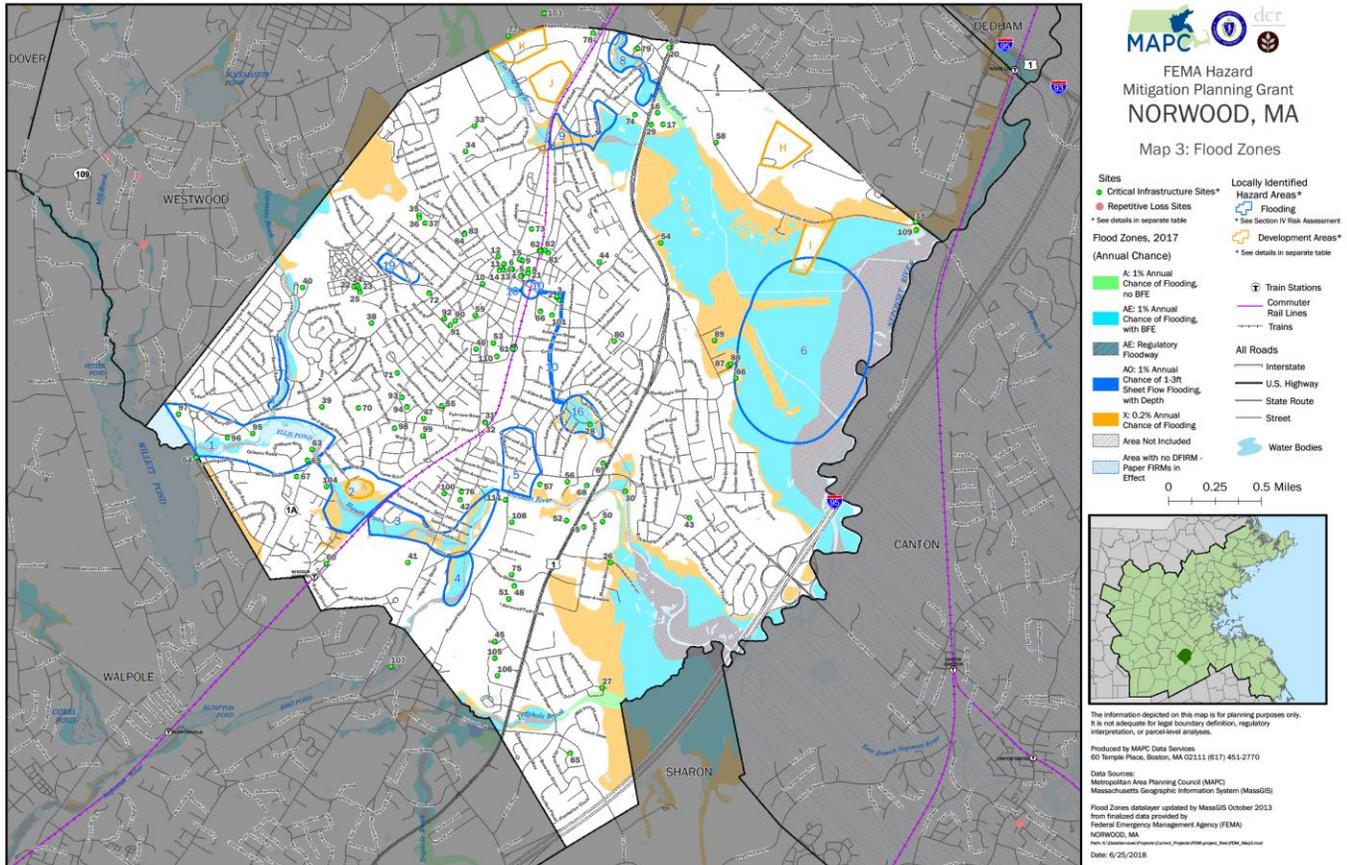


TOWN OF NORWOOD HAZARD MITIGATION PLAN 2018 UPDATE



Final Plan
Adopted by the Town
November 6, 2018

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ACKNOWLEDGEMENTS & CREDITS

This plan was prepared for the Town of Norwood by the Metropolitan Area Planning Council (MAPC) under the direction of the Massachusetts Emergency Management Agency (MEMA) and the Massachusetts Department of Conservation and Recreation (DCR). The plan was funded by the Federal Emergency Management Agency's (FEMA) Pre-Disaster Mitigation (PDM) Grant Program.

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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 Norwood Local Hazard Mitigation Planning Team, composed of staff from a number of different Town Departments. This team met on November 14, 2017, January 31, 2018, and May 21, 2018 and discussed where the impacts of natural hazards most affect the town, goals for addressing these impacts, updates to the Town's existing mitigation measures, and new or revised hazard mitigation measures that would benefit the town.

