Storm	January 2004
Severe Snow Storm	January 2005
Severe Snow Storm	April 2007
Severe Snow Storm	December 2010
Severe Snow Storm	January 2011
Blizzard of 2013	February 2013
Blizzard of 2015	January 2015
Severe Snow Storm	March 2018

Source: National Oceanic and Atmospheric Administration

Most recently, in 2015 Massachusetts experienced record-breaking snowfall of 108 inches through a series of blizzards and heavy snow fall in February. This caused major disruptions in transportation, schools, businesses, and other services for several weeks.

The Town of Arlington does not keep local records of winter storms. Data for Middlesex County, which includes Arlington, is the best available data to help understand previous occurrences and impacts of heavy snow events. According to National Climate Data Center (NEIC) records, from 1996 to 2019, Middlesex County experienced 76 heavy snowfall events, resulting in and $229,000 in property damage. No injuries or deaths were reported. See Table 18 for and heavy snow events and impacts in Middlesex County.

Table 18: Heavy Snow Events and Impacts in Middlesex County, 2000 to 2019

Date	Type	Deaths	Injuries	Property Damage ($)
1/13/2000	Heavy Snow	0	0	0
1/25/2000	Heavy Snow	0	0	0
2/18/2000	Heavy Snow	0	0	0
12/30/2000	Heavy Snow	0	0	0
1/20/2001	Heavy Snow	0	0	0
2/5/2001	Heavy Snow	0	0	0
3/5/2001	Heavy Snow	0	0	0
3/9/2001	Heavy Snow	0	0	0
3/30/2001	Heavy Snow	0	0	0
12/8/2001	Heavy Snow	0	0	0
3/20/2002	Heavy Snow	0	0	0
3/16/2004	Heavy Snow	0	0	0
2/24/2005	Heavy Snow	0	0	0
12/13/2007	Heavy Snow	0	0	0

12/16/2007	Heavy Snow	0	0	0
12/19/2007	Heavy Snow	0	0	0
1/14/2008	Heavy Snow	0	0	28000
1/14/2008	Heavy Snow	0	0	20000
1/14/2008	Heavy Snow	0	0	20000
2/22/2008	Heavy Snow	0	0	0
3/1/2008	Heavy Snow	0	0	0
12/19/2008	Heavy Snow	0	0	0
12/20/2008	Heavy Snow	0	0	8000
12/21/2008	Heavy Snow	0	0	0
12/31/2008	Heavy Snow	0	0	0
1/10/2009	Heavy Snow	0	0	0
1/11/2009	Heavy Snow	0	0	0
1/18/2009	Heavy Snow	0	0	0
3/1/2009	Heavy Snow	0	0	0
3/2/2009	Heavy Snow	0	0	0
12/9/2009	Heavy Snow	0	0	15000
12/9/2009	Heavy Snow	0	0	500
12/19/2009	Heavy Snow	0	0	0
12/20/2009	Heavy Snow	0	0	0
1/18/2010	Heavy Snow	0	0	0
2/16/2010	Heavy Snow	0	0	15000
2/23/2010	Heavy Snow	0	0	8000
1/12/2011	Heavy Snow	0	0	0
1/26/2011	Heavy Snow	0	0	0
10/29/2011	Heavy Snow	0	0	30000
12/29/2012	Heavy Snow	0	0	0
2/8/2013	Heavy Snow	0	0	0
2/8/2013	Heavy Snow	0	0	0
2/23/2013	Heavy Snow	0	0	0
3/7/2013	Heavy Snow	0	0	0
3/18/2013	Heavy Snow	0	0	0
12/14/2013	Heavy Snow	0	0	0
12/17/2013	Heavy Snow	0	0	0
1/2/2014	Heavy Snow	0	0	0
1/18/2014	Heavy Snow	0	0	0
2/5/2014	Heavy Snow	0	0	0
2/13/2014	Heavy Snow	0	0	0
2/18/2014	Heavy Snow	0	0	0
11/26/2014	Heavy Snow	0	0	10000
1/24/2015	Heavy Snow	0	0	0
1/26/2015	Heavy Snow	0	0	0
2/2/2015	Heavy Snow	0	0	0
2/8/2015	Heavy Snow	0	0	0
2/14/2015	Heavy Snow	0	0	0
2/5/2016	Heavy Snow	0	0	70000
2/5/2016	Heavy Snow	0	0	5000
3/21/2016	Heavy Snow	0	0	0
4/4/2016	Heavy Snow	0	0	0
12/29/2016	Heavy Snow	0	0	0
3/14/2017	Heavy Snow	0	0	0
11/15/2018	Heavy Snow	0	0	0

Source: NOAA, National Environmental Information Center

Winter storms are a potential town-wide hazard in Arlington, where the average annual snowfall is 48 - 72 inches (see Map 6 in Appendix A). Arlington's vulnerability is primarily related to restrictions to travel on roadways, temporary road closures, school closures, and potential restrictions on emergency vehicle access. The impacts of winter storms are also related to the weight of snow and ice, which can cause roof collapses and cause tree limbs to fall. This in turn can cause property damage and potential injuries. Power outages may also result from fallen trees and utility lines.

A number of public safety issues can arise during heavy snow storms. Impassible streets are a challenge for emergency vehicles and affect residents and businesses. Snow-covered sidewalks force people to walk in streets, which are already less safe due to snow, slush, puddles, and ice. Large piles of snow can also block sight lines for drivers, particularly at intersections. Not all residents are able to clear their properties, especially the elderly. Refreezing of melting snow can cause dangerous roadway conditions. In addition, transit operations may be impacted, as they were in the 2015 blizzard which caused the closure of the MBTA system for one day and limited services on several transit lines for several weeks.

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

Winter Storms and Climate Change

As with nor'easters, warmer ocean water and air will provide more fuel for storms. According to the *Massachusetts State Hazard Mitigation and Climate Adaptation Plan* changing atmospheric patterns favor the development of winter storms.

Ice Storms

The ice storm category covers a range of different weather phenomena that collectively involve rain or snow being converted to ice in the lower atmosphere leading to potentially hazardous conditions on the ground. Hail size typically refers to the diameter of the hailstones. Warnings and reports may report hail size through comparisons with real-world objects that correspond to certain diameters, shown in Table 19.

Table 19: Hail Size Comparisons

Description	Diameter (inches)
Pea	0.25
Marble or mothball	0.50
Penny or dime	0.75
Nickel	0.88
Quarter	1.00
Half dollar	1.25
Walnut or ping pong ball	1.50
Golf ball	1.75
Hen's egg	2.00
Tennis ball	2.50

Baseball	2.75
Tea cup	3.00
Grapefruit	4.00
Softball	4.50

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

Town-specific data for previous ice storm occurrences are not collected by the Town of Arlington. The best available local data is for Middlesex County through the National Environmental Information Center. Middlesex County, which includes the Town of Arlington, experienced 46 events from 2000 to 2017 (see Table 20).

Table 20: Middlesex County Hail Events, 2000-2019

Date	Event	Magnitude	Deaths	Injuries	Damage ($)
7/18/2000	Hail	1	0	0	0
6/20/2001	Hail	1.75	0	0	0
7/12/2001	Hail	1.5	0	0	0
5/27/2002	Hail	0.75	0	0	0
6/2/2002	Hail	0.75	0	0	0
8/13/2003	Hail	0.75	0	0	0
7/2/2004	Hail	0.75	0	0	0
8/20/2004	Hail	0.88	0	0	75,000
5/21/2006	Hail	0.75	0	0	0
7/11/2006	Hail	1	0	0	0
7/28/2006	Hail	0.75	0	0	0
6/5/2007	Hail	1.25	0	0	0
6/22/2007	Hail	0.75	0	0	0
7/9/2007	Hail	1	0	0	0
7/28/2007	Hail	0.88	0	0	0
6/23/2008	Hail	0.75	0	0	0
6/24/2008	Hail	0.75	0	0	0
7/1/2008	Hail	0.88	0	0	0
7/2/2008	Hail	0.75	0	0	0
8/3/2008	Hail	0.75	0	0	0
8/7/2008	Hail	1	0	0	0
8/10/2008	Hail	0.75	0	0	0
5/24/2009	Hail	1	0	0	0
6/27/2009	Hail	0.88	0	0	0
7/7/2009	Hail	0.75	0	0	0
7/8/2009	Hail	1.75	0	0	0
5/4/2010	Hail	0.75	0	0	0
5/7/2011	Hail	0.75	0	0	0
6/1/2011	Hail	0.75	0	0	0
8/2/2011	Hail	0.75	0	0	0

8/19/2011	Hail	0.75	0	0	0
3/13/2012	Hail	1.25	0	0	0
3/14/2012	Hail	1	0	0	0
6/23/2012	Hail	0.75	0	0	0
7/18/2012	Hail	1	0	0	0
10/30/2012	Hail	1	0	0	0
6/17/2013	Hail	0.75	0	0	0
5/25/2014	Hail	0.75	0	0	0
7/3/2014	Hail	1	0	0	0
8/7/2014	Hail	0.75	0	0	0
9/6/2014	Hail	0.88	0	0	0
8/4/2015	Hail	1	0	0	0
8/15/2015	Hail	0.75	0	0	0
7/23/2016	Hail	.75	0	0	0
6/27/2017	Hail	1.00	0	0	0
8/2/2017	Hail	.75	0	0	0
6/29/19	Hail	.75	0	0	0

*Magnitude refers to diameter of hail stones in inches
Source: NOAA, National Environmental Information Center

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

GEOLOGIC HAZARDS

Geologic hazards include earthquakes, landslides, sinkholes, subsidence, and unstable soils such as fill, peat, and clay. Town officials did not identify any problems with areas of geologic instability, such as sinkholes or subsidence. Although new construction under the most recent building code generally will be built to seismic standards, there are still many structures in town which pre-date the most recent building code. Information on geologic hazards in Arlington can be found on Map 4 in Appendix A.

Earthquakes

Damage in an earthquake stems from ground motion, surface faulting, and ground failure in which weak or unstable soils, such as those composed primarily of saturated sand or silts, liquefy. The effects of an earthquake are mitigated by distance and ground materials between the epicenter and a given location. An earthquake in New England affects a much wider area than a similar earthquake in California due to New England's solid bedrock geology (NESEC).

Seismologists use a magnitude scale known as the Richter scale to express the seismic energy released by each earthquake. The typical effects of earthquakes in various ranges are summarized in Table 21 below.

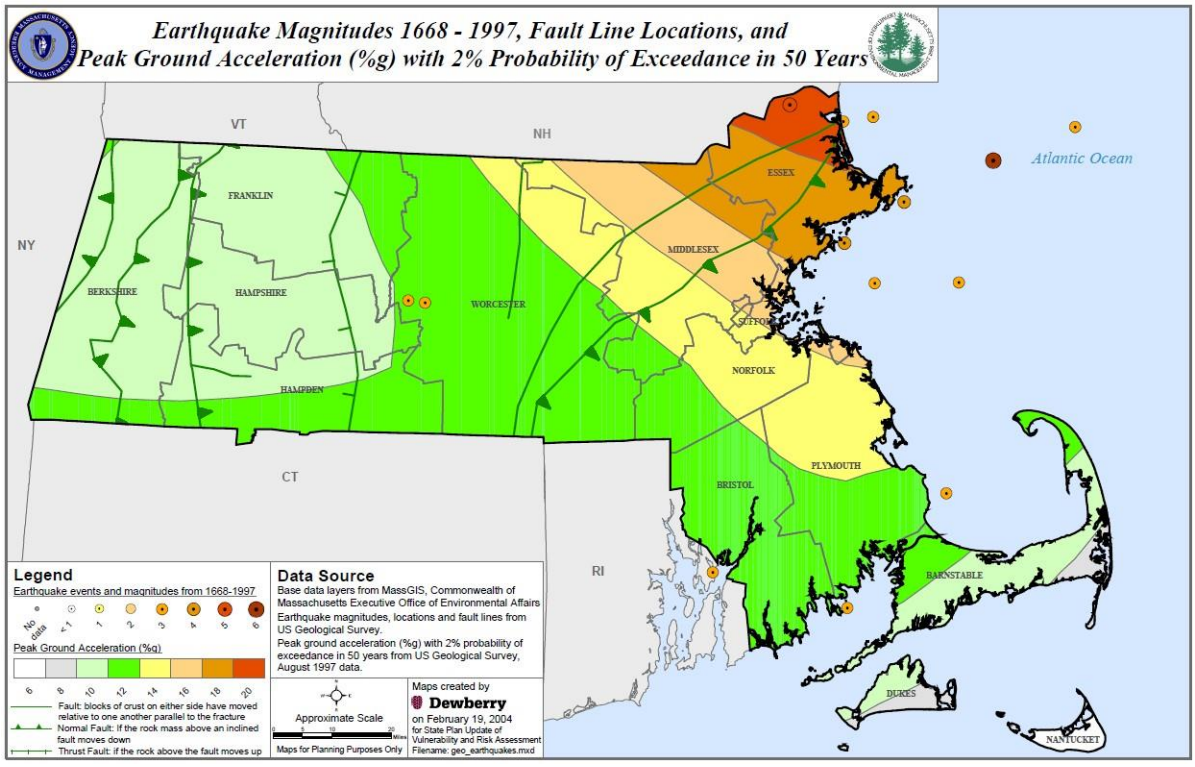
Table 21: Richter Scale and Effects

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

One measure of earthquake risk is ground motion, which is measured as maximum peak horizontal acceleration, expressed as a percentage of gravity (%g). The range of peak ground acceleration in Massachusetts is from 10 %g to 20 %g, with a 2% probability of exceedance in 50 years (see Figure 6). Arlington is in the middle part of the range for Massachusetts, at 16 %g, making it a relatively moderate area of earthquake risk within the state, although the state as a whole is considered to have a low risk of earthquakes compared to the rest of the country. There have been no earthquakes with an epicenter in Arlington (see Map 4 in Appendix A).

Figure 6: State of Massachusetts Earthquake Probability Map



Source: Massachusetts State Hazard Mitigation Plan

Although New England has not experienced a damaging earthquake since 1755, seismologists state that a serious earthquake occurrence is possible. There are five seismological faults in

Massachusetts, but there is no discernible pattern of previous earthquakes along these fault lines. Earthquakes can occur without warning and may be followed by aftershocks. Most older buildings and infrastructure were constructed without specific earthquake resistant design features.

According to the State Hazard Mitigation Plan, New England experiences an average of five earthquakes per year. From 1668 to 2007, 355 earthquakes were recorded in Massachusetts (NESEC). Most have originated from the La Malbaie fault in Quebec or from the Cape Anne fault located off the coast of Rockport. The region has experienced larger earthquakes in the distant past, including a magnitude 5.0 earthquake in 1727 and a 6.0 earthquake that struck in 1755 off the coast of Cape Anne. More recently, a pair of damaging earthquakes occurred near Ossipee, NH in 1940. A 4.0 earthquake centered in Hollis, Maine in October 2012 was felt in the Boston area. Historic records of some of the more significant earthquakes in the region are shown in Table 22.

Table 22: Historical Earthquakes in Massachusetts or Surrounding Area

Location	Date	Magnitude
MA - Cape Ann	11/10/1727	5
MA - Cape Ann	12/29/1727	NA
MA - Cape Ann	2/10/1728	NA
MA - Cape Ann	3/30/1729	NA
MA - Cape Ann	12/9/1729	NA
MA - Cape Ann	2/20/1730	NA
MA - Cape Ann	3/9/1730	NA
MA - Boston	6/24/1741	NA
MA - Cape Ann	6/14/1744	4.7
MA - Salem	7/1/1744	NA
MA - Off Cape Ann	11/18/1755	6
MA - Off Cape Cod	11/23/1755	NA
MA - Boston	3/12/1761	4.6
MA - Off Cape Cod	2/2/1766	NA
MA - Offshore	1/2/1785	5.4
MA - Wareham/Taunton	12/25/1800	NA
MA - Woburn	10/5/1817	4.3
MA - Marblehead	8/25/1846	4.3
MA - Brewster	8/8/1847	4.2
MA - Boxford	5/12/1880	NA
MA - Newbury	11/7/1907	NA
MA - Wareham	4/25/1924	NA
MA - Cape Ann	1/7/1925	4
MA - Nantucket	10/25/1965	NA
MA - Boston	12/27/74	2.3
VA - Mineral	8/23/11	5.8
MA - Nantucket	4/12/12	4.5
ME - Hollis	10/17/12	4.0
CT-Wauregan	1/12/2015	3.3
CT-Wauregan	1/12/2015	2.6
NH-East Kingston	2/15/2018	2.7

Source: City of Boston, Hazard Identification and Risk Assessment

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

Earthquakes are a potential town-wide hazard in Arlington. Much of the development in town pre-dates the current building code and could be vulnerable in the event of a severe earthquake. Potential earthquake damages to Arlington have been estimated using HAZUS-MH. Total building damages are estimated at $857.6 million for a 5.0 magnitude earthquake and $6.32 billion for a 7.0 magnitude earthquake. Other potential impacts such as evacuation needs and debris removal are detailed in Table 33.

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

Landslides

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

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

There is no universally accepted measure of landslide extent, but it has been represented as a measure of the destructiveness. Table 23 below summarizes the estimated intensity for a range of landslides. Fast moving rock falls have the highest intensity while slow moving landslides have the lowest intensity.

All the Town of Arlington has been classified as having a low risk for landslides (see Map 4, Appendix A). Local officials did not identify any significant issues related to landslides. Should a landslide occur in the future, the type and degree of impacts would be highly localized. The Town’s vulnerabilities could include damage to structures, damage to transportation and other infrastructure, and localized road closures. Injuries and casualties, while possible, would be unlikely given the low extent and impact of landslides in Arlington.

Table 23: Landslide Volume and Velocity

Estimated Volume (m^3)	Expected Landslide Velocity		
	Fast moving (rock fall)	**Rapid moving (debris flow)**	**Slow moving (slide)**
<0.001	Slight intensity	--	--
<0.5	Medium intensity	--	--
>0.5	High intensity	---	--
<500	High intensity	Slight intensity	--
500-10,000	High intensity	Medium intensity	Slight intensity
10,000 – 50,000	Very high intensity	High intensity	Medium intensity
>500,000	--	Very high intensity	High intensity
>500,000	--	--	Very high intensity

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

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

FIRE-RELATED HAZARDS

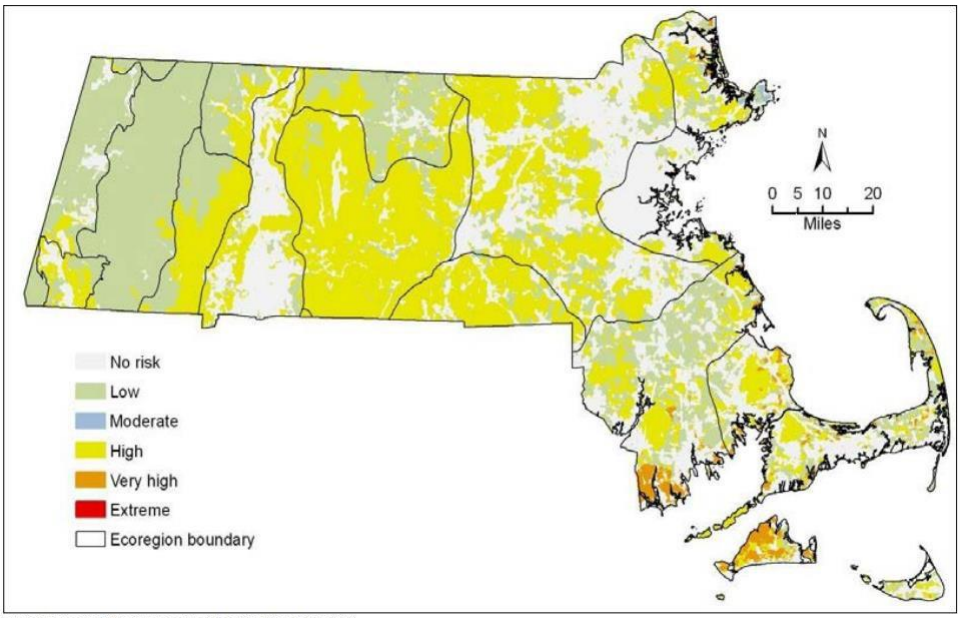
A brush fire is an uncontrolled fire occurring in a forested or grassland area. In the Boston Metro region, these fires rarely grow to the size of a wildfire as seen more typically in the western U.S. As their name implies, these fires typically burn no more than the underbrush of a forested area. There are three different classes of wild fires: (1) surface fires are the most common type and burn along the floor of a forest, moving slowly and killing or damaging trees; (2) ground fires are usually started by lightning and burn on or below the forest floor; (3) crown fires spread rapidly by wind, jumping along the tops of trees.

Wildfire season can begin in March and usually ends in late November. The majority of wildfires typically occur in April and May, when most vegetation is void of any appreciable moisture, making them highly flammable. Once "green-up" takes place in late May to early June, the fire danger usually is reduced somewhat. A wildfire differs greatly from other fires by its extensive size, the speed at which it can spread out from its original source, its potential to unexpectedly change direction, and its ability to jump gaps such as roads, rivers and fire breaks.

These fires can present a hazard where there is the potential for them to spread into developed or inhabited areas, particularly residential areas where sufficient fuel materials might exist to allow the fire the spread into homes. Protecting structures from fire poses special problems and can stretch firefighting resources to the limit. If heavy rains follow a fire, other natural disasters can occur, including landslides, mudflows, and floods. If the wildfire destroys the ground cover, then erosion becomes one of several potential problems.

According the National Wildfire Risk Assessment, Arlington is located in an area that has no significant risk of wildfires (Figure 7)

Figure 7: Massachusetts Wildfires Risk Areas



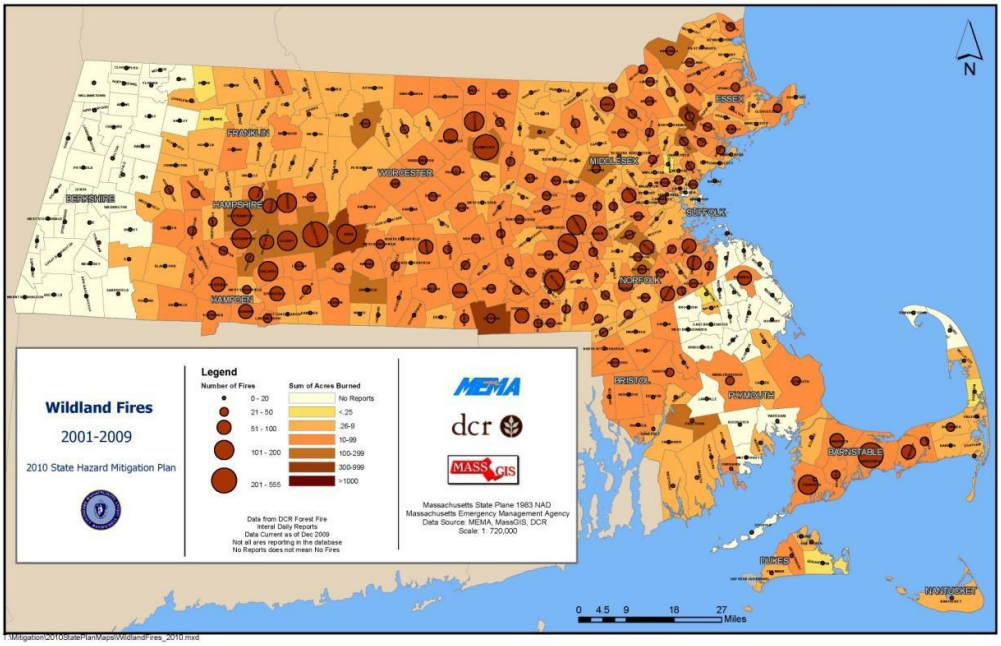
Source: Northeast Wildfire Risk Assessment Geospatial Work Group, 2009

Source: Northeast Wildfire Risk Assessment Geospatial Work Group, 2009

Potential Fire Hazards In Arlington

Wildfires in Massachusetts are measured by the number of fires and acres burned. The most recent data available for wildfires in Massachusetts, shown in Figure 8, indicates that the wildfire extent in Arlington ton consists of 0 to 20 recordable fires from 2001 to 2009, with no recorded acres burned.