Public participation in this planning process is important for improving awareness of the potential impacts of natural hazards and to build support for the actions the Town takes to mitigate them. The Town's Local Hazard Mitigation Planning Team hosted two public meetings, the first on March 12, 2018 and the second on July 10, 2018 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. See Public Meetings (page 17-18) for comments.

RISK ASSESSMENT

The Norwood 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 B.

The Norwood Local Hazard Mitigation Planning Team identified 111 Critical Facilities. These are also shown on the map series and listed in Table 30, 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 Norwood estimates property damages from Hurricanes of category 2 and 4 (\$22.8 million to \$97.4 million), earthquakes of magnitudes 5 and 7 (\$641.23 million to \$4.466 billion), and the 1% and .2% chance of flooding (\$20.9 to \$31.6 million).

HAZARD MITIGATION GOALS

The Norwood Local Multiple Hazard Community Planning Team endorsed the following nine hazard mitigation goals at the January 31, 2018 team meeting.

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 communities, state, regional and federal agencies to ensure regional cooperation and solutions for hazards affecting multiple communities.
7. Ensure that future development meets federal, state and local standards for preventing and reducing the impacts of natural hazards.
8. Take maximum advantage of resources from FEMA and MEMA to educate Town staff and the public about hazard mitigation.
9. Consider the potential impacts of future climate change and incorporate climate sustainability and resiliency in hazard mitigation planning.

HAZARD MITIGATION STRATEGY

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

PLAN REVIEW & UPDATE PROCESS

The process for developing Norwood’s Hazard Mitigation Plan 2018 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 hosted by the Planning Board and the Board of Selectmen. The plan was also available on the Town’s website for public comment. See Public Meetings (page 17-18) for comments.
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 and assessed the potential impacts of flooding using the latest data.
Section 5: Goals	The Hazard Mitigation Goals were reviewed and endorsed by the Norwood Local Hazard Mitigation Planning Team.
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 2011 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 2018 Plan Update or modify or delete them. The Plan Update's hazard mitigation strategy reflects both new measures and measures carried forward from the 2011 plan. The Local Hazard Mitigation Team prioritized all of these measures based on current conditions.
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 35, Norwood made good progress implementing mitigation measures identified in the 2011 Hazard Mitigation Plan. Many flood protection projects have been completed, including: channel and drainage maintenance and improvements beneath the Washington Street bridge, and at the Norwood Airport, at Purgatory, Plantingfield, Meadow, Traphole, and Howes Brooks. The Morse Street bridge was reconstructed, culvert work at Winter Street was completed, and equipment to improve access to fire hazards was purchased. In addition, the Town made two significant open space purchases and adopted the Community Preservation Act, which will facilitate future purchases.

Several projects that were not completed will be continued into this plan update. In many cases where the town made drainage improvements, additional goals identified in the 2011 plan were not completed. As a result drainage projects at the Norwood Airport, and Purgatory, Plantingfield, Meadow, and Howes Brooks are included in the 2018 plan. A project to increase the size of a culvert at Dean Street is underway and will be completed in 2019. Open space purchases are an ongoing priority. Projects related to the Willett Pond, and Hollingsworth & Vose Dams were not completed are continued in the 2018 plan. Progress on the dams is challenging as ownership is private and, the Hollingsworth and Vose dam is not located in Norwood.

Moving forward into the next five year plan implementation period there will be many more opportunities to incorporate hazard mitigation into the Town's decision making processes. Though not formally done in the 2011 Plan, the Town will document any actions taken within this iteration of the Hazard Mitigation Plan on challenges met and actions successfully adopted as part of the ongoing plan maintenance to be conducted by the Norwood Hazard Mitigation Implementation Team, as described in Section 9 Plan Adoption and Maintenance.

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 Norwood received a grant from the Federal Emergency Management Agency (FEMA) under the Pre-Disaster Mitigation (PDM) Program, to assist the Town in updating its local Hazard Mitigation Plan, which was first adopted in 2011.

WHAT IS A HAZARD MITIGATION PLAN?

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

PREVIOUS FEDERAL/STATE DISASTERS

The Town of Norwood has experienced 21 natural hazards that triggered federal or state disaster declarations since 1991. These are listed in Table below. The majority of these events involved flooding, while five were due to hurricanes or nor'easters, and four were due to severe winter weather.

Table 2: Previous Federal/State Disaster Declarations

Disaster Name (Date of Event)	Type of Assistance	Declared Areas
Hurricane Bob (August 1991)	FEMA Public Assistance Project Grants	Counties of Barnstable, Bristol, Dukes, Essex, Hampden, Middlesex, Plymouth, Nantucket, Norfolk, Suffolk
	Hazard Mitigation Grant Program	Counties of Barnstable, Bristol, Dukes, Essex, Hampden, Middlesex, Plymouth, Nantucket, Norfolk, Suffolk (16 projects)
No-Name Storm (October 1991)	FEMA Public Assistance Project Grants	Counties of Barnstable, Bristol, Dukes, Essex, Middlesex, Plymouth, Nantucket, Norfolk

Disaster Name (Date of Event)	Type of Assistance	Declared Areas
	FEMA Individual Household Program	Counties of Barnstable, Bristol, Dukes, Essex, Middlesex, Plymouth, Nantucket, Norfolk
	Hazard Mitigation Grant Program	Counties of Barnstable, Bristol, Dukes, Essex, Middlesex, Plymouth, Nantucket, Norfolk, Suffolk (10 projects)
March Blizzard (March 1993)	FEMA Public Assistance Project Grants	All 14 Counties
January Blizzard (January 1996)	FEMA Public Assistance Project Grants	All 14 Counties
May Windstorm (May 1996)	State Public Assistance Project Grants	Counties of Plymouth, Norfolk, Bristol
October Flood (October 1996)	FEMA Public Assistance Project Grants	Counties of Essex, Middlesex, Norfolk, Plymouth, Suffolk
	FEMA Individual Household Program	Counties of Essex, Middlesex, Norfolk, Plymouth, Suffolk
	Hazard Mitigation Grant Program	Counties of Essex, Middlesex, Norfolk, Plymouth, Suffolk (36 projects)
(1997)	Community Development Block Grant-HUD	Counties of Essex, Middlesex, Norfolk, Plymouth, Suffolk
June Flood (June 1998)	FEMA Individual Household Program	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester
	Hazard Mitigation Grant Program	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester (19 projects)
(1998)	Community Development Block Grant-HUD	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester
March Flood (March 2001)	FEMA Individual Household Program	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester
	Hazard Mitigation Grant Program	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester (16 projects)
February Snowstorm (Feb 17-18, 2003)	FEMA Public Assistance Project Grants	All 14 Counties
January Blizzard (January 22-23, 2005)	FEMA Public Assistance Project Grants	All 14 Counties
Hurricane Katrina (August 29, 2005)	FEMA Public Assistance Project Grants	All 14 Counties
May Rainstorm/ Flood (May 12-23, 2006)	Hazard Mitigation Grant Program	Statewide
April Nor'easter (April 15-27, 2007)	azard Mitigation Grant Program	Statewide

Disaster Name (Date of Event)	Type of Assistance	Declared Areas
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
Tropical Storm Irene (August 27-28, 2011)	FEMA Public Assistance	Statewide
Hurricane Sandy (October 27-30, 2012)	FEMA Public Assistance	Statewide
Severe snowstorm and Flooding (February 8-09, 2013)	FEMA Public Assistance; Hazard Mitigation Grant Program	Statewide
Blizzard of 2015 (January 26-28, 2015)	FEMA Public Assistance; Hazard Mitigation Grant Program	Statewide

Source: Database provided by MEMA

FEMA FUNDED MITIGATION PROJECTS

The Town of Norwood has received funding from FEMA for three projects under the Hazard Mitigation Grant Program (HMGP). The projects totaled \$153,285, with \$114,969 covered by FEMA grants and \$38,316 by local funding. The projects are summarized in Table 3 below.

Table 3: FEMA-Funded Mitigation Projects

Grant	Project Title	Scope of Work	Total Cost	Federal Funding	Local Funding
1364-10	Sumner Street Culvert	Culvert rebuilt and enlarged	\$121,335	\$91,001	\$30,334
HMGP 06	Local Hazard Mitigation Plan	Development of first hazard mitigation plan	\$12,000	\$9,000	\$3,000
HMGP 16	Local Hazard Mitigation Plan	5-Year update of hazard mitigation plan	\$19,950	\$14,968	\$4,982

Source: MEMA 2016 Database

COMMUNITY PROFILE

Located on Interstate 95 and just a few miles southwest of the intersection of Interstates 95 and 93, Norwood has a population of 29,000. It is bordered on the north and northwest by the town of Westwood, on the east by the town of Canton, on the south by the town of Sharon and to the west and southwest by Walpole.

The earliest European settlers of what eventually became the Town of Norwood arrived from Dedham in the late 17th century. The attraction was the swift moving Neponset River in present day South Norwood near the East Walpole line. The Neponset River was to become the driving force for the town's development throughout the next two centuries. Known officially as the second parish of Dedham, most inhabitants referred to their village by its Indian name, Tiot. The population grew through the 18th century, and names such as Tiot, Morse Village, and Ellis distinguished the various population centers.