Figure 8: Massachusetts Wildfires, 2001 to 2009



Source: Massachusetts State Hazard Mitigation Plan

Based on input from the Local Hazard Mitigation Team which includes the Arlington Fire Chief, brush fires in Arlington are relatively rare and have generally occurred in only one isolated forested area in the Town off of Thorndike Street in an area called Thorndike Fields. For this plan update, the Fire Chief also identified a second potential fire hazard site, near the intersection of Summer Street and Washington Street. These two sites are identified as areas 9 and 10 on Map 8, "Hazard Areas" in Appendix A. None of the previous brush fires have resulted in major property damage and no loss of life has ever been reported. These brush fires are localized and are likely a result of either someone setting a fire or the careless disposal of lit material such as cigarettes or matches.

Potential damages from wildfires in Arlington would depend on the extent and type of land affected. Potential vulnerabilities to wildfires include damage to structures and other improvements and impacts on natural resources such as town conservation land. Smoke and air pollution from wildfires can be a health hazard, especially for sensitive populations including children, the elderly, and those with respiratory and cardiovascular diseases. However, given the limited areas in town potentially subject to brush fires, and the lack of a Wildfire-Urban Interface, significant damages are unlikely. The town has not experienced significant damages due to wildfire in the past.

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

Wildfires and Climate Change

Drought and warmer temperatures may lead to an increase in wildfires if forests dry out and become more flammable.

EXTREME TEMPERATURES

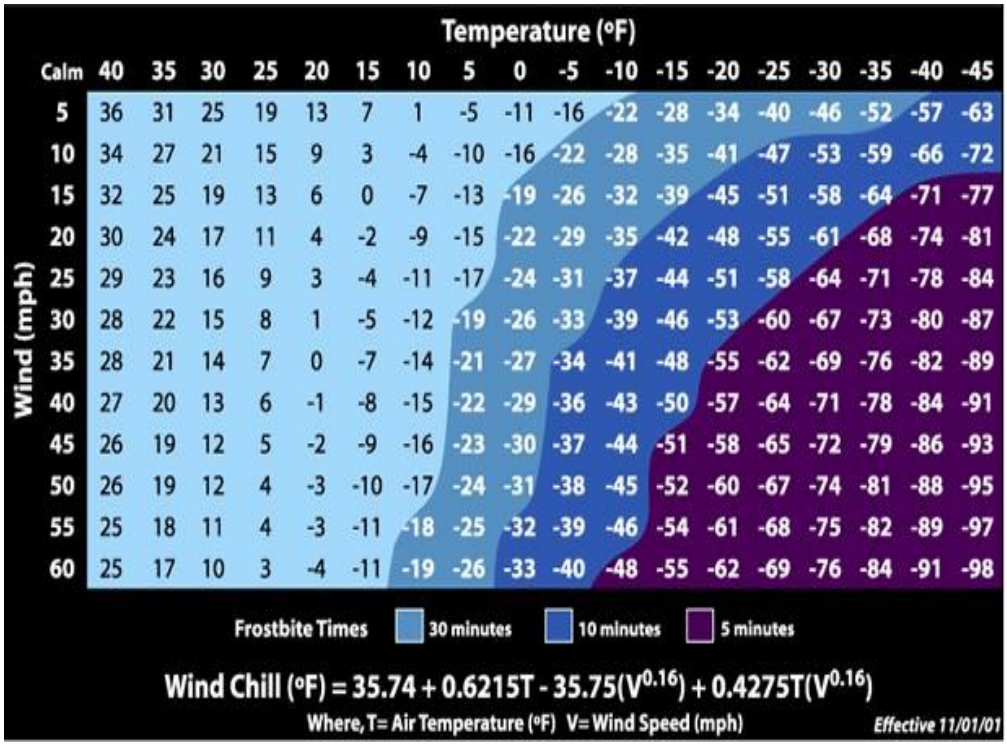
Extreme temperatures occur when either high temperature or low temperatures relative to average local temperatures occur. These can occur for brief periods of time and be acute, or they can occur over long periods of time where there is a long stretch of excessively hot or cold weather.

Arlington 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 that are far outside of the normal seasonal ranges for Massachusetts. The average temperature for winter (December to February) in Massachusetts is 31.8°F. The average temperature for summer (June to August) is 71°F. Extreme temperatures are a town-wide hazard.

EXTREME COLD

For extreme cold, temperature is typically measured using the Wind Chill Temperature Index, which is provided by the National Weather Service (NWS). The latest version of the index was implemented in 2001 and is meant to show how cold conditions feel on unexposed skin and can lead to frostbite. The index is provided in Figure 9 below.

Figure 9: Wind Chill Temperature Index and Frostbite Risk



Source: National Weather Service

Extreme cold is relative to the normal climatic lows in a region. Temperatures that drop decidedly below normal and wind speeds that increase can cause harmful wind chill factors. The wind chill is the apparent temperature felt on exposed skin due to the combination of air temperature and wind speed. Extreme cold is a dangerous situation that can result in health emergencies for susceptible people, such as those without shelter, those who are stranded, or those who live in homes that are poorly insulated or without heat. The elderly and people with disabilities are often most vulnerable. In Arlington, 16.4 percent of the population are over 65 and 9.0 percent of the population has a disability

The best available local data on extreme cold in Arlington are for Middlesex County, through the National Environmental Information Center (NEIC). There are three extreme cold events on record since 2000 for the county, which caused no deaths, no injuries, or property damage (Table 24).

Table 24: Middlesex County Extreme Cold and Wind Chill Occurrences

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

Source: NOAA, National Environmental Information Center

EXTREME HEAT

A heat wave in Massachusetts is defined as three or more consecutive days above 90°F. Another measure used for identifying extreme heat events is through a Heat Advisory from the NWS. These advisories are issued when the heat index (Figure 10) is forecasted to exceed 100°F for two or more hours; an excessive heat advisory is issued if the forecast predicts the temperature to rise above 105°F.

Figure 10: Heat Index Chart

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

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

Source: National Weather Service

The best available local data for extreme heat in Arlington are for Middlesex County, through the National Environmental Information Center. Since 2010, there have been two excessive heat days, which resulted in one death, no injuries, and no property damage (Table 25).

Table 25: Middlesex County Extreme Heat Occurrences

Date	Deaths	Injuries	Damage ($)
7/6/2010	0	0	0
7/5/2013	1	0	0
Total	**1**	**0**	**0**

Source: NOAA, National Environmental Information Centers

Extreme heat poses many health risks. Prolonged exposure to high temperatures can cause heat-related illnesses, such as heat cramps, heat exhaustion, heat stroke, and in severe cases, death. Heat exhaustion is the most common heat-related illness and if untreated, it may progress to heat stroke. Prolonged heat exposure can also exacerbate pre-existing conditions, including respiratory illnesses, cardiovascular disease, and mental illnesses.

In Arlington, 16.4% of the people are over 65 years old. Senior adults are at particularly high risk to heat for several reasons. They may not adjust to sudden changes in temperature as quickly as younger people, they are more likely to have a chronic medical condition whose symptoms may be exacerbated by heat, and they are more likely to be taking prescription medications that affect their ability to control body temperature.

Power failures can occur during heat waves, where intense heat spikes electricity demand and aging infrastructure. This occurred in June 2017 in the neighboring Town of Belmont, where intense heat causes a spike in electricity demand. With its aging infrastructure, the combination of these factors led to equipment failure. Loss of electricity not only impair a resident's ability to cool, but can cause significant medical emergency for those who require electronic medical equipment or from food-borne illnesses from contaminated food, ingested after loss of refrigeration.

Extreme temperatures are medium frequency events based on past occurrences, and as defined by the Massachusetts State Hazard Mitigation Plan. Both extreme cold and hot weather events occur between once in five years to once in 50 years, or a 2% to 20% chance of occurring each year. However, due to climate change, this will likely change in the future, as described in the following section.

HEAT ISLANDS

MAPC performed a heat island analysis to ascertain the areas of Arlington that are most at risk to extreme heat. A heat island is defined as an area whose temperature ranges more than 1.8-.54° F greater during the daytime or up to 22° F greater in the evening than the surrounding areas. MAPC used LANDSAT satellite imagery at 30 m resolution to ascertain land surface temperatures during the daytime in the warmest months of 2016. This analysis is shown in Map 9 in Appendix A. The hottest 5% areas, or "hot spots," generally follow the Massachusetts Avenue corridor, which is the most densely developed part of town with the greatest amount of impervious surfaces. There are also "hot spots" in parts of East Arlington, in a relatively dense residential area north and west of Massachusetts Avenue. Map 10 also shows the range of tree cover across the town. Areas with higher tree coverage are the coolest areas on the heat island map, showing the clear benefits of trees to mitigate extreme heat.

Extreme Temperatures and Climate Change

Extreme cold events are predicted to decrease in the future, while extreme heat is projected to increase.

Global temperatures increased by nearly 2 degrees in the last century and even small changes in temperature have widespread and significant changes to our climatic system. For example, the northeast has experienced a 10-day increase in the growing season in since 1980.

Future temperature projections for the Boston Harbor watershed, which includes Arlington, are shown below (Table 26). The projections show an increase in average temperatures and an increasing likelihood of heat waves, as indicated by the increased number of days over 90 and 100 degrees each year.

Table 26. Projected Temperature Change for the Boston Harbor Watershed

Temperature (F°)	Observed Baseline 1971-2000	Projected 2020-2049	Projected 2040-2069	Projected 2060-2089	Projected 2080-2099
Annual temperature	50°	52-54°	53-56°	53-59°	54-61°
Days over 90 ° (days/year)	8	13-23	16-37	17-57	19-75
Days over 100 ° (days/year)	0.05	.29-2	.37-4	.52-9	.60-16

The projected increase in extreme heat and heat waves is the source of one of the key health concerns related to climate change. Prolonged exposure to high temperatures can cause heat-related illnesses, such as heat cramps, heat exhaustion, heat stroke, and death. Heat exhaustion is the most common heat-related illness and if untreated, it may progress to heat stroke. People who perform manual labor, particularly those who work outdoors, are at increased risk for heat-related illnesses. Prolonged heat exposure and the poor air quality and high humidity that often accompany heat waves can also exacerbate pre-existing conditions, including respiratory illnesses, cardiovascular disease, and mental illnesses.

The senior population is often at elevated risk due to a high prevalence of pre-existing and chronic conditions. People who live in older housing stock (as is often the case with public housing), and in housing without air conditioning have increased vulnerability to heat-related illnesses. Power failures are more likely to occur during heat waves, affecting the ability of residents to remain cool during extreme heat. Individuals with pre-existing conditions and those who require electric medical equipment may be at increased risk during a power outage.

DROUGHT

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

In Massachusetts, droughts are caused by the prevalence of dry northern continental air and a decrease in coastal- and tropical-cyclone activity. During the 1960s, a cool drought occurred because dry air from the north caused lower temperatures in the springs and summers of 1962 through 1965. The northerly winds drove frontal systems to sea along the southeast coast and prevented the northeastern states from receiving moisture (U.S. Geological Survey). This is considered the record drought in Massachusetts modern history.

Average annual precipitation in Massachusetts is 44 inches per year, with approximately three to four-inch average amounts for each month of the year. Regional monthly precipitation ranges from zero to 17 inches and statewide annual precipitation ranges from 30 to 61 inches. Thus, in

the driest calendar year (1965), the statewide precipitation total of 30 inches was only 68% of the average total.

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. Arlington is located in the Northeast region. Drought is a potential town-wide hazard in Arlington.

Five levels of drought have been developed to characterize drought severity: Normal, Advisory, Watch, Warning, and Emergency. These levels are based on conditions of natural resources and provide information on the current status of water resources. The levels provide a framework from which to take actions to assess, communicate, and respond to drought conditions.

The drought levels begin with a normal situation where data are routinely collected and distributed, move to heightened vigilance with increased data collection during an advisory, and 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 become necessary. Drought levels are used to coordinate both state agency and local response to drought situations.

As dry conditions can have a range of different impacts, a number of drought indices are available to assess these various impacts. Massachusetts uses a multi-index system that takes advantage of several of these indices to determine the severity of a given drought or extended period of dry conditions. Drought level is determined monthly based on the number of indices which have reached a given drought level. Drought levels are declared on a regional basis for each of the six regions in Massachusetts. County by county or watershed-specific determinations may also be made. A determination of drought level is based on seven indices:

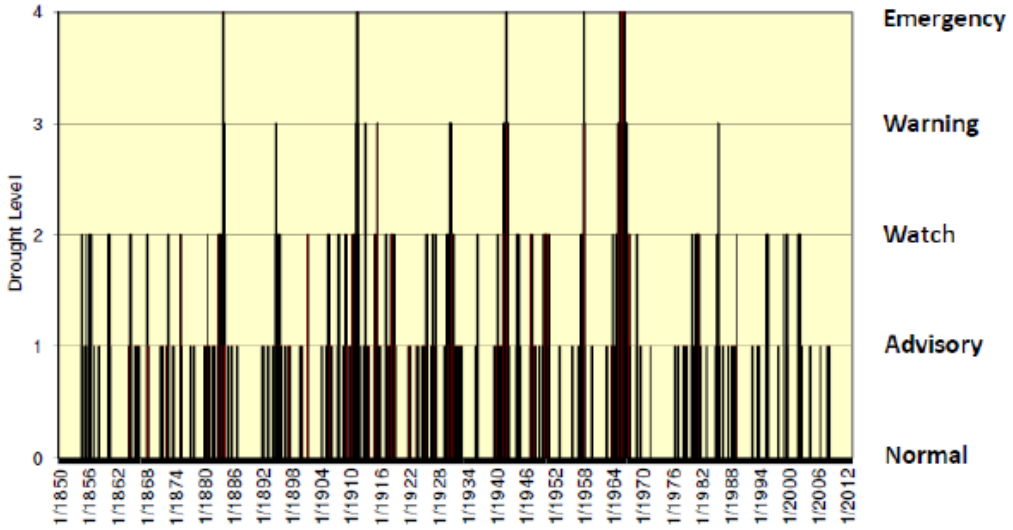
1. Standardized Precipitation Index (SPI) reflects soil moisture and precipitation.
2. Crop Moisture Index (CMI) reflects soil moisture conditions for agriculture.
3. Keetch Byram Drought Index (KBDI) is designed for fire-potential assessment.
4. Precipitation Index is a comparison of measured precipitation to normal precipitation.
5. The Groundwater Level Index is based on the number of consecutive month's groundwater levels below normal (lowest 25% of period of record).
6. The Stream flow Index is based on the number of consecutive months that stream flow levels are below normal (lowest 25% of period of record).
7. The Reservoir Index is based on the water levels of small, medium, and large index reservoirs across the state, relative to normal conditions for each month.

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

Arlington does not collect data relative to drought events. Because drought tends to be a regional hazard, this plan references state data as the best available data for drought. The statewide scale is a composite of the six regions in the state. Regional composite precipitation values are based on monthly values from six stations, and three stations in the smaller regions (Cape and Islands and West regions).

Figure 11 depicts the incidents of drought levels' occurrence in Massachusetts since 1850 using the Standardized Precipitation Index (SPI) parameter alone. On a monthly basis, the state was in a Drought Watch to Emergency condition 11% of the time since 1850.

Figure 11: Statewide Drought Levels using SPI Thresholds since 1850



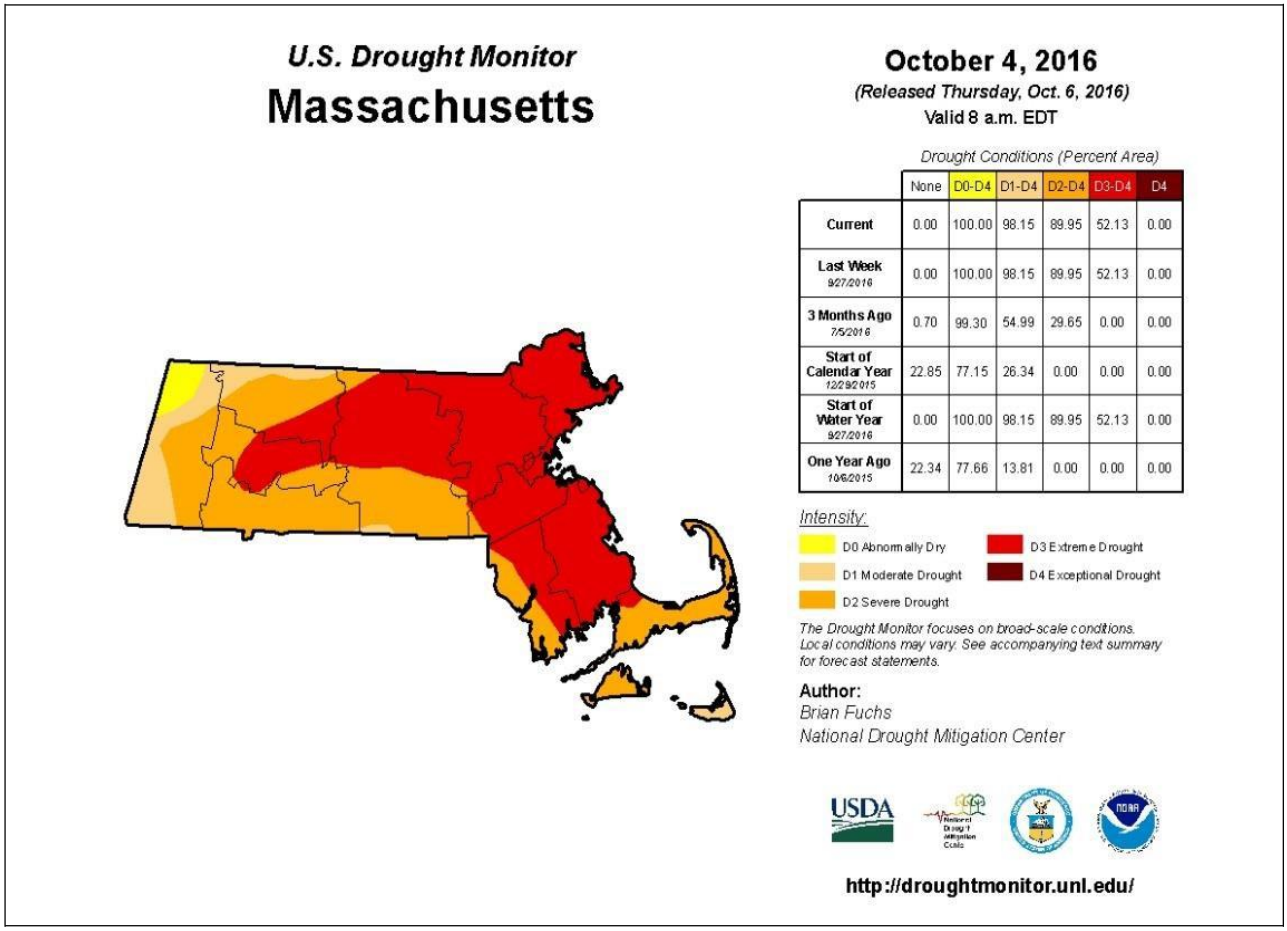
Source: Massachusetts State Drought Management Plan 2013

Drought emergencies have been reached infrequently, with five events occurring in the period between 1850 and 2012: 1883, 1911, 1941, 1957, and 1965 to 1966. The drought period between 1965 and 1966 is viewed as the most severe drought to have occurred in modern times in Massachusetts because of its long duration. On a monthly basis over the 162-year period of record, there is a 1% chance of being in a drought emergency.

Drought warning levels not associated with drought emergencies have occurred five times, in 1894, 1915, 1930, 1985, and 2016. On a monthly basis over the 162-year period of record, there is a 2% chance of being in a drought warning. Arlington was under a drought warning from August to December 2016. By the fall of 2016, more than half of Massachusetts was experiencing severe drought conditions (Figure 12).

Drought watches not associated with higher levels of drought generally have occurred in three to four years per decade between 1850 and 1950. In the 1980s, there was a lengthy drought watch level of precipitation between 1980 and 1981, followed by a drought warning in 1985. A frequency of drought watches at a rate of three years per decade resumed in the 1990s (1995, 1998, and 1999). In the 2000s, drought watches occurred in 2001 and 2002. The overall frequency of being in a drought watch is 8% on a monthly basis over the 162-year period of record. Table 27 summarizes the chronology of major droughts since 1879.

Figure 12: Drought Conditions in Massachusetts, October 2016



Source: US Drought Monitor, National Drought Mitigation Center

Potential damages of a severe long-term drought could include losses of landscaped areas if outdoor watering is restricted and potential loss of business revenues if water supplies were severely restricted for a prolonged period. As this hazard has never occurred to such a severe degree in Arlington, there are no data or estimates of potential damages, but under a severe long-term drought scenario it would be reasonable to expect a range of potential damages of several million dollars. Another potential vulnerability of droughts could be increased risk of wildfires, although in Arlington there are extremely limited areas subject to brush fires.

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

Table 27: Chronology of Major Droughts in Massachusetts

Table 4-13: Droughts in Massachusetts Based on Instrumental Records

Date	Area Affected	Recurrence Interval (years)	Remarks	Reference
1879-83	—	—		Kinnison (1931) as cited in USGS 1989
1908-12	—	—		Kinnison (1931) as cited in USGS 1989
1929-32	Statewide	10 to >50	Water-supply sources altered in 13 communities. Multistate.	USGS 1989
1939-44	Statewide	15 to >50	More severe in eastern and extreme western Massachusetts. Multistate.	USGS 1989
1957-59	Statewide	5 to 25	Record low water levels in observation wells, northeastern Massachusetts.	USGS 1989
1961-69	Statewide	35 to >50	Water-supply shortages common. Record drought. Multistate.	USGS 1989
1980-83	Statewide	10 to 30	Most severe in Ipswich and Taunton River basins; minimal effect in Nashua River basin. Multistate.	USGS 1989
1985-88	Housatonic River basin	25	Duration and severity as yet unknown. Streamflow showed mixed trends elsewhere.	USGS 1989
1995	—	—	Based on statewide average precipitation	DMP 2013
1998-1999	—	—	Based on statewide average precipitation	DMP 2013
Dec 2001 - Jan 2003	Statewide	—	Level 2 drought (out of 4 levels) was reached statewide for several months	DCR 2017
Oct 2007 - Mar 2008	Statewide except West and Cape and Islands regions	—	Level 1 drought (out of 4 levels)	DCR 2017
Aug 2010 - Nov 2010	Connecticut River Valley, Central and Northeast regions	—	Level 1 drought (out of 4 levels)	DCR 2017
Oct 2014 - Nov 2014	Southeast and Cape and Islands regions	—	Level 1 drought (out of 4 levels)	DCR 2017
Jul 2016 - Apr 2017	Statewide	—	Level 3 drought (out of 4 levels)	DCR 2017

Notes: (1) "—" denotes data not available; (2) USGS 1989 determined dry periods from streamflow and precipitation records. Dry periods that exceeded a recurrence interval of 10 years were deemed droughts; (3) DMP 2013 analyzed precipitation data only and as a statewide average of stations; (4) DCR 2017 compiled data based on historical drought declarations by the State under the protocol in its 2013 Drought Management Plan. DCR = Department of Conservation and Recreation; USGS = United States Geological Survey.

Source: MA Integrated State Hazard Mitigation and Climate Adaptation Plan, 2018

Drought and Climate Change

Changing precipitation patterns and the number of extreme weather events per year is difficult to project into the future. The Northeast Climate Science Center does report an anticipated increase in rainfall for Massachusetts in the spring and winter months and slightly decreased summer rainfall. Consequently, warming temperatures can cause greater evaporation in the summer and fall, as well as earlier snow melt. This, combined with projected higher summer temperatures could increase the frequency of episodic droughts in the future.

LAND USE AND DEVELOPMENT TRENDS

EXISTING LAND USE

The most recent land use statistics available from the state are based on aerial photography done in 2005. Table 28 shows the acreage and percentage of land in 20 categories. The most prevalent land use is High Density Residential at 1,675 acres, or 47.7 % of the total area. If the four residential categories are aggregated, residential uses make up 70.3 % of the area of the town. After all residential uses, the next largest category is commercial, with 245.3 acres, or 7.0 percent of the total land in the town. Town-wide land use is displayed on Map 2 in Appendix A.

Table 28:Arlington 2005 Land Use

Land Use Category	Acres	Percent
Forest	123.2	3.5%
Wetland	10.2	0.3%
Open Land	23.2	0.7%
Participation Recreation	105.6	3.0%
Water-Based Recreation	2.4286	0.1%
Multi-Family Residential	747.6	21.3%
High Density Residential	1675.3	47.7%
Medium Density Residential	29.1	0.8%
Low Density Residential	10.0	0.3%
Commercial	245.3	7.0%
Industrial	10.4	0.3%
Urban Open	13.1	0.4%
Transportation	57.9	1.6%
Water	230.5	6.6%
Golf Course	53.6	1.5%
Urban Public	106.3	3.0%
Cemetery	60.9	1.7%
Nursery	0.6	0.0%
Forested Wetland	3.1	0.1%
Junkyards	1.4	0.0%
TOTAL ACRES	**3509.9**	100.0%

Source: Mass GIS

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

DEVELOPMENT TRENDS

Development trends throughout the metropolitan region are tracked by MassBuilds, MAPC's Development Database, which provides an inventory of new development over the last decade. The database tracks both completed developments and those currently under construction. Using MassBuilds and the 2016 Arlington Housing Production Plan, Table 29 (below) was generated.

Table 29: Summary of Arlington Development and Development Potential

Name	Status	Year	Housing Units	Commercial Square Feet	Project Type
The Legacy	Completed	2000	94		Residential
ALTA Brigham Square	Completed	2013	116	3,500	Residential/office
Arlington 360 (former Symmes Hospital)	Completed	2014	176		Mixed Use
Kimball-Farmer House	Completed	2015	3		Residential
887 Mass Ave	Completed	2019	4	2,477	Mixed Use
20 Westminister	Construction	2020	9		Residential
925-927 Mass Ave	Construction	2020	3	3,882	Mixed Use
117 Broadway	Permitted	2021	14		Mixed Use
19R Park Ave	Permitted	2022	34		Residential
1207-1211 Mass Ave	Projected	2023		24,443	Mixed Use (50-room Hotel and Restaurant)
Thorndike Place (Mugar)	Projected		207		Residential
TOTAL			**660**	**34,302**	

FUTURE DEVELOPMENT

The Town of Arlington is largely built out, with most of the identified potential future land uses expected on redevelopment sites. As new development and redevelopment occurs it will be subject to the latest building code requirements and zoning regulations pertaining to wind,

earthquakes, and flooding.

MAPC consulted with the Local Hazard Mitigation Planning Team to determine areas that may be developed in the future, based on the Town's planning efforts and current development trends and projects. Town staff identified potential significant new development sites, which are listed in Table 30 and shown on Map 8 in Appendix A.

Table 30: Relationship of Potential Development to Hazard Areas

Map ID	Potential Future Project	Flood Zones
C	Mugar Property	66.33% in AE: 1% Annual Chance of Flooding, with BFE
F	Arlington High School	22.15% in X: 0.2% Annual Chance of Flooding
64	Arlington DPW Yard	

Source: MAPC Data Services, GIS Analyst

In order to characterize any change in the Town's vulnerability associated with new developments, a GIS mapping analysis was conducted which overlaid the development sites with the FEMA Flood Insurance Rate Map (see Table 30). The analysis shows that two of the sites are partially located the in zone AE Zone (1% Annual Chance of Flooding), and part of one site is partially within zone X (0.2% Annual Chance of Flooding). Sites partially in a flood zone typically include a portion of the site is not built on.

With respect to landslide risk, all the development sites are located in the area designated as "Low Incidence" for landslides. Other hazards such as wind speed and snowfall rates do not vary across Arlington (See hazard maps in Appendix A). Overall, Arlington's potential future development would not significantly increase the Town's vulnerability if existing regulations are adhered to.

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CRITICAL FACILITIES & INFRASTRUCTURE IN HAZARD AREAS

Critical infrastructure includes facilities that are important for disaster response and evacuation (such as emergency operations centers, fire stations, water pump stations, etc.) and facilities where additional assistance might be needed during an emergency (such as nursing homes, elderly housing, day care centers, etc.). The Local Hazard Mitigation Team identified and mapped 105 critical facilities in Arlington. These facilities are listed in Table 31 and are shown on all of the maps in Appendix A.

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 31.

Column 1: ID #: The first column in Table 31 is an ID number which appears on the maps that are part of this plan. See Appendix A.

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:

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

Column 7: Brush Fire Area: The seventh column identifies areas the local Hazard Mitigation Team identified as having the potential for brush fires.

Column 8: Annual Snowfall: The eighth column provides the range of annual snowfall provided by NESEC.

Table 31: Relationship of Critical Infrastructure to Hazard Areas							
ID	**NAME**	**TYPE**	**Landslide Risk**	**FEMA Flood Zone**	**Local Flood Area**	**Brush Fire Area**	**Annual Snowfall (inches)**
1	A Place to Grow at the Stratton School	Child Care	Low	No	No	No	48-72
2	ABC Pre-school	Child Care	Low	No	No	No	48-72
3	Little Sprouts	Child Care	Low	No	No	No	48-72
4	Arlington Children's Center, Inc.	Child Care	Low	No	No	No	48-72
5	Arlington Creative Start	Child Care	Low	No	No	No	48-72
6	Arlington Heights Nursery School	Child Care	Low	No	No	No	48-72
7	Arlington Infant-Toddler Center	Child Care	Low	No	No	No	48-72
8	Brackett After School Program	Child Care	Low	No	No	No	48-72
9	Bright Start After School @ Bishop	Child Care	Low	No	No	No	48-72
10	Fidelity House Preschool	Child Care	Low	No	No	No	48-72
11	Fidelity House School Age Child Care Pro	Child Care	Low	No	No	No	48-72
12	Great Expectations Preschool	Child Care	Low	No	No	No	48-72
13	Kids Care Club	Child Care	Low	No	No	No	48-72
14	Kids Care Club at the Thompson School	Child Care	Low	No	No	No	48-72
15	Gibbs School	Child Care	Low	No	No	No	48-72
17	Peirce Playcare and Extended Day	Child Care	Low	No	No	No	48-72

Table 31: Relationship of Critical Infrastructure to Hazard Areas							
ID	**NAME**	**TYPE**	**Landslide Risk**	**FEMA Flood Zone**	**Local Flood Area**	**Brush Fire Area**	**Annual Snowfall (inches)**
18	Rogers-Pierce Children's Center	Child Care	Low	No	No	No	48-72
19	Sunshine Nursery School	Child Care	Low	No	No	No	48-72
20	The Afterschool Connection, Inc.	Child Care	Low	No	No	No	48-72
21	Fire Police Support Service (garage)	Municipal	Low	No	Garden Street	No	48-72
22	Headquarters Fire Station	Fire Station	Low	No	No	No	48-72
23	Park Circle Fire Station	Fire Station	Low	No	No	No	48-72
24	Highland Fire Station	Fire Station	Low	No	No	No	48-72
25	Arlington Fire Administration	Municipal	Low	No	No	No	48-72
26	Arlington Town Hall	Municipal	Low	No	No	No	48-72
27	Fire/Police Dispatch	Emergency Operations Center	Low	No	Garden Street	No	48-72
28	Arlington Police Department	Police Station	Low	No	No	No	48-72
29	Hardy Elementary	School	Low	No	No	No	48-72
30	Leslie Ellis School	School	Low	No	No	No	48-72
32	Thompson Elementary	School	Low	No	No	No	48-72
33	Brackett	School	Low	No	No	No	48-72
34	Ecole Bilingue School	School	Low	No	No	No	48-72
35	Arlington Catholic HS	School	Low	No	No	No	48-72
36	St Agnes Elementary	School	Low	No	No	No	48-72

Table 31: Relationship of Critical Infrastructure to Hazard Areas							
ID	**NAME**	**TYPE**	**Landslide Risk**	**FEMA Flood Zone**	**Local Flood Area**	**Brush Fire Area**	**Annual Snowfall (inches)**
37	Cyrus E Dallin	School	Low	No	No	No	48-72
38	Menotomy Preschool	School	Low	X: 0.2% Annual Chance	No	No	48-72
39	LABBB Collaborative - BEHAVIORAL-ARLINGT	School	Low	No	No	No	48-72
40	Arlington High School	School	Low	No	No	No	48-72
41	Ottoson Middle School	School	Low	No	No	No	48-72
42	Germaine Lawrence School (for girls)	School	Low	No	No	No	48-72
43	Bishop Elementary School	School	Low	No	No	No	48-72
44	Covenant School	School	Low	No	No	No	48-72
45	Peirce Elementary	School	Low	No	No	No	48-72
46	Stratton Elementary School	School	Low	No	No	No	48-72
47	Upper Mystic Lake Dam	Dam	Low	AE: Regulatory Floodway	No	No	48-72
48	Arlington Reservoir Dam	Dam	Low	AE: 1% Annual Chance with BFE	No	No	48-72
50	Mrs. T's Company Inc.	Child Care	Low	No	No	No	48-72
51	Community safety building	Emergency Operations Ctr	Low	No	Garden Street	No	48-72
52	Grove St Bridge	Bridge	Low	X: 0.2% Annual Chance	No	No	48-72

Table 31: Relationship of Critical Infrastructure to Hazard Areas							
ID	**NAME**	**TYPE**	**Landslide Risk**	**FEMA Flood Zone**	**Local Flood Area**	**Brush Fire Area**	**Annual Snowfall (inches)**
53	Brattle St Bridge	Bridge	Low	No	Brattle Street	No	48-72
54	Pond Lane Bridge	Bridge	Low	No	No	No	48-72
55	Dow Ave Bridge	Bridge	Low	No	No	No	48-72
56	Park Ave Bridge	Bridge	Low	No	No	No	48-72
57	Pleasant St Bridge	Bridge	Low	No	No	No	48-72
58	Lake St Bridge	Bridge	Low	No	No	No	48-72
59	DPW office	Municipal	Low	No	Grove Street	No	48-72
60	Municipal admin (in HS)	Municipal	Low	No	No	No	48-72
61	Library	Municipal	Low	No	No	No	48-72
62	Minuteman under Route 2	Bridge	Low	AE: Regulatory Floodway	East Arlington / Alewife	No	48-72
63	Alewife Brook bridge	Bridge	Low	X: 0.2% Annual Chance	East Arlington / Alewife	No	48-72
64	DPW Yard	Municipal	Low	X: 0.2% Annual Chance	Grove Street	No	48-72
65	Winslow Towers	Elder Housing	Low	No	No	No	48-72
66	Drake Village	Elder Housing	Low	No	No	No	48-72
67	Qusack Building	Elder Housing	Low	No	Garden Street	No	48-72
69	Park Ave nursing and rehab center	Nursing Home	Low	No	No	No	48-72
70	Spring St Pump Station	Water Pump Station	Low	No	No	No	48-72
71	Brattle Court Pump Station	Water Pump Station	Low	No	No	No	48-72
72	Park Circle Fire Station (Towers)	Communication Tower	Low	No	No	No	48-72
73	Park Circle Tower (1,000,000	Water Storage Tank	Low	No	No	No	48-72

Table 31: Relationship of Critical Infrastructure to Hazard Areas							
ID	**NAME**	**TYPE**	**Landslide Risk**	**FEMA Flood Zone**	**Local Flood Area**	**Brush Fire Area**	**Annual Snowfall (inches)**
	gallons)						
74	Park Circle Tower	Communication Tower	Low	No	No	No	48-72
75	Bellington St Underground Water Storage Tank	Water Storage Tank	Low	No	No	No	48-72
76	Turkey Hill Water Storage Tank	Water Storage Tank	Low	No	No	No	48-72
77	Calvary Church, United Methodist	Church	Low	No	No	No	48-72
78	Church of Our Savior	Church	Low	No	No	No	48-72
79	First Baptist Church	Church	Low	No	No	No	48-72
80	First Parish Unitarian Universalist Chur	Church	Low	No	No	No	48-72
81	Highrock Church	Church	Low	No	No	No	48-72
82	Park Avenue Congregational Church, UCC	Church	Low	No	No	No	48-72
83	Pleasant Street Congregational Church	Church	Low	No	No	No	48-72
84	Saint Agnes Parish	Church	Low	No	No	No	48-72
85	Saint Athanasius Greek Orthodox Church	Church	Low	No	No	No	48-72
86	Saint Camillus	Church	Low	No	No	No	48-72

Table 31: Relationship of Critical Infrastructure to Hazard Areas							
ID	**NAME**	**TYPE**	**Landslide Risk**	**FEMA Flood Zone**	**Local Flood Area**	**Brush Fire Area**	**Annual Snowfall (inches)**
87	St. John's Episcopal Church	Church	Low	No	No	No	48-72
88	St. Paul Lutheran Church	Church	Low	No	No	No	48-72
89	Trinity Baptist Church	Church	Low	No	No	No	48-72
90	Bright View	Assisted Living	Low	No	No	No	48-72
91	Spring Board Day Care	Day Care	Low	No	No	No	48-72
92	Casa Esme	Day Care	Low	No	No	No	48-72
93	Sunrise	Assisted Living	Low	No	No	No	48-72
94	Natural Gas Distributor	Utility	Low	No	No	No	48-72
95	Police Substation	Municipal	Low	No	Sunnyside Avenue	No	48-72
96	Fox Library	Library	Low	No	No	No	48-72
97	Department of Children and Families	30 Mystic St.	Low	No	No	No	48-72
98	Tracks Under Field		Low	AE: Regulatory Floodway	East Arlington / Alewife	No	48-72
99	Reed Street Pump Station	Pump Station	Low	No	No	No	48-72
100	Old Mystic Pump Station	Pump Station	Low	No	No	No	48-72
101	Intervale Pump Station	Pump Station	Low	X: 0.2% Annual Chance	No	No	48-72
102	Pond Land Pump Station	Pump Station	Low	No	No	No	48-72
103	Gould Road Pump Station	Pump Station	Low	No	No	No	48-72

Table 31: Relationship of Critical Infrastructure to Hazard Areas							
ID	**NAME**	**TYPE**	**Landslide Risk**	**FEMA Flood Zone**	**Local Flood Area**	**Brush Fire Area**	**Annual Snowfall (inches)**
104	1 Arizona Terrace	Pump Station	Low	AE: 1% Annual Chance with BFE	Sunnyside Avenue	No	48-72
105	Gould Road Pump Station	Pump Station	Low	No	No	No	48-72
106	Standish Pump Station	Pump Station	Low	No	No	No	48-72
107	Dow Pump Station	Pump Station	Low	No	No	No	48-72
108	Mystic Lake Pump Station	Pump Station	Low	AE: 1% Annual Chance with BFE	No	No	48-72
109	Magnolia Field Pump Station (Storm Drain)	Pump Station	Low	AE: Regulatory Floodway	East Arlington / Alewife	No	48-72
110	Arlington Senior Center	Senior Center	Low	No	No	No	48-72

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 through the HAZUS-MH software.

Introduction to HAZUS-MH

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

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

There are three modules included with the HAZUS-MH software: hurricane wind, flooding, and earthquakes. There are also three levels at which HAZUS-MH can be run. Level 1 uses national baseline data and is the quickest way to begin the risk assessment process. The analysis that follows was completed using Level 1 data.

Level 1 relies upon default data on building types, utilities, transportation, etc. from national databases as well as census data. While the databases include a wealth of information on the nine communities that are a part of this study, 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 a starting point for understanding potential damages from the hazards.

ESTIMATED DAMAGES FROM HURRICANES

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

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

Table 32: Estimated Damages from Hurricanes

	100-year	500-year
Building Characteristics		
Estimated total number of buildings	13,981	
Estimated total building replacement value (2014 $)	$6,423,000,000	
Building Damages		
# of buildings sustaining minor damage	423	2,363
# of buildings sustaining moderate damage	43	457
# of buildings sustaining severe damage	2	29
# of buildings destroyed	0	10
Population Needs		
# of households displaced	0	51
# of people seeking public shelter	0	16
Debris		
Building debris generated (tons)	2,650	12,362
Tree debris generated (tons)	1,392	4,061
# of truckloads to clear building debris	106	494
Value of Damages (millions of dollars)		
Total property damage (buildings and contents)	$34.200	$140.562
Total losses due to business interruption	$1.529	$11380
TOTAL	**$35.73**	**$151.94**

ESTIMATED DAMAGES FROM EARTHQUAKES

The HAZUS earthquake module allows users to define a number of different types of earthquakes and to input a number of different parameters. The module is more useful where there is a great deal of data available on earthquakes. In New England, defining the parameters of a potential earthquake is much more difficult because there is little historical data. The HAZUS earthquake module does offer the user the opportunity to select a number of historical earthquakes that occurred in Massachusetts. For the purposes of this plan, two earthquakes were selected: a 1963 earthquake with a magnitude of 5.0 and an earthquake with a magnitude of 7.0.

Table 33: Estimated Damages from Earthquakes

	Magnitude 5.0	**Magnitude 7.0**
Building Characteristics		
Estimated total number of buildings	13,981	
Estimated total building replacement value (2014 $)	$6,423,000,000	
Building Damages		
# of buildings sustaining slight damage	4,037	389
# of buildings sustaining moderate damage	2,328	2,529
# of buildings sustaining extensive damage	720	3,678
# of buildings completely damaged	194	7,353
Population Needs		
# of households displaced	1,224	12,940
# of people seeking public shelter	558	5,936
Debris		
Building debris generated (tons)	155,000	1,204,000
# of truckloads to clear debris (@ 25 tons/truck)	6,200	48,160
Value of Damages (Millions of dollars)		
Total property damage (structures and contents)	$734.27	$5,579.51
Total losses due to business interruption	$123.35	$739.65
TOTAL	**$857.62**	**$6,319.16**

ESTIMATED DAMAGES FROM FLOODING

The HAZUS flooding module allows users model the potential damages caused by a 100-year flood event and a 500-year flood event.

Table 34: Estimated Damages from Flooding

	100-Year Flood	500-Year Flood
Building Characteristics		
Estimated total number of buildings	13,981	
Estimated total building replacement value (2014 $)	$6,423,000,000	
Building Damages		
# of buildings sustaining moderate damage	67	109
# of buildings sustaining extensive damage	9	32
# of buildings substantially damaged	1	13
Population Needs		
# of households displaced	235	1,177
# of people seeking public shelter	25	69
Value of Damages (Millions of dollars)		
Total building losses	$36.22	$65.50
Total losses due to business interruption	$66.15	$102.30
TOTAL	**$102.38**	**$167.80**

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SECTION 5: HAZARD MITIGATION GOALS

MAPC coordinated with the Local Hazard Mitigation Planning Team to review and discuss the goals from the 2012 Hazard Mitigation Plan for the Town of Arlington. All of the goals are considered critical for the Town and they are not listed in order of importance. Prior to this Hazard Mitigation Plan update process, in 2018 the Town of Arlington held a Municipal Vulnerability Preparedness workshop to plan for future climate change. The local team chose to update their mitigation goals by incorporating climate adaptation and resiliency considerations as noted in Goal 9.

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 Town to develop, review and implement the hazard mitigation plan.

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

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

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

9. Implement multi-benefit climate adaptation and resiliency solutions across town to mitigate hazards and improve resilience.

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SECTION 6: EXISTING MITIGATION MEASURES

The existing protections in the Town of Arlington are a combination of zoning, land use, and environmental regulations, infrastructure maintenance and infrastructure improvement projects. Infrastructure maintenance generally addresses localized drainage clogging problems while large scale capacity problems may require pipe replacement, invert elevation modifications, or large scale bridge improvements and replacements. These more expensive projects are subject to the capital budget process and lack of funding is one of the biggest obstacles to completion of some of the larger projects. The existing mitigation measures in the Town of Arlington are described below and summarized in Table 35 below.

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. The Town's CEMP should be put into the current format.

Communications Equipment – The Town has access to three Incident Command Units, mobile communications centers available to the town through the MA State Police, the MA Dept. of Fire Services, Middlesex County Sheriff's Office, and MEMA. The town is purchasing updated communications equipment for the Fire and Police Depts.

Emergency Power Generators – Emergency power generators can be found in the High School and the Gibbs building. Both of these are natural gas run generators to provide emergency lighting in the event of a power failure.

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

Local Emergency Management Planning Committee (LEPC) - Arlington has its own Local Emergency Planning Committee, and participates in a Regional Emergency Planning Committee.

EXISTING MITIGATION FOR FLOOD-RELATED HAZARDS

National Flood Insurance Program (NFIP) – Arlington participates in the NFIP with 533 policies in force as of the end of 2018. FEMA maintains a database on flood insurance policies and claims. This database can be found on the FEMA website at https://www.fema.gov/policy-claim-statistics-flood-insurance The following information is provided for the Town of Arlington:

Flood insurance policies in force (as of December 31, 2018)	533
Coverage amount of flood insurance policies	$133,935,000
Premiums paid	$370,540
Total losses (all losses submitted regardless of the status)	442
Closed losses	392
Open losses	0
CWOP losses	50
Total payments (Total amount paid on losses)	$1,894,080

The Town complies with the NFIP by enforcing floodplain regulations, maintaining up-to-date floodplain maps, and providing information to property owners and builders regarding floodplains and building requirements.

Street sweeping – All streets are swept at least once annually in the spring and approximately two thirds of the streets are swept a second time in the fall. The Town's street sweeping program will be modified due to the MS4 stormwater permit.

Catch basin cleaning – There are approximately 2,000 catch basins in the Town and they are cleaned out by municipal crews once every two years. The Town's street catch-basin cleaning program will be modified due to the MS4 stormwater permit, which requires catch basins to be cleaned when they are 50 percent full of sediments.

Roadway treatments – The Town uses road salt pre-whetted with Ice-Ban Magic.

Zoning Regulations – Zoning is intended to protect the public health and safety through the regulation of land use. The Arlington Zoning Bylaw includes a Floodplain District (Section 11.04). The objectives of this district are to promote:

1. The health and safety of the occupants of lands subject to seasonal or periodic flooding in the Mill Brook, Alewife Brook, Mystic River, and Mystic Lakes floodplain, as shown on the zoning overlay map of the Town of Arlington.
2. To prevent the reduction of the water-carrying capacity of streams, brooks, rivers, and drainage courses by prohibiting the destruction or alteration of their natural character, and by preventing encroachment by future development, both public and private, in the floodway. A floodway includes the normal channel of a river or stream and those portions of the floodplains adjoining the normal channel which are reasonably required to carry off the flood flow.
3. The preservation of the natural flood control characteristics and the water storage capacity of the floodplain.
4. To protect the public from hazard and loss through the regulation of future development of lands adjoining such watercourses.
5. The safety and purity of water; control and containment of sewage; safety of gas, electric, fuel, and other utilities from breaking, leaking, short-circuiting, grounding, igniting, electrocuting or any other dangers due to flooding.

The Floodplain District is an overlay district, defined by the 100-year floodplain as designated by FEMA. Within the District, by-right uses are limited to agricultural or park/recreational uses. An existing structure may be expanded to a limited extent. Other uses, as allowed in the underlying zoning district, may be allowed by Special Permit, providing that it can be

demonstrated that the proposed construction will not increase flood elevations by more than 1 inch and that the project complies with applicable wetland regulations.

The bylaw was updated and recodified (Sec. 11.04) to be consistent with the Town's more stringent Conservation Commission regulations.

Stormwater Bylaw – The Town of Arlington Stormwater By-Law (Article 15) requires that for any development of a previously undeveloped property with a proposed impervious area of greater than 500 square feet or for the redevelopment of a property in which the area of impervious surface will increase by more than 350 square feet there shall be no net increase in the surface water runoff rate relative to the predevelopment runoff rate. This bylaw will be updated to comply with the EPA MS4 stormwater regulations.

Environmental Design Review Regulation – Large scale, non-residential development or redevelopment as well as any proposed development in certain areas of the Town are subject to the Environmental Design Review Regulation administered by the Arlington Redevelopment Board. On these sites, special attention is given to surface water drainage to ensure that there is no adverse impact on neighboring properties or the public storm drainage system. The regulations encourage measures to prevent erosion, minimize impervious areas, and stormwater treatment. The regulations were updated to be consistent with the Conservation Commission and Department of Public Works requirements.

Wetlands Protection Bylaw - The Town of Arlington Wetlands Protection By-Law (Article 8) protects water resources, wetlands, and their adjoining land areas by controlling activities that might have a significant or cumulative impact on the recognized values of these resource areas, including their ability to serve as a flood control and storm damage prevention feature. Any activity that might fill or otherwise alter these resource areas requires a permit from the Arlington Conservation Commission, which is required to include conditions necessary to protect these recognized values. The adjoining land area under the protection of this by-law includes land within 100 feet of a pond or wetland and land within 200 feet of a river or stream.

DCR dam safety regulations – The state has enacted dam safety regulations mandating inspections and emergency action plans. All new dams are subject to state permitting.

Arlington Great Meadows – Arlington Great Meadows is a 183-acre natural resource conservation area owned by the Town of Arlington in the Town of Lexington, upstream on Mill Brook. Consisting of a rich mosaic of wetland and upland environments, Arlington completed a stewardship plan for the area in 2001. Amongst the numerous natural resource values identified with this property was its value in helping to control flooding downstream in Mill Brook. The report further states that development of the property could result in increased flooding in downstream areas.

Arlington Open Space and Recreation Plan (OSRP)- Arlington's OSRP identifies Elizabeth Island and the Mugar Land for acquisition as open space. Both properties are located in floodplain areas. The OSRP was updated in 2015.

ABC Flood Group – Arlington, Belmont, and Cambridge have formed a flood group out of a shared concern for the serious impact that surface flooding and sewage backflows have in each community. The group has a Joint Powers Agreement and meets on a bi-monthly basis.

EXISTING MITIGATION FOR WIND-RELATED HAZARDS

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

Tree-trimming program – The Town conducts its own tree maintenance and also uses its own equipment to trim and remove trees as needed and grind stumps. The utility company, Eversource, also conducts tree trimming along its transmission lines.

EXISTING MITIGATION FOR WINTER-RELATED HAZARDS

Snow disposal –The town conducts general snow removal operations with its own equipment. The Town currently has an agreement for a snow disposal site but is seeking a longer-term solution.

EXISTING MITIGATION FOR FIRE-RELATED HAZARDS

Outdoor Burning Not Permitted – Outdoor burning is not allowed in Arlington.

Development Review – The Fire Department participates in the review of new development projects on a case by case basis.

EXISTING MITIGATION FOR GEOLOGIC HAZARDS

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

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

Table 35: Arlington Existing Mitigation Measures			
Type of Existing Mitigation Measures	**Area Covered**	**Effectiveness/ Enforcement**	**Updates / Changes Needed**
MULTIPLE HAZARDS			
Comprehensive Emergency Management Plan (CEMP)	Town-wide	Emphasis is on emergency response.	Needs to be put into current CEMP format
Communications Equipment	Town-wide	Effective	The town is purchasing updated communications equipment for the Fire and Police Depts.
Massachusetts State Building Code	Town-wide	Effective for new construction.	New code expected in 2021
Emergency Power Generators	Town-wide	Effective.	Upgrade generators as needed; provide generators at additional locations (Thompson School, DPW).
Participation in the Local Emergency Planning Committee (LEPC)	Town-wide	A forum for inter-departmental cooperation on natural and manmade disasters.	Meets semi-annually; Town is also part of a Regional Emergency Planning Committee
FLOOD HAZARDS			
Participation in the National Flood Insurance Program (NFIP)	Areas identified on the FIRM maps.	There are 533 policies in force.	Encourage all eligible homeowners to obtain insurance.
Street sweeping	Town-wide	Effective.	Will be modified by the MS4 stormwater permit
Catch basin cleaning	Town-wide	Effective.	Will be modified by the MS4 stormwater permit
Roadway winter treatments	Town roads	Effective.	None.
Zoning – Floodplain District	Town-wide	Effective for new construction.	Updated and recodified (11.04)
Stormwater Bylaw	Town-wide	Effective for new construction.	
Environmental Design Review Regulation	Limited areas	Effective for new construction.	Improved standards, consistent with Conservation Comm. and DPW
Wetlands Protection Bylaw	Resource Areas	Effective	Regulations added, includes Cornell rainfall data
DCR Dam Safety Regulations	Dams	Effective	None.
Arlington Reservoir Dam	Mill Brook downstream	Effective.	Emergency Action Plan prepared for Arlington Reservoir Dan in 2013

Table 35 Arlington Existing Mitigation Measures			
Type of Existing Mitigation Measures	**Area Covered**	**Effectiveness/ Enforcement**	**Updates / Changes Needed**
Great Meadows	Mill Brook downstream	Effective	Ensure permanent protection from development.
Arlington OSRP	Proposed conservation areas	Effective if implemented.	OSRP was updated in 2015. Will be updated again before 2022.
ABC Flood Group	Arlington, Belmont, and Cambridge	Effective	Joint Powers Agreement, historically met for bi-monthly meetings, meetings are now quarterly.
WIND HAZARDS			
The Massachusetts State Building Code	Town-wide	Effective for most situations except severe storms	None.
Tree trimming program – Town and Utilities (Eversource)	Town-wide	Eversource trims trees every four years	More effective tree trimming program.
WINTER HAZARDS			
There are no specific measures beyond regular salting and sanding of the roads and local plowing.	Town-wide	Effective	Seek a permanent snow disposal site.
BRUSH FIRE HAZARDS			
Outdoor burning prohibited	Town-wide	Effective.	None.
Development Review	Town-wide	Effective.	None.
GEOLOGIC HAZARDS			
The Massachusetts State Building Code	Town-wide	Effective for most situations.	None.

MITIGATION CAPABILITIES AND LOCAL CAPACITY FOR IMPLEMENTATION

Under the Massachusetts system of "Home Rule," the Town of Arlington is authorized to adopt and from time to time amend several local bylaws and regulations that support the Town's capabilities to mitigate natural hazards. These include the Zoning Bylaw, Stormwater Bylaw, Subdivision and Site Plan Review Regulations, Wetlands Regulations, Health Regulations, Public Works regulations, and local enforcement of the State Building Code. Local bylaws may be amended by the Town Meeting to improve the Town's capabilities, and changes to most regulations simply require a public hearing and a vote of the authorized board or commission. The Town of Arlington has recognized several existing mitigation measures that require implementation or improvements,

and has the capacity based on these Home Rule powers within its local boards and departments to address these.

Several Town departments including Public Works will address planned infrastructure projects. The Department of Public Works will collaborate with state agencies (DCR, MWRA) on dam management issues. Finally, efforts to improve emergency communications will be a collaborative effort among the Fire, Police, and Public Works Departments.

SECTION 7: MITIGATION MEASURES FROM PREVIOUS PLAN

IMPLEMENTATION PROGRESS ON THE PREVIOUS PLAN

At a meeting of the Arlington Local Hazard Mitigation Team, town staff reviewed the mitigation measures recommended in the 2012 Arlington Hazard Mitigation Plan and determined whether each measure had been implemented or not. Of those measures that had not yet been implemented, the local team evaluated whether or not the measure remained relevant and should be carried forward into this Hazard Mitigation Plan 2020 Update. The decision on whether to retain or delete a particular mitigation measure was based on the local team's assessment of the continued relevance or effectiveness of the measure and whether the deferral of action on the measure was due to the inability of the Town to take action on the measure since the previous plan. Table 36 summarizes the status of the 2012 plan's mitigation measures, and the local team's recommendations to include them in the 2020 plan update.

Table 36: Status of Mitigation Measures from the 2012 Plan

Mitigation Area/Topic	Hazard Type	Mitigation Recommended in the 2012 Plan	Priority In 2012 Plan	2020 Status Completed, In Progress, or Not Completed	Include in 2020 Plan?
A) Minuteman Bikeway	Flooding	Reconstruct or improve to withstand flooding (Mill Brook localized drainage, low lying area)	High	In progress	YES
B) East Arlington / Alewife	Flooding	Acquire open space for conservation (Public/Private)	High	In Progress	NO
C) Mill Brook Corridor	Flooding	Address flooding at Colonial Village	High	Not completed	YES
D) Alewife Brook Corridor	Flooding	Address flooding at Sunnyside Avenue	High	Not completed	YES
E) Eliminate Sanitary Sewer Overflows	Flooding	Implement program to eliminate SSOs	High	In progress	YES
F) Town-wide	Multi-hazard	Purchase mobile, long-running generators and/or install fixed, multi-fuel generators in designated emergency shelters	High	Completed	NO
G) Town-wide	Multi-hazard	Purchase hand-held GPS units and mobile radio communications equipment	High	Change: enable emergency cell phones for Health Dept.	NO
H) Town-wide	Multi-hazard	Upgrade all generators as needed; provide alternative fuel sources for generators	High	In Progress - Thermal heat for High School	YES

Mitigation Area/Topic	Hazard Type	Mitigation Recommended in the 2012 Plan	Priority In 2012 Plan	2020 Status Completed, In Progress, or Not Completed	Include in 2020 Plan?
I) Land Protection	Flooding	Acquire priority open space parcels for many uses including maintaining flood storage and water infiltration capacity.	High	In progress	YES
J) FIRM mapping and bylaws	Flooding	Update the town's zoning floodplain overlay map consistent with the FEMA Flood Information Rate Maps (FIRM).	High	In progress / Map update for new FIRM Maps	YES
K) Forest & Brattle Streets	Flooding	Install pumps to remove flood water in low areas of the road.	Medium	Not completed	YES
L) East Arlington / Alewife & Sunnyside Ave	Flooding	Program to acquire or elevate homes (for homes still experiencing flooding after other measures have been implemented).	Medium	Not completed	NO
M) Grove Street	Flooding	Renovate DPW building and create flood water storage.	Medium	In progress / redesigning	YES
N) Garden Street	Flooding	Acquire or elevate homes.	Medium	Not completed	NO
O) Town-wide Flooding, Drainage Infrastructure	Flooding	Dedicate more resources for more frequent maintenance of town-owned drainage facilities, such as more frequent removal of sediment.	Medium	In progress / MS4 Permit requirements for cleaning catch basins	YES
P) Flooding, Drainage Infrastructure	Flooding	Follow-up on studies identified in the 2004 Tri-Community Working Group Report.	Medium	Not completed	NO
Q) Town-wide: Flooding, Drainage Infrastructure	Flooding	Study groundwater sourced flooding	Medium	Not completed town researched historic maps of impacted areas	NO
R) Town-wide: Flooding, Drainage Infrastructure	Flooding	Study feasibility of creating stormwater utility	Medium	Not completed	YES
S) Town-wide: Flooding, Drainage Infrastructure	Flooding	Create, based on existing data, a web-based GIS wetlands mapping capacity.	Medium	Completed	NO
T) Town-wide: Flooding,	Flooding	Develop greater emergency flood preparation and	Medium	Completed	NO

Mitigation Area/Topic	Hazard Type	Mitigation Recommended in the 2012 Plan	Priority In 2012 Plan	2020 Status Completed, In Progress, or Not Completed	Include in 2020 Plan?
Drainage Infrastructure		emergency response capacity.			
U) Town-wide: High Winds and Hurricanes	Wind Hazards	Increase available funds for tree maintenance program.	Medium	In Progress	YES
V) Town-wide: Earthquakes	Geologic Hazards	Investigate options to make all public buildings earthquake resistant.	Medium	In progress / All but one Town building meets current Building Code	YES
W) Town-wide	Winter Storms	Identify a new snow dumping location.	Medium	Interim solution completed; need to procure long-term option	YES
X) Drainage Infrastructure	Flooding	Complete locating of all storm drains and catch basins into town GIS data base.	Low	Completed	NO
Y) Town-wide: Stormwater and Erosion Control Outreach and Education	Flooding	Develop a stronger wetland, erosion control, and stormwater education outreach program for town residents and builders	Low	In progress / MS 4 Permit requirements for Public Education	YES

The Town of Arlington has made some progress on achieving mitigation actions from the 2012 plan. Several recommended measures have been completed, including locating and mapping all storm drains, identifying an interim snow dumping location, developing greater flood preparations, and developing a GIS-based wetlands mapping capacity. Several others are in progress, including improvements to Minuteman Bikeway, open space acquisitions, program to eliminate SSOs, generators at the High School and Gibbs Building, relocation of the DPW building, increased sediment removal from catch basins, and increased resources for tree trimming.

Policy, programmatic areas, and plans that incorporated hazard mitigation priority achievements since the 2012 plan include: the completion of a Municipal Vulnerability Preparedness project in 2018, revisions to zoning bylaw and wetlands regulations in 2019, preparation of a detailed hydrologic and hydraulic assessment of flooding in the Mill Brook and evaluation of mitigation options, preparation of an Emergency Action Plan (EAP) for the Arlington Reservoir Dam in 2013, and an updated Open Space and Recreation Plan in 2015. The Town will also draw on the 2019 Hazard Mitigation Plan update as part of its strategy to establish new climate resilience priorities and natural hazard safety planning going forward.

Moving forward into the next five-year plan implementation period there will be many more opportunities to incorporate hazard mitigation into the Town's decision-making processes. The challenges the Town faces in implementing these measures are primarily due to limited funding and available staff time. This plan should help the Town prioritize the best use of its limited resources for enhanced mitigation of natural hazards.

SECTION 8: 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.

https://www.fema.gov/hazard-mitigation-grant-program
https://www.fema.gov/pre-disaster-mitigation-grant-program
https://www.fema.gov/flood-mitigation-assistance-grant-program

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)

PROCESS FOR SETTING PRIORITIES FOR MITIGATION MEASURES

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

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

Table 37 demonstrates the prioritization of the Town's recommended hazard mitigation measures. For each mitigation measure, the geographic extent of the potential benefiting area is identified as is an estimate of the overall benefit and cost of the measures. The benefits, costs, and overall priority were evaluated in terms of the following factors:

Estimated Benefits	
High	Action will result in a significant reduction of hazard risk to people and/or property from a hazard event
Medium	Action will likely result in a moderate reduction of hazard risk to people and/or property from a hazard event
Low	Action will result in a low reduction of hazard risk to people and/or property from a hazard event
Estimated Costs	
High	Estimated costs greater than $250,000
Medium	Estimated costs between $50,000 to $250,000
Low	Estimated costs less than $50,000 and/or staff time
Priority	
High	Action very likely to have political and public support and necessary maintenance can occur following the project, and the costs seem reasonable considering likely benefits from the measure
Medium	Action may have political and public support and necessary maintenance has potential to occur following the project
Low	Not clear if action has political and public support and not certain that necessary maintenance can occur following the project

Table 37: Mitigation Strategy Prioritization

Mitigation Area/Topic	Mitigation Measure	Geographic Coverage	Estimated Benefit	Estimated Cost	Priority
FLOODING HAZARDS					
A) Minuteman Bikeway	Reconstruct or improve to withstand flooding (Mill Brook localized drainage, low lying area).	Minuteman Path	High	High	High
C) Mill Brook Corridor	Address flooding at Colonial Village.	Mill Brook corridor	High	High	High
D) Alewife Brook Corridor	Address flooding at Sunnyside Avenue.	Alewife Bk. corridor	High	High	High
E) Sanitary Sewer Overflows (SSOs)	Implement program to eliminate Sanitary Sewer Overflows.	Town-wide	High	High	High
I) Land Protection	Acquire priority open space parcels for many uses including maintaining flood storage and water infiltration capacity and for conservation.	Town-wide	Medium	High	Medium
J) FIRM mapping and bylaws	Update the town's zoning floodplain overlay map consistent with the FEMA Flood Information Rate Maps (FIRM).	Town-wide	Medium	Low	Low
K) Forest & Brattle Streets	Install pumps to remove flood water in low areas of the road.	Forest & Brattle Streets	High	High	High
M) Grove Street	Renovate DPW building and IT Data Center and create flood water storage.	Grove Street	Medium	High	Medium
O) Town-wide Flooding, Drainage	Dedicate more resources for more frequent maintenance of town-owned drainage facilities, such as more frequent removal of sediment.	Town-wide	Medium	High	Medium
R) Town-wide: Flooding, Drainage	Study feasibility of creating stormwater utility.	Town-wide	Medium	Medium	Medium

Mitigation Area/Topic	Mitigation Measure	Geographic Coverage	Estimated Benefit	Estimated Cost	Priority
Y) Town-wide: Stormwater Outreach and Education	Develop a stronger wetlands, erosion control, and stormwater education outreach program for town residents and builders.	Town-wide	Medium	Low	Medium
Z) Town-wide Flooding, Drainage	Develop a public/private partnership to facilitate drainage improvements, including "green" and "grey" infrastructure solutions and adjacent public lands/parks.	Town-wide	High	High	High
WIND HAZARDS					
U) Town-wide: High Winds and Hurricanes	Conduct a street tree inventory and Increase available funds for tree maintenance; coordinate with utilities.	Town-wide	Medium	Medium	Medium
GEOLOGIC HAZARDS					
V) Town-wide: Earthquakes	Investigate options to make all public buildings earthquake resistant.	Town-wide	Low	Low	Low
WINTER HAZARDS					
W) Town-wide	Identify a new permanent snow dumping location.	Town-wide	High	High	High
AA)Town-wide Public Buildings	Identify pubic buildings that may be vulnerable to snow loads and conduct a structural assessment if needed.	Town-wide	Medium	Low	Medium
WILDFIRE HAZARDS					
BB) Town-wide	Provide public information about brushfire hazards and preventative measures.	Town-wide	Low	Low	Medium
DROUGHT HAZARDS					
CC)Town-wide	Adopt guidelines for new development and town properties to promote drought-tolerant landscaping and site design.	Town-wide	Medium	Low	Medium

Mitigation Area/Topic	Mitigation Measure	Geographic Coverage	Estimated Benefit	Estimated Cost	Priority
EXTREME TEMPERATURES					
DD)Town-wide	Enhance public awareness on the risks of extreme temperatures and resources available to residents.	Town-wide	Medium	Low	Medium
MULTI-HAZARDS					
H) Town-wide	Upgrade all generators as needed; provide alternative fuel sources for generators.	Town-wide	Medium	Low	Medium

RECOMMENDED MITIGATION STRATEGY

INTRODUCTION TO RECOMMENDED MITIGATION STRATEGY - TABLE 38

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

Priority – The designation of high, medium, or low priority was done at the meeting of the Local Hazard Mitigation Team as described above and shown in Table 37. The designations reflect discussion and a consensus developed at the meeting but could change in the future as conditions in the community change. In determining project priorities, the local team considered potential benefits and project costs.

Implementation Responsibility – The designation of implementation responsibility was determined by the Local Hazard Mitigation Team based on a general knowledge of what each municipal department is responsible for. It is likely that some 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. 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 examples. http://www.rurdev.usda.gov/rd/newsroom/2002/cfg.html

Abbreviations Used in Table 38

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

ACOE = Army Corps of Engineers.
CPA = Community Preservation Act
MADOT = Massachusetts Department of Transportation
DCR = Department of Conservation and Recreation
DHS/EOPS = Department of Homeland Security/Emergency Operations
EPA/DEP = Environmental Protection Agency/Department of Environmental Protection
SRF = State Revolving Fund (Water & Wastewater)
USDA = United States Department of Agriculture

Table 38. Arlington Recommended Mitigation Measures						
Mitigation Area/Topic	**Mitigation Measure**	**Priority**	**Implementation Responsibility**	**Time Frame**	**Estimated Cost**	**Potential Funding Sources**
FLOODING HAZARDS						
A) Minuteman Bikeway	Reconstruct or improve to withstand flooding (Mill Brook localized drainage, low lying area)	High	DPW	2020-23	High	Arlington General Fund/CPA/FEMA
C) Mill Brook Corridor	Address flooding at Colonial Village	High	Planning & Community Development DPW	2021-24	High	Arlington General Fund/FEMA
D) Alewife Brook Corridor	Address flooding at Sunnyside Avenue	High	Planning & Community Development DPW	2021-24	High	Arlington General Fund/FEMA
E) Sanitary Sewer Overflows (SSOs)	Implement program to eliminate Sanitary Sewer Overflows	High	DPW	2020-25	High	Arlington General Fund/SRF/FEMA
I) Land Protection	Acquire open space parcels for multiple uses, including maintaining flood storage and water infiltration capacity and for conservation.	Medium	Planning & Community Development	2020-25	High	Arlington General Fund/CPA
J) FIRM mapping and bylaws	Update the town's zoning overlay map consistent with the FEMA Flood Information Rate Maps (FIRM).	Low	GIS/ Planning & Community Development	2020-21	Low	N/A

Table 38. Arlington Recommended Mitigation Measures						
Mitigation Area/Topic	**Mitigation Measure**	**Priority**	**Implementation Responsibility**	**Time Frame**	**Estimated Cost**	**Potential Funding Sources**
K) Forest & Brattle Streets	Install pumps to remove flood water in low areas of the road.	High	DPW	2020-25	High	Arlington General Fund/FEMA
M) Grove Street	Renovate DPW building and IT Data Center and create flood water storage.	Medium	DPW	2020-23	High	Arlington Capital Fund
O) Town-wide Flooding, Drainage	Dedicate more resources for more frequent maintenance of town-owned drainage facilities, such as more frequent removal of sediment.	Medium	DPW	2020-25	High	Arlington General Fund/Stormwater Budget
R) Town-wide: Flooding, Drainage	Study feasibility of creating stormwater utility.	Medium	DPW	2020-22	Medium	Arlington General Fund/MVP/ MAPC Technical Assistance
Y) Town-wide: Stormwater Outreach and Education	Develop a stronger wetland, erosion control, and stormwater education outreach program for town residents and builders.	Medium	Planning & Community Development DPW	2020-23	Low	Arlington General Fund
Z) Town-wide Flooding, Drainage	Develop a public/private partnership to facilitate drainage improvements, including “green” and “grey” infrastructure solutions and adjacent public lands/parks.	High	Planning & Community Development DPW	2020-25	High	Arlington General Fund/MVP

Mitigation Area/Topic	Mitigation Measure	Priority	Implementation Responsibility	Time Frame	Estimated Cost	Potential Funding Sources
WIND HAZARDS						
U) Town-wide: High Winds and Hurricanes	Conduct a street tree inventory and Increase available funds for tree maintenance; coordinate with utilities.	Medium	DPW/Tree Warden	2020-25	Medium	Arlington General Fund
GEOLOGIC HAZARDS						
V) Town-wide: Earthquakes	Investigate options to make all public buildings earthquake resistant.	Low	Inspectional Services / Facilities	2022-24	Low	Arlington General Fund
WINTER HAZARDS						
W) Town-wide	Identify a new snow permanent dumping location.	Medium	DPW	2020-23	High	Arlington General Fund
AA) Town-wide Public Buildings	Identify pubic buildings that may be vulnerable to snow loads and conduct a structural assessment if needed.	Medium	Facilities	2020-23	Low	Arlington General Fund / MII
WILDFIRE HAZARDS						
BB) Town-wide	Provide public information about brushfire hazards and preventative measures.	Medium	Fire Dept.	2020-23	Low	Arlington General Fund
DROUGHT						
CC) Town-wide	Adopt guidelines for new development and town properties to promote.	Medium	Redevelop-ment Board	2020-23	Low	Arlington General Fund

Hazard Area	Mitigation Measure	Priority	Implementation Responsibility	Time Frame	Estimated Cost	Potential Funding Sources
	drought-tolerant landscaping and site design.					
EXTREME TEMPERATURES						
DD) Town-wide	Enhance public awareness on the risks of extreme temperatures and resources available to residents.	Medium	Public Information Officer/ Police/Fire	2020-23	Low	Arlington General Fund
MULTI-HAZARDS						
H) Town-wide	Upgrade all generators as needed; provide alternative fuel sources for generators.	Medium	Police/Fire/DPW Facilities	2020-23	Low	Arlington General Fund/FEMA

REGIONAL AND INTER-COMMUNITY CONSIDERATIONS

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

REGIONAL PARTNERS

In 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 Town of Arlington, the Department of Conservation and Recreation (DCR), the Massachusetts Water Resources Authority (MWRA), Massachusetts Department of Transportation (MassDOT), the Massachusetts Bay Transportation Authority (MBTA), the Mystic River Watershed Association, and the Charles River Watershed Associations. 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.

Examples of regional facilities in Arlington include:

- ☐ State Routes 2, 2A, 3 and 60
- ☐ Alewife Brook Parkway, Route 16
- ☐ Mystic Valley Parkway
- ☐ MBTA Bus Routes 77 and 79
- ☐ Upper Mystic Lake Dam (DCR)
- ☐ MassDOT District 4 Headquarters

INTER-COMMUNITY CONSIDERATIONS

Alewife Brook

The nature of the Alewife Brook basin has characteristics that make the area prone to flooding even before the introduction of an urbanized environment with large amounts of impervious surfaces and drainage systems. Urbanization of this environment has therefore only exacerbated these issues, with the result that there are significant amounts of flooding from the Alewife Brook and its tributaries, particularly in portions of Cambridge and Arlington. In an attempt to collectively understand and begin to address this issue, Arlington, Belmont, and Cambridge have together formed the ABC Flood Group, (originally the Tri-Community Flood Group), which issued a report in 2004.

The report identifies several topics for future study. Among those is analysis of the effects of the relatively low bridges over the brook and how these may constrain floodwaters leading to greater flooding. The working group could also consider developing a shared set of low-impact design (LID) standards targeting stormwater controls for development projects in the respective communities and a shared outreach program encouraging property owners to take greater steps to retain stormwater on their properties, thereby keeping some portion of the stormwater out of the conveyance system and potentially reducing flooding in the brook. There are a number of other potential projects that would benefit all three communities that could be explored through this working group.

While the report indicates that the Amelia Earhart Dam on the Mystic River has sufficient pumping capacity to ensure that floodwaters are conveyed downstream, since the report's publication there is consensus that a fourth pump is critical to addressing flooding in the Alewife Brook area as larger storms in recent years have led to more numerous flooding events. This will become more important as climate change continues to drive more intense rainfall events, as well as rising sea levels and potentially higher storm surges.

Groundwater Sourced Flooding

A number of communities in this part of the region experience a relatively high incidence of groundwater sourced flooding in basements including Arlington, Belmont, and Watertown. This flooding appears to be linked to high water tables created by clay layers in the soil. Areas that flood appear to be scattered across these communities and in each of the above towns, local staff indicated that they did not have an accurate way to predict exactly where or when basement flooding might occur. These communities might benefit from sharing the cost of investigating the causes of this flooding, mapping the most likely areas impacted, and developing awareness programs for property owners.

NEW DEVELOPMENT AND INFRASTRUCTURE

As part of the process of developing recommendations for new mitigation measures for this plan update, the Town considered the issues related to new development, redevelopment, and infrastructure needs in order limit future risks. Those efforts include the Wetlands regulations that were recently adopted, the updated and recodified Zoning Bylaw, and the Municipal Vulnerability Preparedness plan completed in 2018 and the Municipal Vulnerability Preparedness project at Wellington Park completed in 2019.

SECTION 9: PLAN ADOPTION & MAINTENANCE

PLAN ADOPTION AND APPROVAL

The Arlington Hazard Mitigation Plan was adopted by the Select Board on [ADD DATE]. See Appendix D for documentation. The plan was approved by FEMA on [ADD DATE] for a five-year period that will expire on [ADD DATE]. See Appendix E for documentation of plan approval.

PLAN MAINTENANCE

Although many of the mitigation measures from the Town's previous 2012 Hazard Mitigation Plan have been implemented, since that plan was adopted there has not been an ongoing local process to guide implementation of the plan. Such a process is needed over the next five years for the implementation of this plan update and will be structured as described below.

MAPC worked with the Arlington Hazard Mitigation Team to prepare this plan. This group will continue to meet on an as-needed basis to coordinate the implementation and maintenance of this plan, with the Environmental Planner designated as the team coordinator. Additional members could be added to the local team from businesses, non-profits and institutions. The Town will encourage public participation during the next 5-year planning cycle. As updates and a review of the plan are conducted by the Hazard Mitigation Team, these will be placed on the Town's web site, and any meetings of the Hazard Mitigation Team will be publicly noticed in accordance with town and state open meeting laws.

IMPLEMENTATION AND EVALUATION SCHEDULE

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

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

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

The Hazard Mitigation Implementation Team will use the information from the Mid-Term progress review to identify the needs and priorities for the plan update and seek funding for the plan update process. Potential sources of funding may include FEMA Pre-Disaster Mitigation grants and

the Hazard Mitigation Grant Program. Both grant programs can pay for 75% of a planning project, with a 25% local cost share required.

Prepare and Adopt an Updated Local Hazard Mitigation Plan – Once the resources have been secured to update the plan, the Hazard Mitigation 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 Town will need to review the current FEMA hazard mitigation plan guidelines at that time for any changes in requirements for hazard mitigation plans since the previous plan. Once the next plan update is prepared, the Town will submit it to MEMA and FEMA for review and approval, and adopt the plan update in order to obtain formal FEMA approval of the plan.

INTEGRATION OF THE PLAN WITH OTHER PLANNING PROCESSES

Upon approval of the Arlington 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. At a minimum, the plan will be reviewed and discussed with the following departments:

- ☐ Fire / Emergency Management
- ☐ Police
- ☐ Public Works / Highway
- ☐ Engineering
- ☐ Planning and Community Development
- ☐ Conservation
- ☐ Parks and Recreation
- ☐ Health and Human Services
- ☐ Inspectional Services

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

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

SECTION 10: LIST OF REFERENCES

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

Town of Arlington, Zoning Bylaw

Town of Arlington, Bylaws, Storm Water Mitigation Town

of Arlington *Open Space and Recreation Plan,* 2015

Town of Arlington Municipal Vulnerability Preparedness report, 2018

Town of Arlington Housing Production Plan, 2016

Town of Arlington, *Natural Resource Inventory & Stewardship Plan of Arlington's Great Meadows in Lexington*, July 2001.

Cambridge Climate Vulnerability Assessment. Part 1. April 2017

Center for Disease Control and Prevention, *Natural Disasters and Severe Weather*

FEMA, *Local Mitigation Plan Review Guide*, October 2011

FEMA, Flood Insurance Rate Maps for Middlesex County, MA, 2014

Gamble, J. L., Hurley, B. J., Schultz, P. A., Jaglom, W. S., Krishnan, N., & Harris, M., *Climate Change and Older Americans,* 2014

MA EOEEA and MEMA, *State Hazard Mitigation and Climate Adaptation Plan*, 2018

MEMA, *Massachusetts State Hazard Mitigation Plan*, 2013

Metropolitan Area Planning Council, GIS Lab, Regional Plans and Data.

Northeast Climate Center UMass Amherst. Mass. Climate Change Projections, 2017

Northeast Wildfire Risk Assessment Geospatial Work Group,

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

NOAA National Environmental Information Center

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

USGCRP, I*mpacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment*, 2018

USGS, National Water Information System, http://nwis.waterdata.usgs.gov/usa/nwis

USGS, *Landslide Types and Processes*. Fact Sheet 2003-3072

US Census, 2010 and American Community Survey 2017 5-Year Estimates

Weston and Sampson, *Mill Brook Evaluation*, 2014

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APPENDIX A: 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 eight panels displaying the following information:

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

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

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

Map 3: Flood Zones – The map of flood zones used the FEMA NFIP Flood Zones for Middlesex County as its source. 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

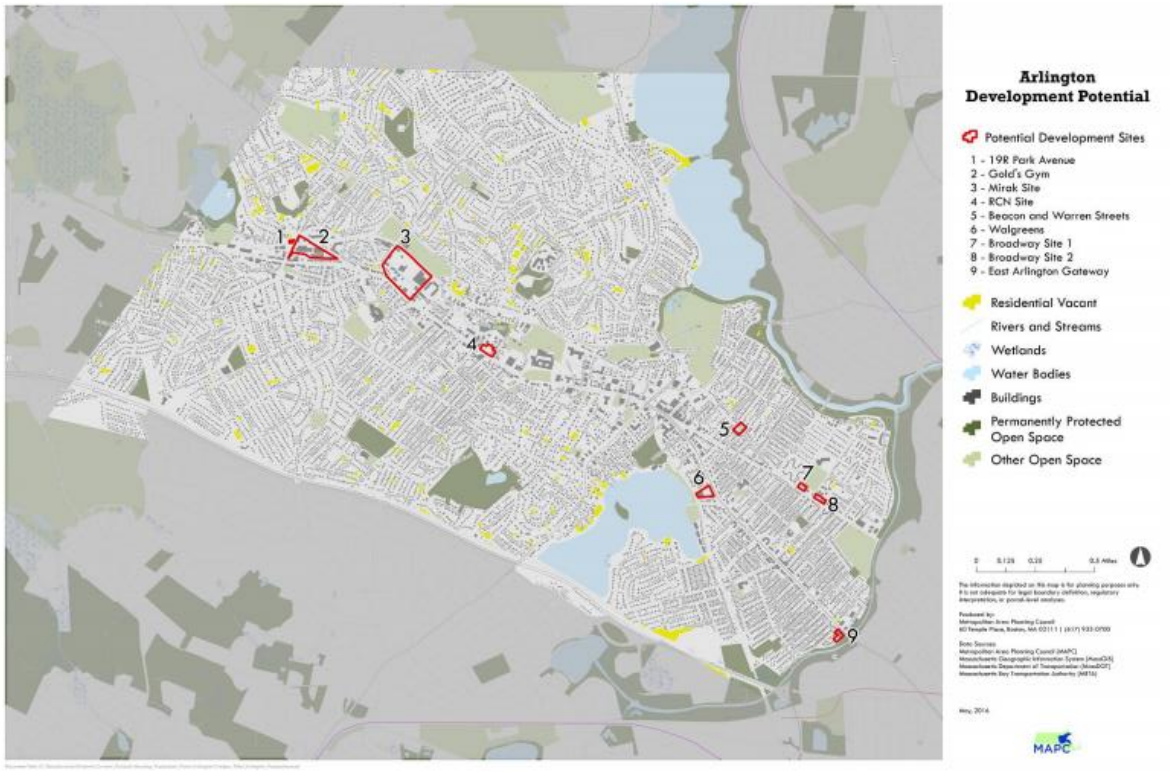
not within that community. This map also shows the location of tornadoes with a classification as to the level of damages. What appears on the map varies by community since not all communities experience the same wind-related events. These maps also show the 100 year wind speed.

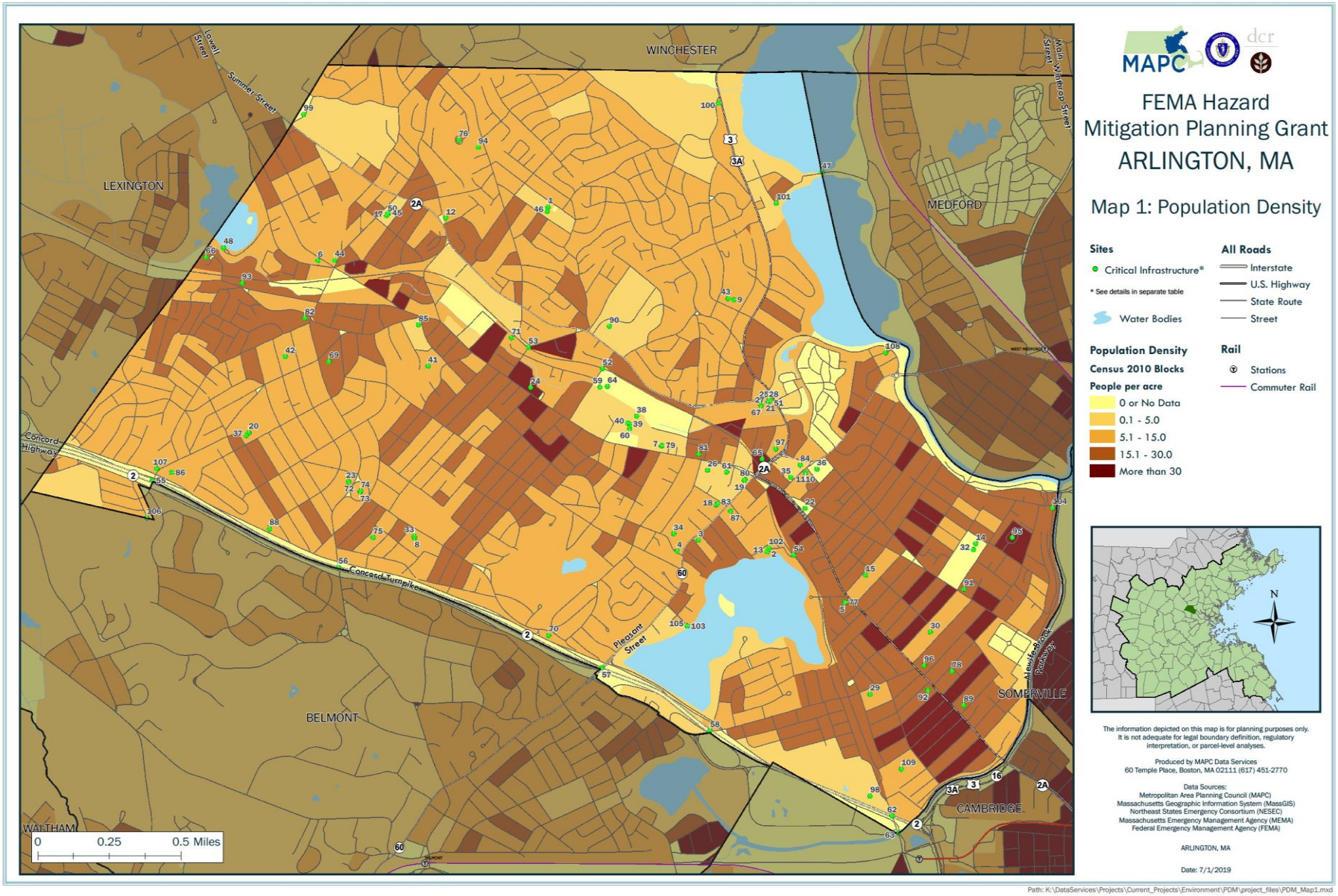
Map 6: Average Snowfall - - This map shows the average snowfall and open space. It also shows storm tracks for nor'easters, if any storms tracked through the community.

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.

Map 9: Extreme Heat- MAPC uses LANDSAT 30m spatial resolution satellite data to extract land surface temperature to assess a community's exposure to present-day extreme heat and any vulnerabilities to rising temperatures with climate change. The extreme heat analysis uses date from 2016 with satellite images on days of 90° or higher at Logan Airport, July 13 and August 30, 2016 and created land surface temperature using a methodology development by Walawender, Hajto, and Iwaniuk (2012) called Landsat TRS Tools. This map illustrates the hottest areas in the top fifth percentile for the 101 towns in Metropolitan Boston.


Arlington
Development Potential
Potential Development Sites
1 - 19R Park Avenue
2 - Gold's Gym
3 - Mirak Site
4 - RCN Site
5 - Beacon and Warren Streets
6 - Walgreens
7 - Broadway Site 1
8 - Broadway Site 2
9 - East Arlington Gateway
Residential Vacant
Rivers and Streams
Wetlands
Water Bodies
Buildings
Permanently Protected Open Space
Other Open Space
MAPC


FEMA Hazard
Mitigation Planning Grant
ARLINGTON, MA
Map 1: Population Density
Sites
Critical Infrastructure*
* See details in separate table
Water Bodies
All Roads
Interstate
U.S. Highway
State Route
Street
Population Density
Census 2010 Blocks
People per acre
0 or No Data
0.1 - 5.0
5.1 - 15.0
15.1 - 30.0
More than 30
Rail
Stations
Commuter Rail
WINCHESTER
LEXINGTON
MEDFORD
BELMONT
SOMERVILLE
CAMBRIDGE
WALTHAM
Concord Turnpike
Pleasant Street
Alewife Brook Parkway
Concord Highway
Lowell Street
Summer Street
Main Street/Winthop Street
0 0.25 0.5 Miles
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analyses.
Produced by MAPC Data Services
60 Temple Place, Boston, MA 02111 (617) 451-2770
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
ARLINGTON, MA
Date: 7/1/2019
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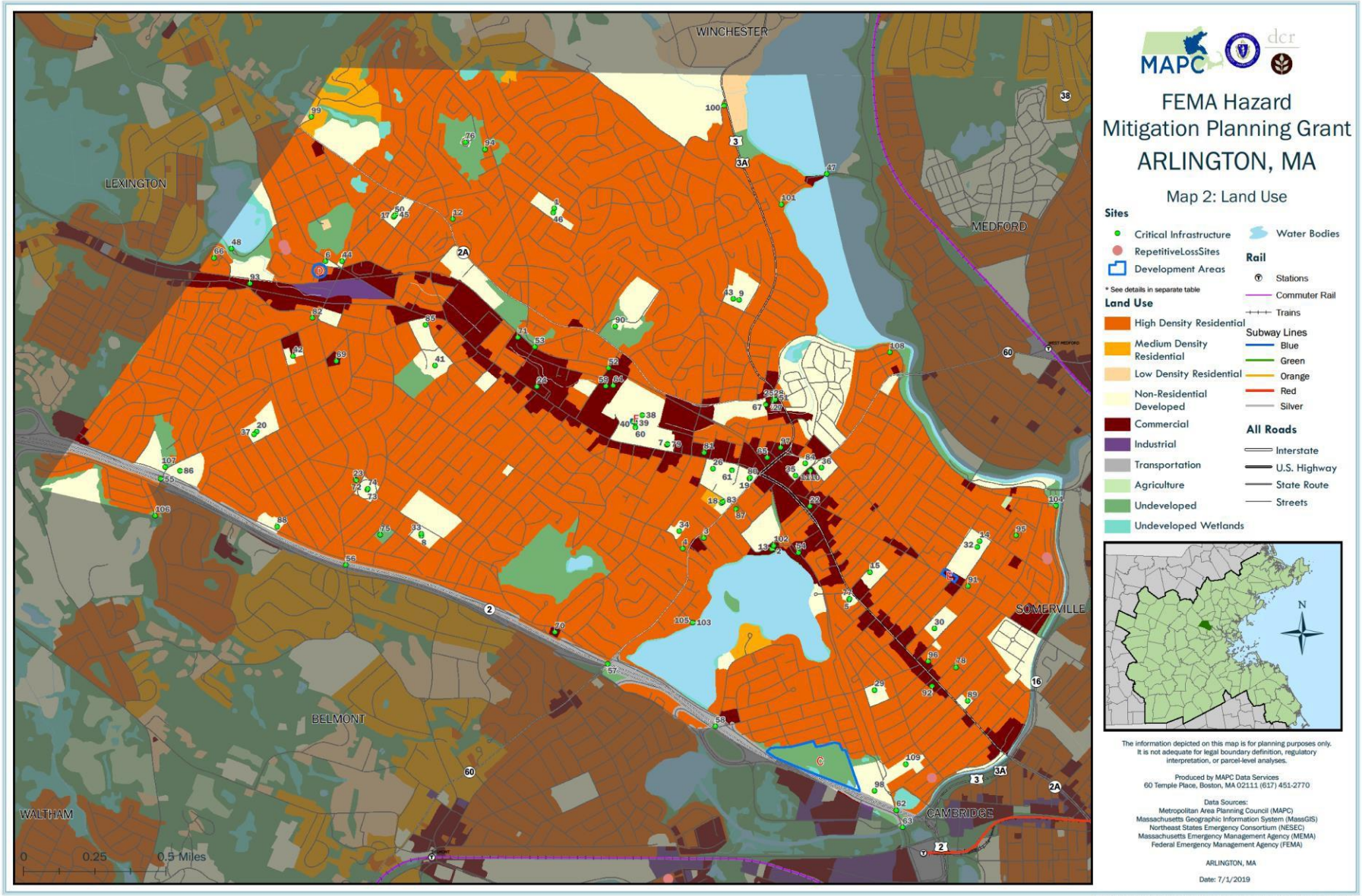
WINCHESTER
LEXINGTON
MEDFORD
SOMERVILLE
BELMONT
WALTHAM
CAMBRIDGE
0
0.25
0.5 Miles
MAPC
dcr
FEMA Hazard Mitigation Planning Grant
ARLINGTON, MA
Map 2: Land Use
Sites
Critical Infrastructure
RepetitiveLossSites
Development Areas
* See details in separate table
Land Use
High Density Residential
Medium Density Residential
Low Density Residential
Non-Residential Developed
Commercial
Industrial
Transportation
Agriculture
Undeveloped
Undeveloped Wetlands
Water Bodies
Rail
Stations
Commuter Rail
Trains
Subway Lines
Blue
Green
Orange
Red
Silver
All Roads
Interstate
U.S. Highway
State Route
Streets
N
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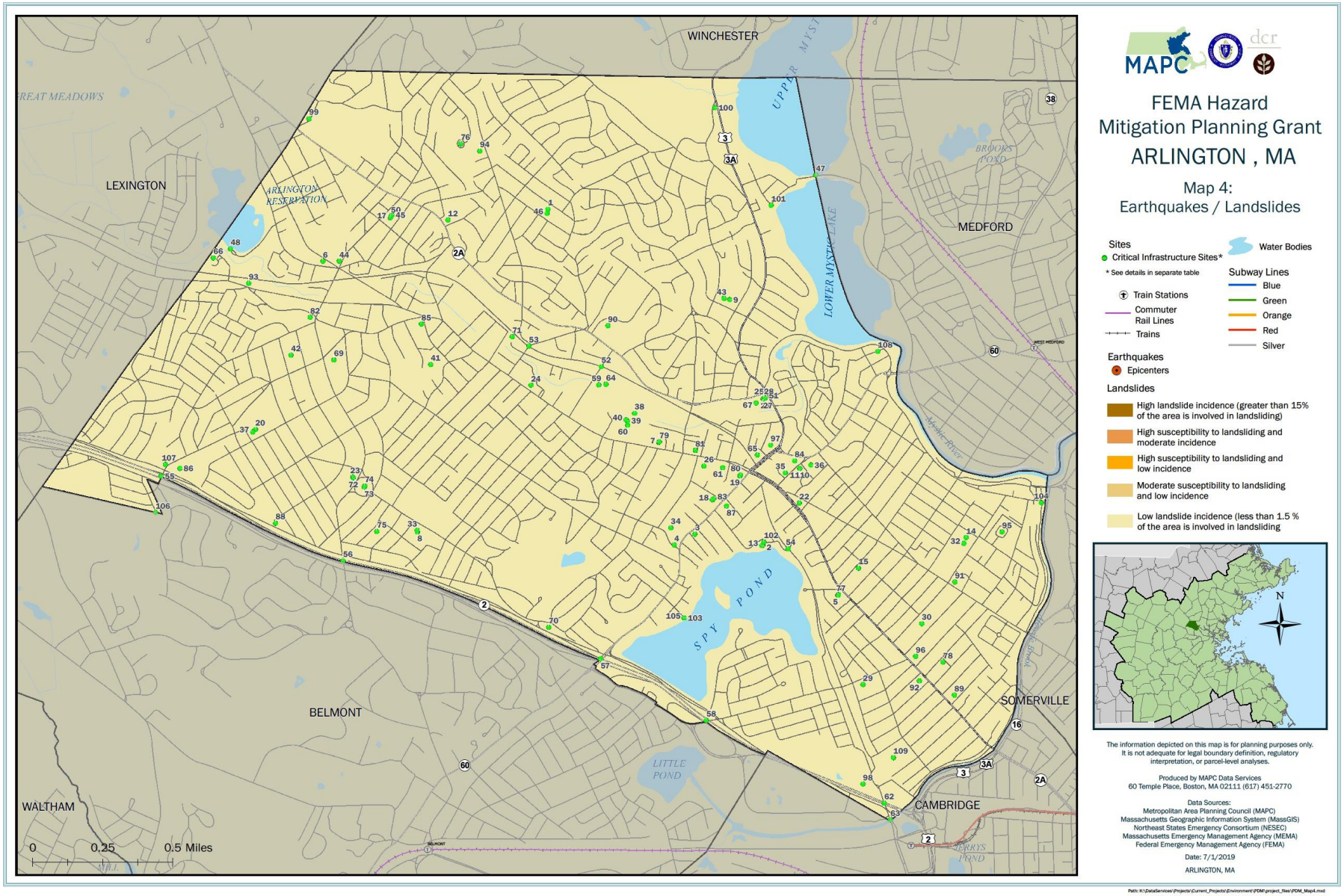
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
ARLINGTON, MA
Date: 7/1/2019


WINCHESTER
LEXINGTON
MEDFORD
BELMONT
WALTHAM
SOMERVILLE
CAMBRIDGE
REAT MEADOWS
ARLINGTON RESERVATION
UPPER MYSTIC LAKE
LOWER MYSTIC LAKE
BROOKS POND
SPY POND
LITTLE POND
PERRYS POND
Mystic River
Malden River
0
0.25
0.5 Miles
MAPC
dcr
FEMA Hazard Mitigation Planning Grant
ARLINGTON , MA
Map 4:
Earthquakes / Landslides
Sites
Critical Infrastructure Sites*
* See details in separate table
Train Stations
Commuter Rail Lines
Trains
Water Bodies
Subway Lines
Blue
Green
Orange
Red
Silver
Earthquakes
Epicenters
Landslides
High landslide incidence (greater than 15% of the area is involved in landsliding)
High susceptibility to landsliding and moderate incidence
High susceptibility to landsliding and low incidence
Moderate susceptibility to landsliding and low incidence
Low landslide incidence (less than 1.5 % of the area is involved in landsliding
N
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analyses.
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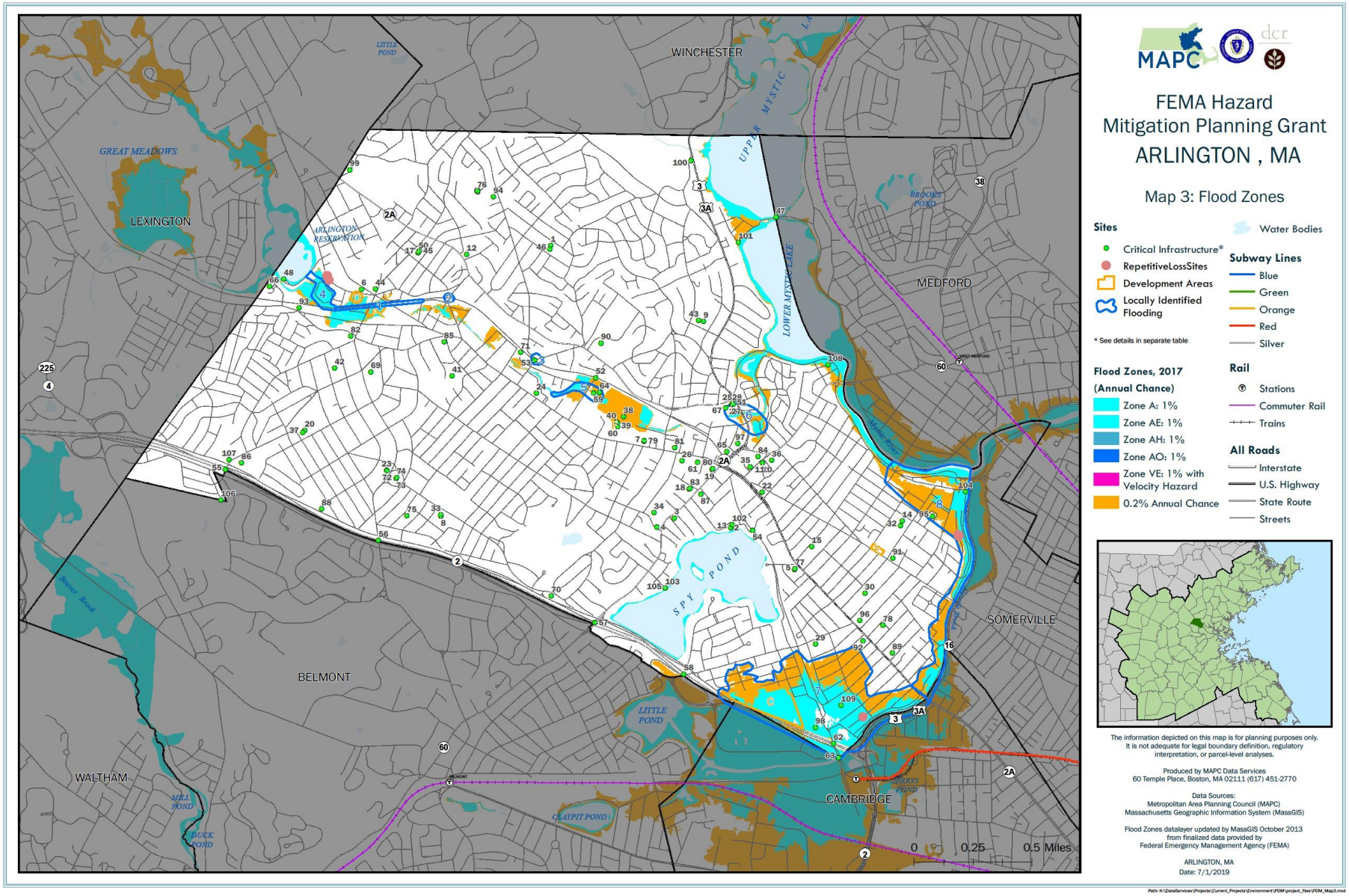
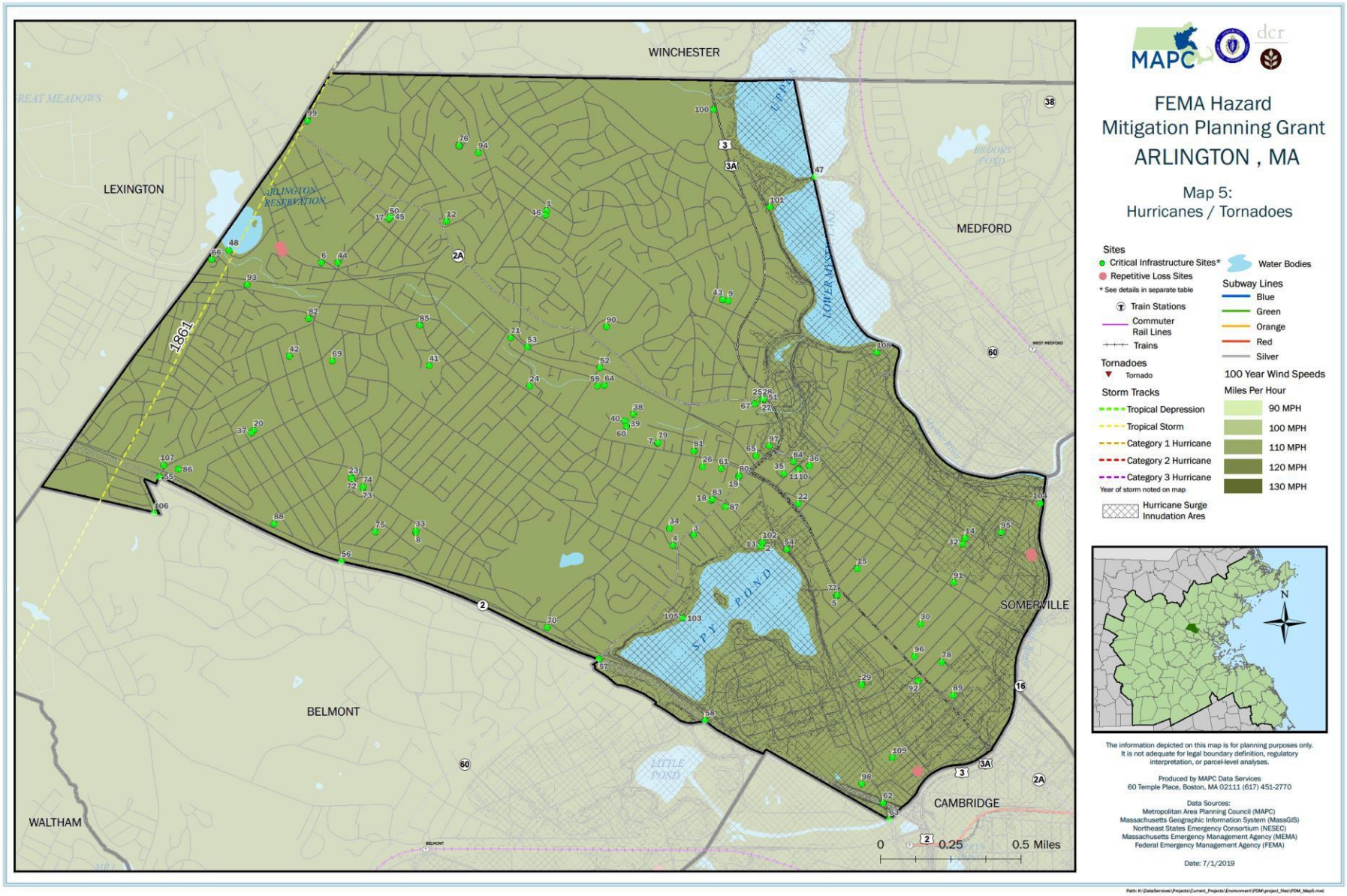
60 Temple Place, Boston, MA 02111 (617) 451-2770
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
Date: 7/1/2019
ARLINGTON, MA


FEMA Hazard
Mitigation Planning Grant
ARLINGTON , MA
Map 3: Flood Zones
Sites
Critical Infrastructure*
RepetitiveLossSites
Development Areas
Locally Identified Flooding
* See details in separate table
Water Bodies
Subway Lines
Blue
Green
Orange
Red
Silver
Flood Zones, 2017
(Annual Chance)
Zone A: 1%
Zone AE: 1%
Zone AH: 1%
Zone AO: 1%
Zone VE: 1% with Velocity Hazard
0.2% Annual Chance
Rail
Stations
Commuter Rail
Trains
All Roads
Interstate
U.S. Highway
State Route
Streets
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analyses.
Produced by MAPC Data Services
60 Temple Place, Boston, MA 02111 (617) 451-2770
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Flood Zones datalayer updated by MassGIS October 2013
from finalized data provided by
Federal Emergency Management Agency (FEMA)
ARLINGTON, MA
Date: 7/1/2019
WINCHESTER
LEXINGTON
MEDFORD
SOMERVILLE
BELMONT
WALTHAM
CAMBRIDGE
SPY POND
LITTLE POND
GREAT MEADOWS
ARLINGTON RESERVATION
UPPER MYSTIC LAKE
LOWER MYSTIC LAKE
BROOKS POND
MILL POND
DUCK POND
CLAYPIT POND
JERRYS POND
Beaver Brook
0 0.25 0.5 Miles


FEMA Hazard
Mitigation Planning Grant
ARLINGTON , MA
Map 5:
Hurricanes / Tornadoes
Sites
Critical Infrastructure Sites*
Repetitive Loss Sites
* See details in separate table
Train Stations
Commuter Rail Lines
Trains
Tornadoes
Tornado
Storm Tracks
Tropical Depression
Tropical Storm
Category 1 Hurricane
Category 2 Hurricane
Category 3 Hurricane
Year of storm noted on map
Hurricane Surge Innudation Ares
Water Bodies
Subway Lines
Blue
Green
Orange
Red
Silver
100 Year Wind Speeds
Miles Per Hour
90 MPH
100 MPH
110 MPH
120 MPH
130 MPH
WINCHESTER
LEXINGTON
MEDFORD
SOMERVILLE
BELMONT
CAMBRIDGE
WALTHAM
ARLINGTON RESERVATION
SPY POND
LITTLE POND
1961
0
0.25
0.5 Miles
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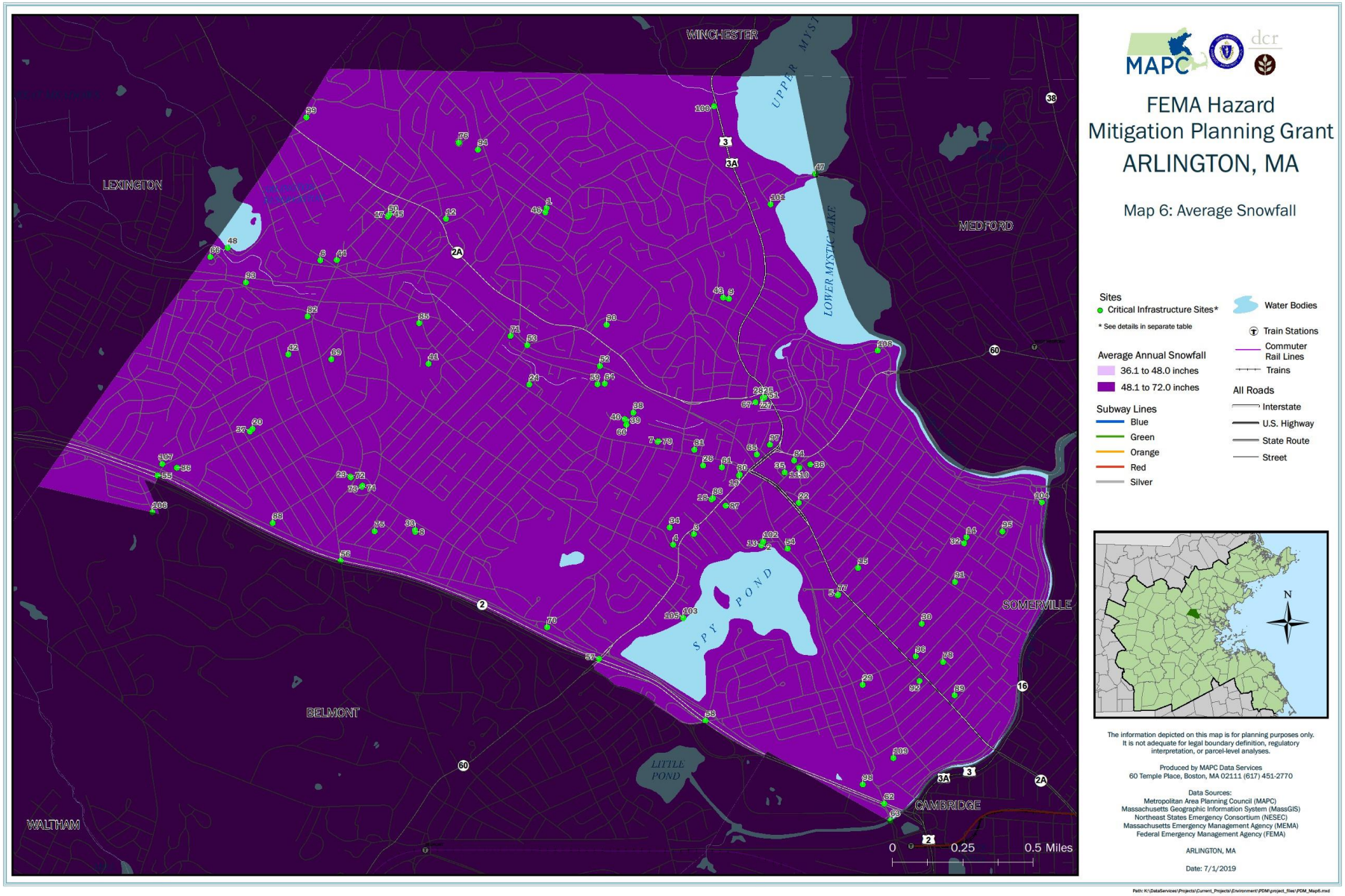
60 Temple Place, Boston, MA 02111 (617) 451-2770
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
Date: 7/1/2019


FEMA Hazard
Mitigation Planning Grant
ARLINGTON, MA
Map 6: Average Snowfall
Sites
Critical Infrastructure Sites*
* See details in separate table
Average Annual Snowfall
36.1 to 48.0 inches
48.1 to 72.0 inches
Subway Lines
Blue
Green
Orange
Red
Silver
Water Bodies
Train Stations
Commuter Rail Lines
Trains
All Roads
Interstate
U.S. Highway
State Route
Street
WINCHESTER
LEXINGTON
MEDFORD
SOMERVILLE
CAMBRIDGE
BELMONT
WALTHAM
UPPER MYSTIC LAKE
LOWER MYSTIC LAKE
SPY POND
LITTLE POND
0 0.25 0.5 Miles
N
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analyses.
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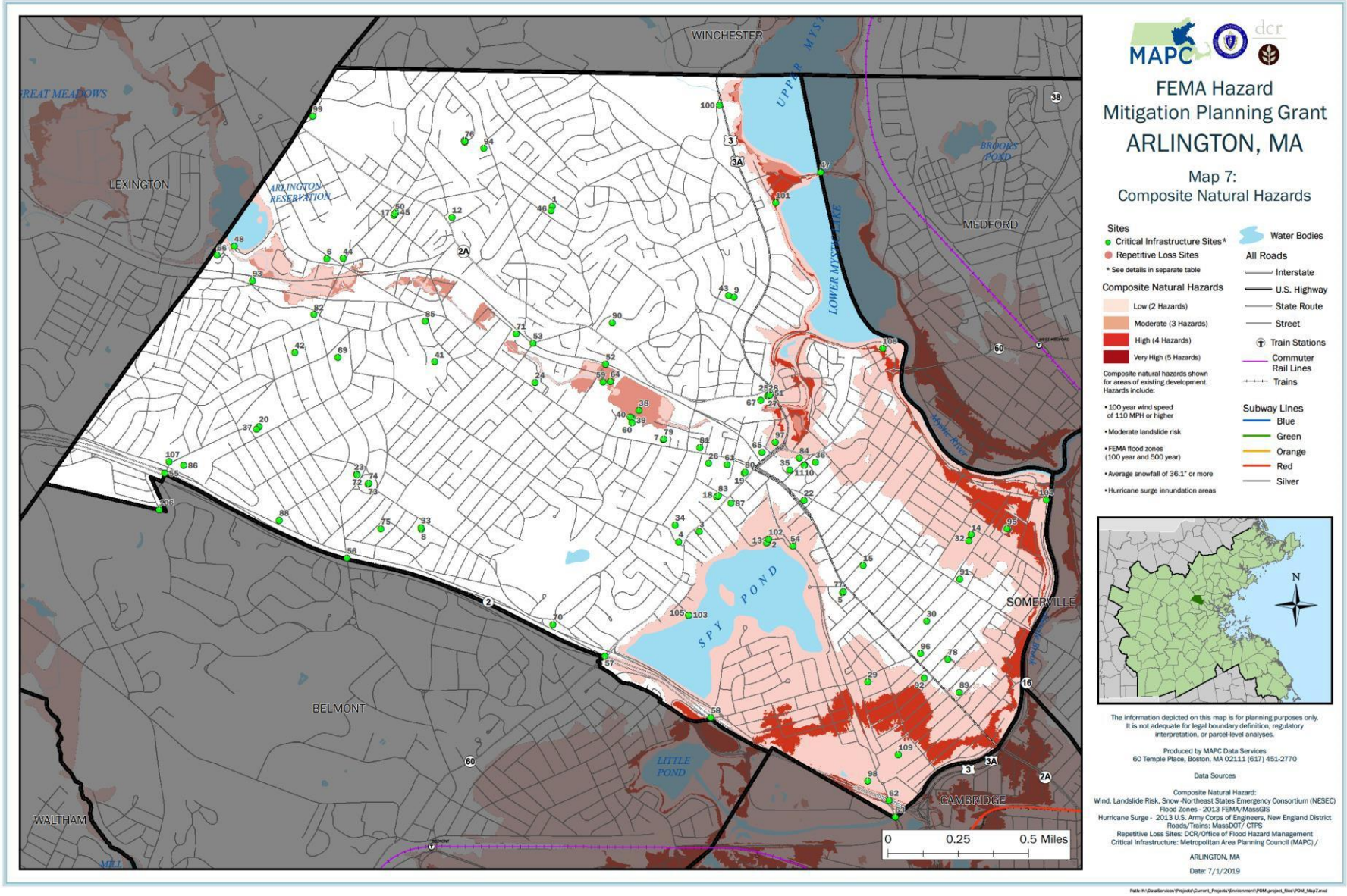
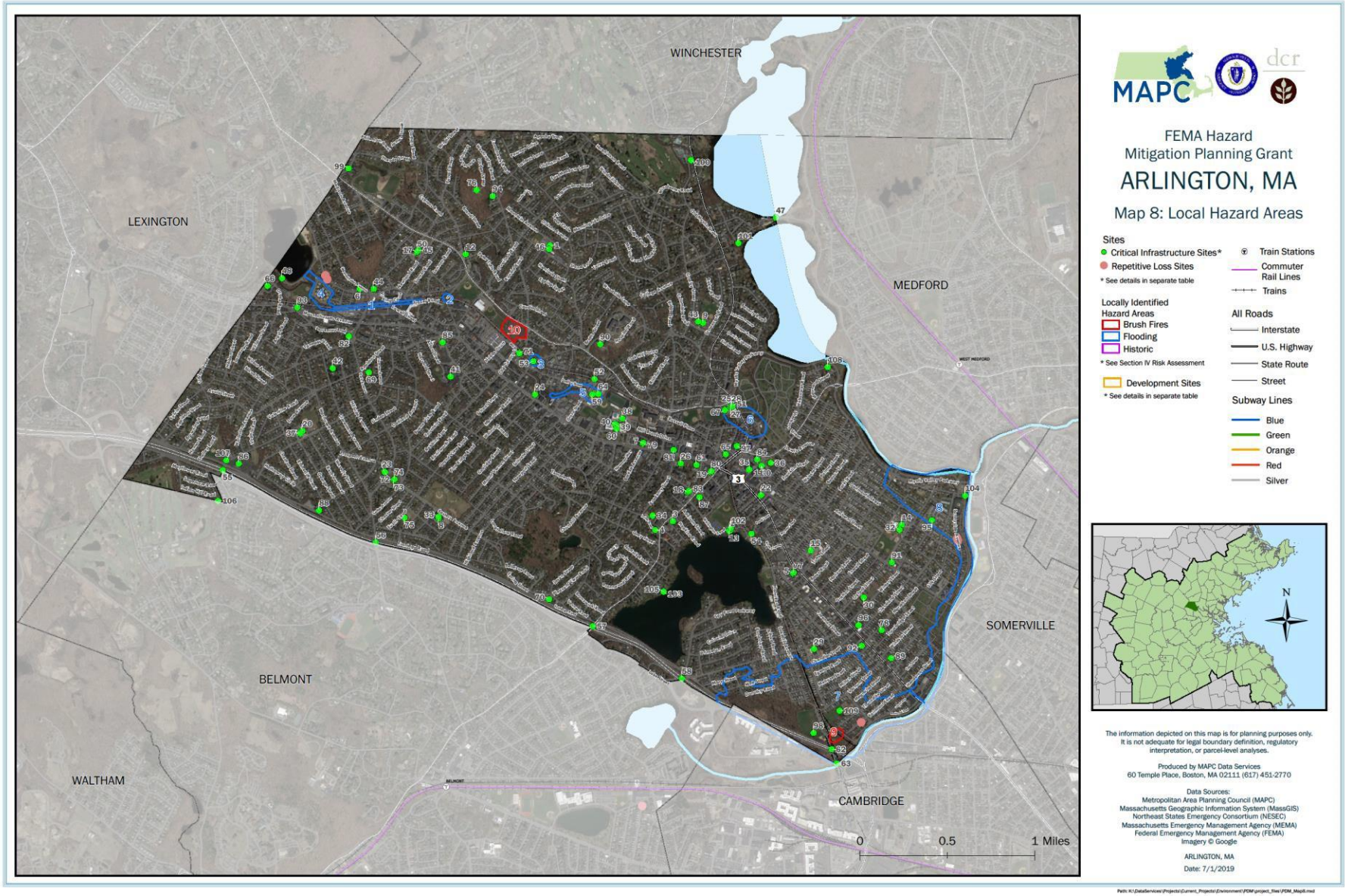
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
ARLINGTON, MA
Date: 7/1/2019


FEMA Hazard
Mitigation Planning Grant
ARLINGTON, MA
Map 7:
Composite Natural Hazards
Sites
Critical Infrastructure Sites*
Repetitive Loss Sites
* See details in separate table
Composite Natural Hazards
Low (2 Hazards)
Moderate (3 Hazards)
High (4 Hazards)
Very High (5 Hazards)
Composite natural hazards shown for areas of existing development. Hazards include:
• 100 year wind speed of 110 MPH or higher
• Moderate landslide risk
• FEMA flood zones (100 year and 500 year)
• Average snowfall of 36.1" or more
• Hurricane surge innundation areas
Water Bodies
All Roads
Interstate
U.S. Highway
State Route
Street
Train Stations
Commuter Rail Lines
Trains
Subway Lines
Blue
Green
Orange
Red
Silver
WINCHESTER
LEXINGTON
BELMONT
WALTHAM
MEDFORD
SOMERVILLE
CAMBRIDGE
SPY POND
LITTLE POND
ARLINGTON RESERVATION
BROOKS POND
0 0.25 0.5 Miles
N
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analyses.
Produced by MAPC Data Services
60 Temple Place, Boston, MA 02111 (617) 451-2770
Data Sources
Composite Natural Hazard:
Wind, Landslide Risk, Snow -Northeast States Emergency Consortium (NESEC)
Flood Zones - 2013 FEMA/MassGIS
Hurricane Surge - 2013 U.S. Army Corps of Engineers, New England District
Roads/Trains: MassDOT/ CTPS
Repetitive Loss Sites: DCR/Office of Flood Hazard Management
Critical Infrastructure: Metropolitan Area Planning Council (MAPC) /
ARLINGTON, MA
Date: 7/1/2019


WINCHESTER
LEXINGTON
MEDFORD
BELMONT
SOMERVILLE
WALTHAM
CAMBRIDGE
0
0.5
1 Miles
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
ARLINGTON, MA
Map 8: Local Hazard Areas
Sites
Critical Infrastructure Sites*
Repetitive Loss Sites
* See details in separate table
Locally Identified
Hazard Areas
Brush Fires
Flooding
Historic
* See Section IV Risk Assessment
Development Sites
* See details in separate table
Train Stations
Commuter
Rail Lines
Trains
All Roads
Interstate
U.S. Highway
State Route
Street
Subway Lines
Blue
Green
Orange
Red
Silver
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The information depicted on this map is for planning purposes only.
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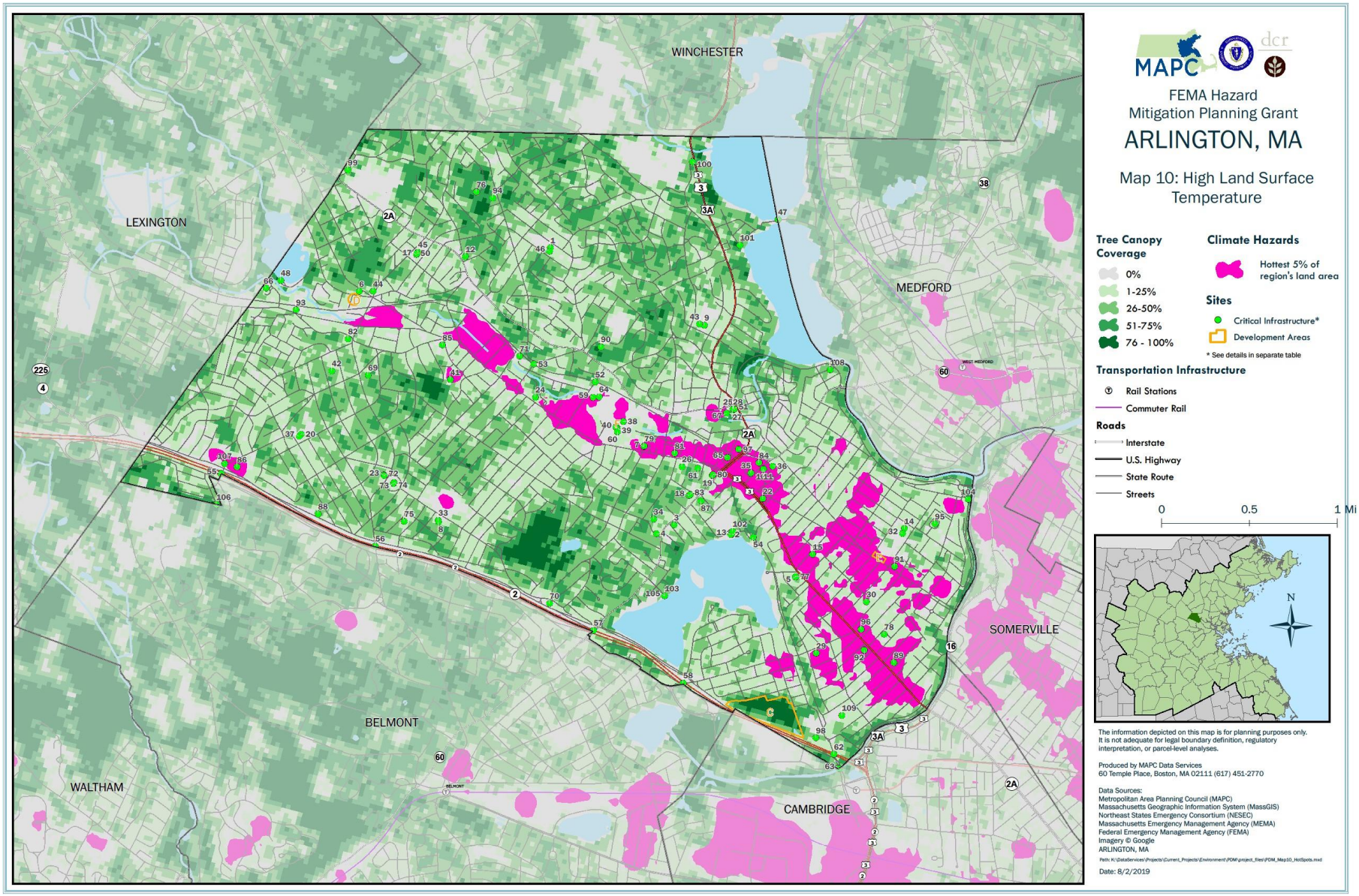
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
Imagery © Google
ARLINGTON, MA
Date: 7/1/2019


WINCHESTER
LEXINGTON
MEDFORD
SOMERVILLE
BELMONT
WALTHAM
CAMBRIDGE
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
ARLINGTON, MA
Map 10: High Land Surface Temperature
Tree Canopy Coverage
0%
1-25%
26-50%
51-75%
76 - 100%
Climate Hazards
Hottest 5% of region's land area
Sites
Critical Infrastructure*
Development Areas
* See details in separate table
Transportation Infrastructure
Rail Stations
Commuter Rail
Roads
Interstate
U.S. Highway
State Route
Streets
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1 Mi
N
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analyses.
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Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
Imagery © Google
ARLINGTON, MA
Date: 8/2/2019

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APPENDIX B: LOCAL TEAM MEETING AGENDAS

Agendas for the
Arlington Local Hazard Mitigation Team meetings

March 12, 2019
June 27, 2019
September 24,2019

Arlington Hazard Mitigation Plan Update

Local Hazard Mitigation Planning Team

AGENDA
Meeting #1

March 12, 2019
1:00 to 2:30 PM

Arlington Town Hall
2nd Floor Conference Room

---

1. Review Project Scope of Work and Schedule

2. Update Critical Facilities Inventory and Mapping

3. Identify/update local hazards:

a) Flood Hazard Areas
b) Fire Hazard Areas (brushfires/wildfires)
c) Dams
d) Extreme Heat
e) Other hazards

4. Identify/Update New and Potential Development Sites

5. Discuss Public Involvement and Outreach

a) Identify local stakeholders
b) Schedule first public meeting

Arlington Local Hazard Mitigation Team

Team Meeting#2
June 27, 2019
10:00 AM

Arlington Town Hall
2nd Floor Conference Room

10:00 Introductions

10:05 Presentation of Flood Claims Data for the 2010 Storms

Anne Herbst, Senior Environmental Planner, will present a summary of the FEMA flood claims data for the March/April 2010 storms in Arlington.

10:30 Review and Update of Mitigation from the 2012 Plan

Update the *Existing* Mitigation Measures from the 2012 plan

Status of the *Recommended* Mitigation Measures from the 2012 plan

10:45 Next Steps

Fall 2019, Team Meeting #3 (final) and Final Public Meeting

11:50 Adjourn

Arlington Hazard Mitigation Plan Update

Local Hazard Mitigation Planning Team

Team Meeting#3

September 24, 2019
1:00 - 2:30 PM

Arlington Town Hall
2nd Floor Conference Room

AGENDA

1. Review and Update the Hazard Mitigation Strategy

a) Update Mitigation Measures in the previous plan (Table 1)
b) Add new Mitigation Measures for the 2019 plan (Table 2)
c) Consider MVP Recommendations (see MVP summary)
d) Identify time frames, cost estimates, lead agencies
e) Prioritize recommended mitigation

2. Review and Update Hazard Mitigation Goals

3. Public Involvement and Outreach

a) Identify local stakeholders
b) Schedule second public meeting

4. Adjourn

APPENDIX C: DOCUMENTATION OF PUBLIC MEETINGS

Arlington Public Meetings

June 13, 2019
January 27, 2020

Agendas
Meeting Flyers
Meeting Notices
Meeting Presentation
Engagement Exercise Results

Arlington Hazard Mitigation Plan Update

Public Meeting

June 13, 2019
7:00 PM

Arlington Senior Center
Central School
27 Maple Street

AGENDA

7:00 Introductions; Hazard Mitigation overview; orientation for engagement exercise

7:10 Participants mark up maps and posters to show their values and concerns

7:30 Review and discuss the exercise, summarize results

7:45 PowerPoint presentation on Hazard Mitigation Plan

8:10 Questions and discussion on the plan

8:25 Next Steps

8:30 Adjourn

Hazard Mitigation Plan
Public Meeting

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



The Town of Arlington is preparing a Hazard Mitigation Plan update to help the town reduce its vulnerability to natural hazards such as flooding, hurricanes, and winter storms. Please join the Town for a presentation and discussion about the Hazard Mitigation Plan update at a public meeting. Your input and suggestions for the plan are welcome, please join us!

Date:	Thursday, June 13, 2019
Time:	7:00 pm
Location:	Senior Center, Main Room Central School 27 Maple St, Arlington, MA

For more information, please contact
Emily Sullivan at Esullivan@town.arlington.ma.us

MAPC
METROPOLITAN AREA PLANNING COUNCIL

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

CALENDAR LISTING / MEDIA ADVISORY

ARLINTON'S HAZARD MITIGATION PLAN TO BE DISCUSSED AT JUNE 13 PUBLIC MEETING

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

What: At a public meeting on Thursday, June 13 at 7:00 PM, a presentation on the Town's Hazard Mitigation Plan will be made by the Metropolitan Area Planning Council (MAPC), which is assisting the Town with the preparation of an updated plan. There will be an opportunity for questions and discussion with MAPC and Town staff following the presentation.

The Town of Arlington is preparing an updated Hazard Mitigation plan that will document natural hazards that affect the Town, such as floods, hurricanes, and winter storms, as well as actions that the Town can take to reduce its vulnerability to these hazards. Once completed and approved by the Federal Emergency Management Agency (FEMA), the Town will be eligible for federal Hazard Mitigation Grants from FEMA.

When: Thursday, June 13, 2019, 7:00 PM

Where: Senior Center, Main Room
Central School
27 Maple Street, Arlington, MA

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

##

Arlington Hazard Mitigation Plan
Public Meeting Notification

Dear Town of Arlington stakeholder:

The Arlington Hazard Mitigation Plan is being updated to help the town reduce its vulnerability to natural hazard events such as flooding, hurricanes and winter storms. Natural hazards can have serious impacts on the Town of Arlington and its residents and businesses. The Metropolitan Area Planning Council (MAPC) is assisting the Town in the preparation of the updated plan.

Please join the Town for a presentation and discussion on the Arlington Hazard Mitigation Plan Update at a public meeting on the following date and location:

Thursday, June 13 at 7:00 PM
Arlington Senior Center
Central School
27 Maple Street, Arlington, MA

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

Best regards,
Martin Pillsbury

Martin Pillsbury | **Director of Environmental Planning**
Metropolitan Area Planning Council
60 Temple Place | Boston, MA 02111
617.933.0747 | mpillsbury@mapc.org | www.mapc.org

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

Arlington Hazard Mitigation Plan 2019 Update

Public Meeting
June 13, 2019

Martin Pillsbury
Metropolitan Area Planning Council

Why is Arlington doing this Plan?

- The **Federal Disaster Mitigation Act of 2000** requires towns to adopt a Hazard Mitigation Plan to be eligible for FEMA mitigation grants.
- Arlington's first plan was prepared in 2012 and now must be updated
- This Plan will meet FEMA's requirement and make the Town eligible for FEMA mitigation project grants

A Plan for Mitigating Damages from Natural Hazards

- Flooding
- High winds, hurricanes, tornadoes
- Winter storms, snow & ice
- Brush fires
- Earthquakes, landslides
- Extreme temperatures
- Drought

A Mitigation Plan , not an Emergency Response Plan

What is Hazard Mitigation?

To reduce or prevent loss of life, injuries and property damage by using long-term strategies ***before*** a disaster happens **(Pre-Disaster Mitigation)**

What preventive actions are being taken **NOW** to reduce future risks and damages?

What additional actions can be taken in the **FUTURE** to reduce vulnerability and increase resilience?


Breaking the Cycle of Disaster & Rebuilding
Rebuild
Disaster
Disaster
Rebuild


Six Tools & Techniques for Hazard Mitigation
1. Prevention
2. Property Protection
3. Public Education
4. Natural Resources Protection
5. Structural Projects
6. Emergency Services Protection

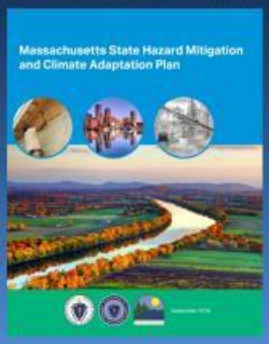
How the Plan Is Being Developed

- The Town coordinates the plan through its Hazard Mitigation Team, with multiple Town departments.
- MAPC provides technical assistance to the Town to prepare the plan under a MEMA grant.
- Two public meetings, first during plan development, and the second during review of the draft plan.
- Submittal of a draft plan to MEMA and FEMA for review, revision, and approval.

Plan Development Steps

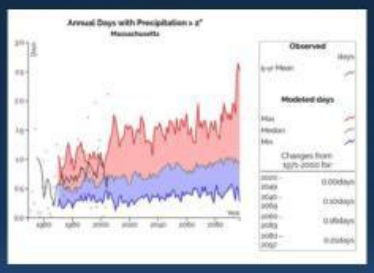
Hazard Identification & Mapping

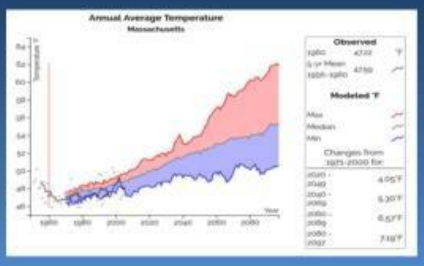
- State & Federal data on floodplains, snowfall, wind speeds, hurricanes earthquakes, etc.
- Review Mass. State Hazard Mitigation and Climate Adaptation Plan
- Coordinate with Local Team to get *local* information on hazard areas



MA State Hazard Mitigation and Climate Adaptation Plan 2018

- First state plan to integrate Hazard Mitigation and Climate Adaptation
- Assesses both historic and future projected hazards such as extreme heat, rainfall, and sea level rise.





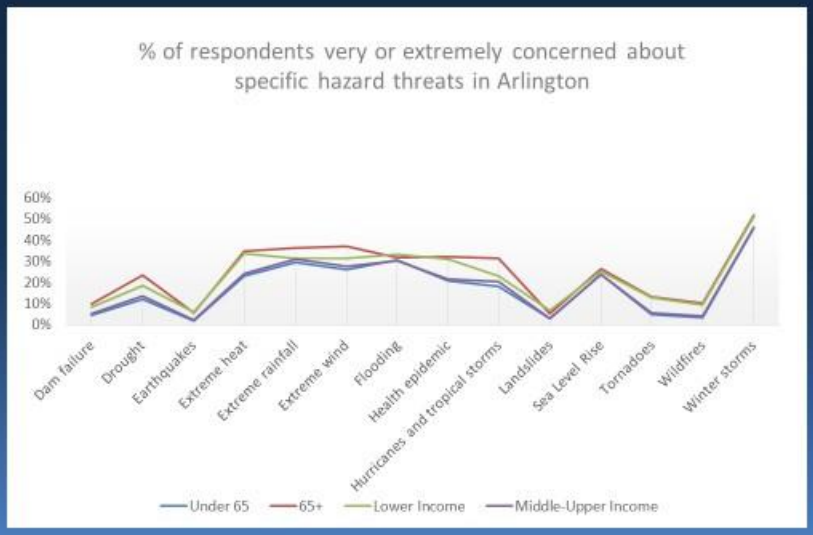
Arlington's MVP Project

- The Town's **Municipal Vulnerability Preparedness** (MVP) Workshop was held in 2018. Vulnerabilities identified include:
- **Transportation:** flooding; snow/ice; heat
- **Other Infrastructure:**
  - Amelia Earhart Dam, Mill Brook, Alewife Brook, Reeds Brook
  - Electric lines and utilities.
- **Ecosystems:**
  - Water quality impacts from runoff, sewer
  - Tree health impacts from climate change
- **Vulnerable Populations:** Flooding; heat; snow/ice

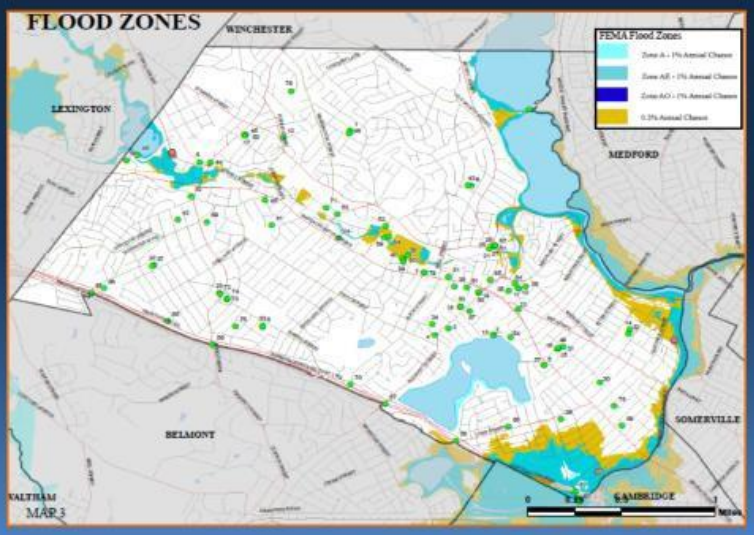
Town Hazard Mitigation Survey

- The Town conducted survey in 2019 to understand residents' perception of hazard risks in the community.
- The most significant hazard risk was winter storms, with seniors expressing the most concern (52% very/extremely concerned).
- Seniors and lower income households were significantly more concerned about extreme heat (35%) than younger and middle- to upper-income households (24%).
- Similar gaps in concern were seen about health epidemics
- The Town will use the survey results to identify opportunities for public outreach concerning specific hazards.

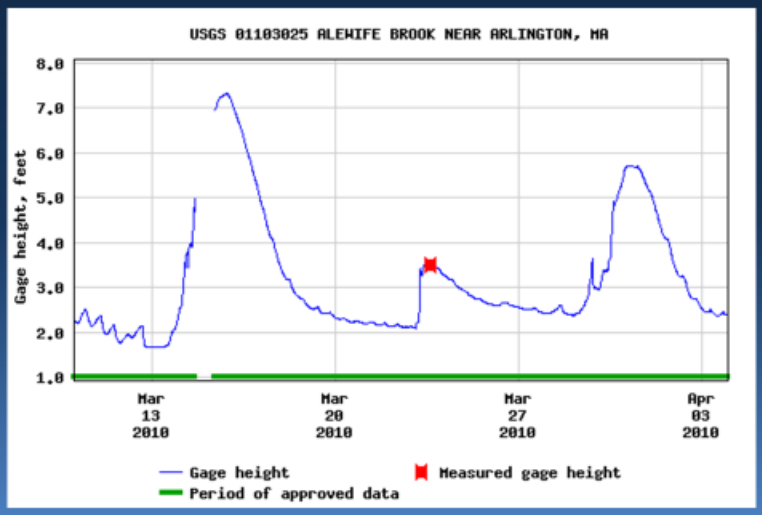
Hazard Identification & Mapping



Flood Hazard Areas—FEMA Flood Map



USGS Gauge-Alewife Brook 2010



Locally-Identified Hazard Areas

9 potentially hazard prone areas for flooding and brushfires identified by the Local Team:

1	Minuteman Path	Flooding
2	Forest Street	Flooding
3	Brattle Street	Flooding
4	Colonial Village	Flooding
5	Grove Street	Flooding
6	Garden Street	Flooding
7	East Arlington / Alewife	Flooding
8	Sunnyside Avenue	Flooding
9	Thorndike	Brush Fire

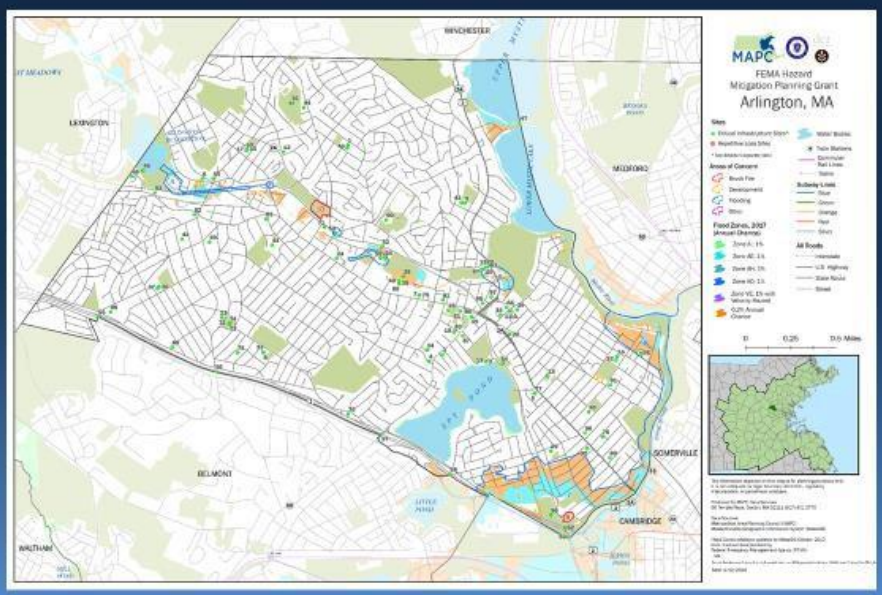
Critical Facilities

89 sites identified including:

- Disaster response sites such as fire and police stations
- Sites requiring assistance, such as elderly housing
- Critical infrastructure (Dams, pump stations, communications)

A Place to Grow at the Stratton School	Stratton Elementary School
ABC Pre-school	Upper Mystic Lake Dam
Another Place to Grow	Arlington Reservoir Dam
Arlington Children's Center, Inc.	Kelleher Center
Arlington Creative Start	Mrs T's Company Inc
Arlington Heights Nursery School	Community safety building
Arlington Infant-Toddler Center	Grove St Bridge
Brackett After School Program	Brattle St Bridge
Bright Start After School @ Bishop	Pond Lane Bridge
Fidelity House Preschool	Dow Ave Bridge
Fidelity House School Age Child Care	Park Ave Bridge
Great Expectations Preschool	Pleasant St Bridge
Kids Care Club	Lake St Bridge
Kids Care Club at the Thompson Schl	DPW office
Learn to Grow	Municipal admin (in HS)
Lesley Ellis School	Library
Peirce Playcare and Extended Day	Minuteman man under Route 2
Rogers-Pierce Children's Center	Alewife brook bridge
Sunshine Nursery School	DPW garage
The Afterschool Connection, Inc.	Winslow Towers
Fire Police Support Service (garage)	Drake Village
Headquarters Fire Station	Qusack Building
Park Circle Fire Station	Lake St Nursing Home
Highland Fire Station	Park Ave nursing and rehab center
Arlington Fire Administration	Spring St Pump Station
Arlington Town Hall	Brattle Court Pump Station
Fire/Police Dispatch	Park Circle Fire Staion (Towers)
Arlington Police Department	Park Circle Tower (1,000,000 gal)
Hardy Elementary	Park Circle Tower
Dearborn Academy	Bellington St. Water Tank
Lesley Ellis School	Turkey Hill Water Storage Tank
Thompson Elementary	Calvary Church, United Methodist
Brackett	Church of Our Saviour
Ecole Bilingue School	First Baptist Church
Arlington Catholic HS	First Parish Unitarian Universalist
St Agnes Elementary	Highrock Church
Cyrus E Dallin	Park Avenue Congregational Church
Menotomy Preschool	Pleasant Street Congregational
LABBB Collaborative	St. Agnes Parish
Arlington High School	St. Athanasius Greek Orthodox
Ottoson Middle School	St. Camillus
Germaine Lawrence School	St. John's Episcopal Church
Bishop Elementary School	St. Paul Lutheran Church
Covenant School	Trinity Baptist Church
Pierce Elementary	

Critical Facilities & Infrastructure



Vulnerability Analysis: Estimated Damages

FEMA'S HAZUS-MH Program

HURRICANE Estimated Damages

Category 2 Hurricane (57mph) damage:	$	1,960
Category 4 Hurricane (98 mph) damage:	$	48,340,000

EARTHQUAKE Estimated Damages

Magnitude 5 total property damage:	$	60,720,000
Magnitude 7 total property damage:	$	298,310,000

FLOODING: Areas subject to localized flooding:

Low Estimate of Damages (10% Damage):	$	21,917,000
High Estimate of Damages (50% Damage):	$	109,587,000

Next Steps: Update Mitigation Strategies

Update the mitigation measures recommended in the Plan:

- What are the Town's existing Mitigation measures?
- Where are the gaps? What additional actions will further reduce vulnerability?
- What are the mitigation priorities, costs, timelines?

Existing Mitigation Measures

MULTI-HAZARD
- Comprehensive Emergency Mgt. Plan
- Local Emergency Planning Comm. (LEPC)
- Tri-Community Group
- Massachusetts State Building Code
- Emergency Generators
- Communications Equipment

FLOOD RELATED HAZARDS
- National Flood Insurance Program (NFIP)
- Street Sweeping & Catch basin cleaning
- Roadway treatments
- Zoning – Floodplain regulations
- Environmental Design Review Regulations
- Stormwater and Wetlands Bylaws
- Open Space and Recreation Plan

WIND-RELATED HAZARDS
- Tree trimming program
- Massachusetts State Building Code

WINTER-RELATED HAZARDS
- Snow removal operations
- Sand/salt roadway application

GEOLOGIC HAZARDS
- Massachusetts State Building Code

BRUSH FIRE RELATED HAZARDS
- Permits for outdoor burning
- Development Review

DAMS
- DCR Dam Safety regulations
- Permits required for construction

Next Steps

MAPC will assist the Town's Hazard Mitigation Team to:

- Update the existing mitigation measures
- Review status of recommendations from the 2012 plan
- Develop and prioritize new mitigation strategies for this Plan Update
- Hold a 2nd Public Meeting to review the Draft Plan

Final Steps: Plan Approval and Adoption

- Draft plan will be reviewed by MEMA and FEMA, revisions if needed
- FEMA will issue a notice of "Approval Pending Adoption"
- The Town will vote to adopt the plan
- FEMA will issue formal plan approval
- Approved plan will be in effect for 5 years
- The Town will be eligible for FEMA mitigation grants

Arlington Public Meeting #1
June 13, 2019
Summary of Public Engagement Exercise

At the first public meeting, participants were invited to review the Existing Conditions maps of Arlington and annotate on one map the town's strengths, and on another map, their top concerns for natural hazards and climate impacts in Arlington. The annotated maps are shown below, and the results are summarized here:

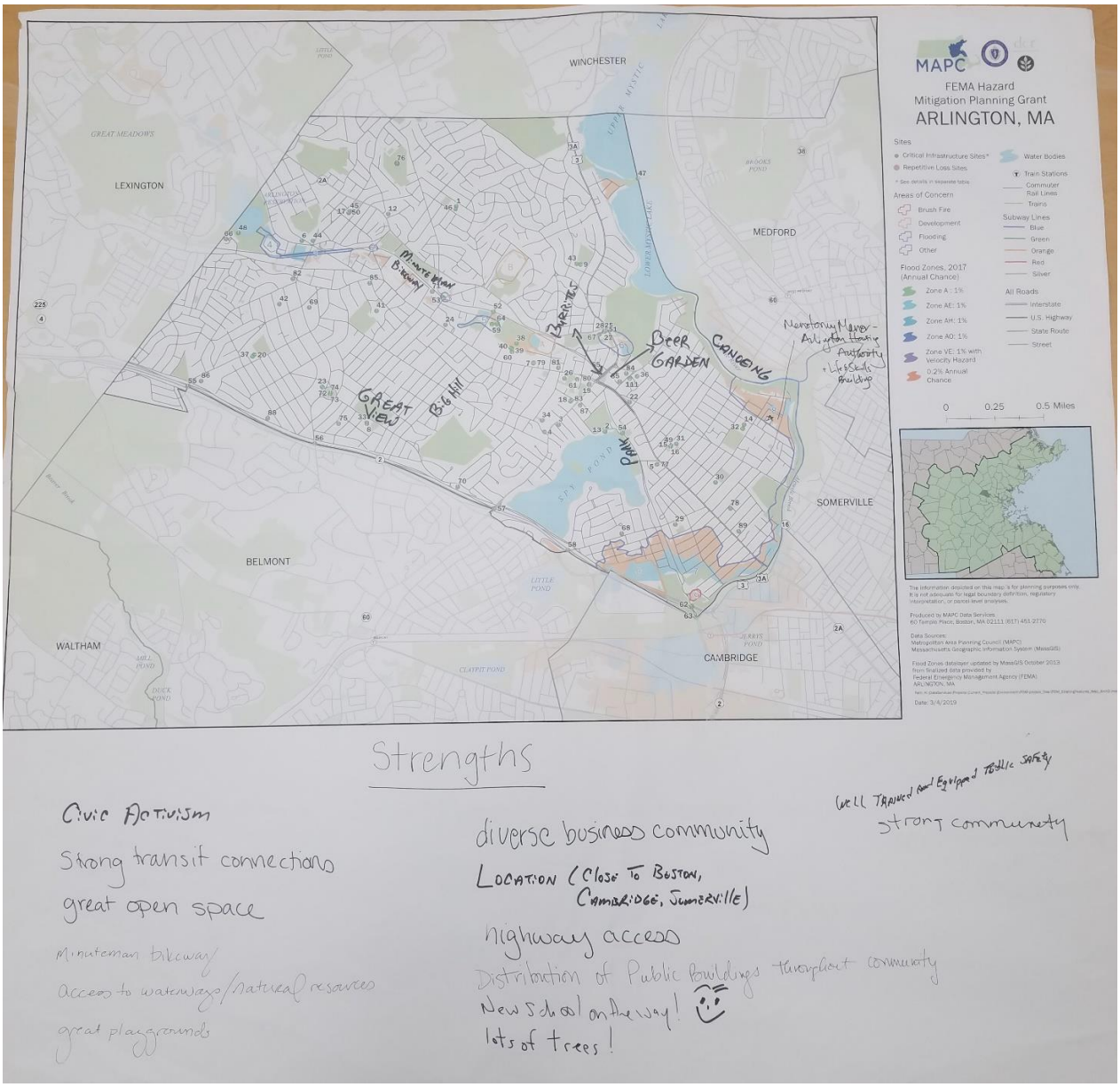
Arlington's Strengths

- ☐ Civic activism
- ☐ Strong community
- ☐ Well-trained and equipped Public Safety
- ☐ Strong transit connections
- ☐ Lots of trees
- ☐ Great Open Space
- ☐ Minuteman Bikeway
- ☐ Access to waterways/natural resources - canoeing
- ☐ Great playgrounds
- ☐ Hills with great views
- ☐ Diverse business community
- ☐ Location close to Boston, Cambridge, Somerville
- ☐ Highway access
- ☐ Distribution of public buildings throughout community
- ☐ Menotomy Manor-Arlington Housing, Life Skills Building
- ☐ New school on the way

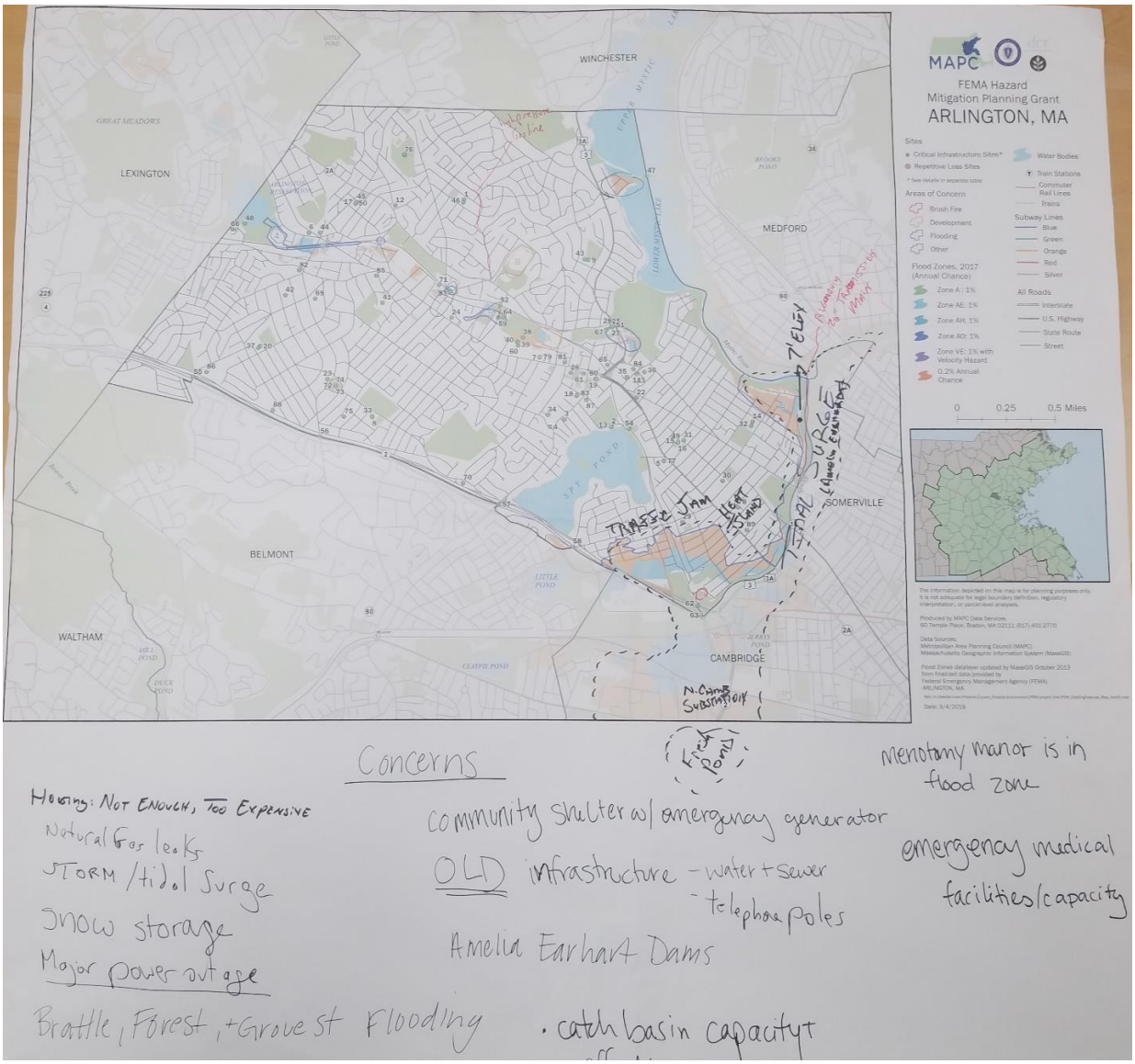
Top Concerns for Arlington

- ☐ Brattle, Forest, and Grove Street flooding
- ☐ Menotomy Manor is in flood zone
- ☐ Catch basin capacity and effectiveness
- ☐ Major power outage
- ☐ Heat island
- ☐ Snow storage
- ☐ Old infrastructure – water, sewer, telephone poles
- ☐ Storm / tidal surge
- ☐ Community shelter/emergency generator
- ☐ Emergency medical facilities/capacity
- ☐ Housing-not enough, too expensive
- ☐ Natural Gas leaks/Algonquin 26-inch gas transmission main
- ☐ Amelia Earhart Dam
- ☐ North Cambridge substation
- ☐ Traffic jams

Arlington Public Meeting #1
Annotated Map - Strengths



Arlington Public Meeting #1
Annotated Map - Concerns



Public Meeting #2
[TO BE ADDED}

Public Meeting #2
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Public Meeting #2
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Public Meeting #2
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Public Meeting #2
[TO BE ADDED}

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APPENDIX D: DOCUMENTATION OF PLAN ADOPTION

[TO BE COMPLETED AFTER FEMA REVIEW AND NOTICE OF APPROVABLE PENDING ADOPTON]

[Print on Town Letterhead]

CERTIFICATE OF ADOPTION
SELECT BOARD
TOWN OF ARLINGTON, MASSACHUSETTS

A RESOLUTION ADOPTING THE
TOWN OF ARLINGTON HAZARD MITIGATION PLAN 2020 UPDATE

WHEREAS, the Town of Arlington established a Committee to prepare the *Town of Arlington Hazard Mitigation Plan 2020 Update*; and

WHEREAS, the *Town of Arlington Hazard Mitigation Plan 2020 Update* contains several potential future projects to mitigate potential impacts from natural hazards in the Town of Arlington, and

WHEREAS, duly-noticed public meetings were held by the Town on June 13, 2019 and ON January 27, 2020, and

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

NOW, THEREFORE BE IT RESOLVED that the Town of ARLINGTON SELECT BOARD adopts the *Town of Arlington Hazard Mitigation Plan 2020 Update*, in accordance with M.G.L. 40 §4 or the charter and bylaws of the Town of Arlington.

ADOPTED AND SIGNED this Date. _____

Name(s)

APPENDIX E: DOCUMENTATION OF PLAN APPROVAL

[TO BE ADDED AFTER FEMA APPROVES THE FINAL PLAN]

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APPENDIX F: SUMMARY MVP RECOMMENDATIONS

In 2018, Arlington received a Municipal Vulnerability Preparedness (MVP) Planning Grant from the Executive Office of Energy and Environmental Affairs. The grant allowed the Town to examine its strengths and vulnerabilities, as well as identify priority resilience-building actions. The grant process was coordinated by the Municipal Vulnerability Preparedness core group composed of Town Officials, business leaders, and community members, and was led by Department of Planning and Community Development staff with the help of the consultant Kleinfelder. The top priority identified through the workshop is addressing flooding in the Mill Brook Corridor, which has recently and historically caused significant damage to homes, businesses, and other properties in the brook's vicinity. Other vulnerabilities identified through this process include potential disruptions due to heavy rainfall, ice and snow storms, extreme heat, and sea level rise leading to storm surge from the Mystic River and Alewife Brook.

Building off the success of the MVP Planning Grant, the Town was awarded an MVP Action Grant to develop and implement ecologically sensitive flood management measures in the Mill Brook Corridor. This project built off of the Mill Brook /Wellington Park Project, which is a cooperative effort with the Mystic River Watershed Association (MyRWA), funded by the Community Preservation Act (CPA) to improve public access and recreational opportunities in the Mill Brook Corridor at Wellington Park, and in other areas of the park.

To learn more about the MVP Planning Process and the vulnerabilities identified, please find an excerpt of Arlington's MVP report below. The Local Hazard Mitigation Planning Team included members of the MVP planning effort and ensured consistency between the MVP report and this hazard mitigation plan update.

Implement multi-benefit solutions along Mill Brook

All four groups recommended actions to improve conditions along the Mill Brook corridor, from Arlington Reservoir to Mystic Lakes. Flooding in this area affects important public services as well as the economic center of the community.

The Town has recently completed a corridor-wide hydrological study to better understand flooding locations, causes, and solutions. Once effective solutions can be identified to mitigate flooding along Mill Brook, the Town should evaluate and prioritize them for implementation over the short and long-term. The prioritization and implementation processes should involve and educate private landowners along Mill Brook. Priority should be given to effective flood mitigation projects that achieve multiple community objectives for Mill Brook. Objectives may include improving water quality, structural stability, daylighting, recreational use, pest and vector control, economic development, and urban heat island mitigation.

Address flooding and heat hazards in East Arlington

East Arlington is more exposed to flooding and heat hazards than any other neighborhood in Arlington. Its exposure to flooding is related to its topography and proximity to Alewife Brook and the Mystic River. Its high heat exposure is due to the density of housing and limited tree cover and pervious surfaces. DCR is a critical stakeholder for the Town to work with on solutions to flooding in East Arlington. DCR is responsible for critical green and gray flood mitigation infrastructure along Alewife Brook and the Mystic River. The Town should open an ongoing dialogue to encourage DCR to take all necessary actions to increase the flood protection provided by the Amelia Earhart Dam, Mystic River Reservation, and Alewife Reservation. DCR needs to take actions to address riverine, storm surge, and sea level rise flooding. Such actions could include elevating the Amelia Earhart Dam and adding pumping capacity, creating multi-use levees and adding storage capacity along the reservations, and participating in regional dam/reservoir management schemes. Realistically, the actions themselves could take decades to plan, design, fund, and implement. In the near-term, the Town should create tailored plans for evacuation, sheltering, communications, and providing ongoing public services for a scenario in which East Arlington is exposed to a 500-year flood.

To mitigate the urban heat island in East Arlington, the Town should prioritize the neighborhood as part of its ongoing tree planting and maintenance activities, using native resilient species. This program should use the heat map presented in the workshop and recently collected street tree inventory data to identify target locations where tree planting is most needed. In planning these activities, the Town should review planned roadway, sidewalk, and utility upgrades to ensure compatibility and identify opportunities to incorporate tree planting in ongoing work. This type of exercise, linking planning and operations, could be a pilot for a more comprehensive Green Streets Master Plan, described below.

Address heat hazards along Massachusetts Avenue corridor

Heat maps used in the workshop clearly show that Massachusetts Avenue is surrounded by an urban heat island. Many Arlington residents and workers walk through this corridor to access the bus transit system, local businesses, and civic facilities. As extreme heat events increase, these uses will become more dangerous, especially for vulnerable populations.

Actions should be taken in the near-term by the Town and private owners to mitigate dangerous heat levels along the corridor. As part of ongoing activities, the Town should plant more native and diverse tree species and increase pervious surfaces within the public right of way, especially around facilities used by vulnerable populations. The Town should study the feasibility of implementing a "road diet" along the corridor that could increase the area available for tree planting and green stormwater infrastructure, while also improving accessibility and bus transit operations. Mitigating the heat island will also require that private owners, especially those with large flat roofs and large impervious parking lots, take actions on their own properties. The Town should support such action with education and consider incorporating new requirements or incentives in bylaws, regulations, and permitting processes.

Develop and implement green infrastructure projects, policies, and plans

Green infrastructure has the capacity to mitigate flooding and extreme heat, in addition to providing other social, economic, and environmental benefits. The Town should incorporate green infrastructure in its ongoing capital and maintenance projects, wherever feasible. The Mill Brook corridor hydrological study, mentioned above, should be used in the near term to evaluate the costs and benefits of different green infrastructure strategies to achieve flooding, heat, and water quality goals. Through the planning and implementation process, potential public investments in green infrastructure as well as policies affecting private property should be investigated. Once effective solutions are identified, the Town should develop a Green Streets Master Plan. Such a plan should target, optimize, and coordinate capital and maintenance investments in trees, utilities, green infrastructure, and drainage systems. The Town should concurrently review its existing plans, bylaws, regulations, and permitting processes, as well as models used by other municipalities, to identify potential mechanisms for effecting green infrastructure adoption on private property.

Incorporate resilience in the DPW and High School redesign

The Town is redesigning two critical municipal facilities that are located in FEMA floodplain along Mill Brook. The new facilities should be designed to be resilient to future heat and flooding hazards. A climate change vulnerability assessment of both sites can inform conceptual designs for the future facilities. The assessment should produce estimates of future flooding and extreme heat levels to inform design criteria for the new facilities. The assessment should also develop resiliency recommendations and associated cost estimates for each facility. The recommendations should address the key functional requirements of each facility. For example, at the DPW facility design and operational recommendations should be provided to maintain access and egress and protect supplies and equipment during a flood. For the school, design options should be recommended for resilient cooling systems and sheltering capacity. In addition, these sites are adjacent to each other and both have large available land areas. They should be evaluated for renewable energy generation with advanced battery storage, which could also serve as emergency power. The assessment findings and recommendations can be used to inform requirements and as a base review for each stage of design.

Increase the functionality of Arlington's bike paths

The Town is launching a dockless bikeshare system. Docking locations should

consider accessibility issues, and opportunities to improve connections. Policy changes should allow for pedal-assist bikes

HIGH PRIORITY

The following actions are considered high priority:

• Incorporate climate projections for future rainfall storm events into drainage design criteria and the Town's stormwater bylaw.
• Implement ongoing improvements to public schools to assure continuity of operation in extreme weather events. Schools should have efficient cooling and heating systems, flood-protected access, and emergency generators, at a minimum. Prepare a plan to implement ADA improvements, decrease car dependency, and improve bus stop conditions and route inefficiencies.
• Evaluate the cost-effectiveness of acquiring Poet's Corner for snow, flood, and/or salt storage.
• Evaluate micro-grid opportunities with renewable energy and storage in locations that connect multiple Town properties.
• Advocate for Eversource to proactively improve electric transmission capacity.
• Evaluate establishing a stormwater utility to raise funds for necessary flood and water quality improvements.
• Address the vulnerability of Armstrong Ambulance and other businesses along the Mill Brook to flooding.
• Increase the capacity of the culvert from Spy Pond to Alewife Brook under Route 2.
• Coordinate with Cambridge, Belmont, Somerville, Winchester, and Medford on climate resiliency plans.
• Review and update the Environmental Design Review special permit criteria to encourage the consideration of climate change hazards and resiliency strategies.

MODERATE PRIORITY

The following actions are considered medium priority:

• Address the resiliency needs of elderly populations, including cooling centers, flood evacuation plans, improving bus stop shading, and continuity of care plans for services such as food delivery during extreme weather events.
• Conduct an energy audit of Town Hall, Robbins Library, and the Senior Center and make improvements such as white roofs and solar panels. Use dehumidification to enhance paper file longevity or digitize files.
• Initiate a Regional Dam Management Plan, which includes storage improvements and procedures for lowering Arlington Reservoir, Spy Pond, and Mystic Lakes ahead of storms.
• Improve sweeping and catch basin cleanout, and implement alternative and more environmentally friendly snow and ice treatment.
• Develop emergency preparedness information and outreach/network with schools, daycares, and churches, as well as retail, grocery stores, and in each business district.
• Implement a green solution at the Russell Common parking lot and other large lots along the Massachusetts Avenue corridor which will reduce radiant heat.
• Invest in and facilitate green infrastructure projects on public and private property, such as green roofs, permeable pavement, and open space, to offset dark and impermeable surfaces. Extend and replicate successful rain garden pilot projects. Work with owners of large parking lots, such as car dealerships and churches.
• Explore participating in Heat Smart Massachusetts program to make improvements to Arlington Housing Authority properties.
• Take actions to manage vectors and invasive species.

LOWEST PRIORITY

• Educate the public about issues identified by workshop participants. For example, a "Resilient Arlington" campaign can support

individual preparedness by distributing best practices information and providing rain barrels. Another campaign should educate residents on stormwater pollution, how drainage systems flow to local water bodies, and actions to mitigate impacts of residential pollution sources.
• Continue water quality study at the McClellen Park detention basin, to ensure that the former landfill remains safe from leaching.
• Develop a Community Garden Plan that identifies opportunities for expanded or additional gardens and offer education to neighborhoods on how to maintain and develop them.
• Provide education to residents on preventing rodent infestation and expand the Town facilitated composting program with sealed containers to separate compost from general house trash.
• Modify Town evacuation routes to account for current and future flooding and communicate with residents about the changes.
• Prepare Ed Burns Arena to be an emergency shelter with a permanent emergency electrical generator