In 1872 the Massachusetts General Court approved the creation of a new town. South Dedham, after having been a parish of the Town of Dedham for 142 years, took its place among the towns of Norfolk County as "Norwood" on February 13, 1872 when the Act of Incorporation was approved by the General Court. At that time, 1,825 people, almost exclusively Anglo Saxon Protestants, lived within its area of 10.48 square miles.

The railroad came to South Dedham in the late 1840's making it increasingly attractive to industry. Between the years 1872 and 1922, industry replaced agriculture as the economic base of the community. Many of Norwood's industries were world-famous for their products. There were tanneries, printers, and book manufacturers and binderies, an ink mill, railroad shops, foundries, paper mills, a roofing plant, and a floor-covering mill. Several of these old industries have since dissolved or moved but others have survived and prospered.

Attracted by the rise of new industry, various foreign-born peoples moved into the Town and the population increased to over 12,600 during this period. The influx and assimilation of immigrants has placed Norwood among the most culturally diverse towns of its size and type in New England. Norwood achieved a degree of unprecedented prosperity between 1905 and 1922. Economic and physical expansion culminated in the "Town Manager" form of government in 1914 as a more effective way to administer the growing town.

Industrial development continued in Norwood through the mid-20th century. After World War II a gradual shift to high tech occurred in Norwood. Major corporations found Norwood's proximity to Boston and access to major east-coast population centers to be attractive for business. During the 1970's, changes in the global economy forced many manufacturers to shift their operations to different states or out of the country altogether. Norwood replaced much of that manufacturing business with auto related business. Indeed, Norwood's "Automile" is a nationally recognized term. The Town is still considered one of the more important manufacturing, suburban-residential, and wholesale and retail trade centers south of Boston.

(Excerpted from the Norwood Open Space and Recreation Plan)

The Town is governed by a five-member Board of Selectmen with a General Manager and operates under an elected representative Town Meeting format. The town maintains a website at www.norwoodma.gov

Table 4: Norwood Characteristics

Population = 29,018 people
<ul style="list-style-type: none">• 5.7% are under age 5• 14.3% are under age 18• 17.2% are over age 65• 6.7% have a disability• 2.8% of households have no vehicle available• 6.7% of households are limited English-speaking
Number of Housing Units = 12,272
<ul style="list-style-type: none">• 42.5% are renter-occupied housing units• 23.9% of housing units were built before 1940

Sources: 2016 American Community Survey 5-Year Estimates

The Town of Norwood has several unique characteristics to keep in mind while planning for natural hazards:

- Flooding in the town is not a significant threat to lives or property. However, the town does have some problems with water inundation during high rain and storm events and during the spring snowmelt season.
- Most of Norwood's border with Canton to the east, follows the Neponset River. The river and its associated wetlands are among the town's principal flooding concerns.
- Another principal flooding concern is the area immediately downstream of the Willett Pond Dam and dike. The vast majority of Willett Pond is located in neighboring Walpole to the town's west, but the dam and dike are located in Norwood and the majority of flood waters in the event of a dam breach would run into Norwood toward Ellis Pond.
- The town has proactive municipal officials that frequently share information and coordinate on a regular basis.
- Norwood is home to historic structures and sites that are irreplaceable and bring economic value to the town.
- Norwood contains several major roadways that provide emergency routes for evacuation and for routes to medical facilities, including Norwood Hospital, which serves several of its neighboring communities in emergency situations.
- Norwood has some bridge crossings and roadways that could be at risk in the event of flooding.
- Norwood would be a good candidate for flood-related grants due to the potential impact to property, transportation emergency routes, economic/historic resources, and the ability to solve the flooding problems through structural measures such as culvert upgrades, dam and bridge upgrades or flood proofing. The cost-benefit analysis would likely be in the town's favor.
- Much of the critical infrastructure in the town is located in clusters, often near areas of floodplain. These facilities are therefore at higher risk during natural hazards.

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 a Local Hazard Mitigation Planning Teams two public meetings hosted by the local Hazard Mitigation Team, posting of the plan to the Town’s website, and invitations sent to neighboring communities, Town boards and commissions, 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 B.
2. **Assess the Risks & Potential Damages** – Working with local staff, critical facilities, infrastructure, vulnerable populations, and other features are mapped and contrasted with the hazard data from the first step to identify those that might represent particular vulnerabilities to these hazards. Land use data and development trends are also incorporated into this analysis. In addition, MAPC develops estimates of the potential impacts of certain hazard events on the community. MAPC drew on the following resources to complete the plan:
 - Bylaws of the Town of Norwood, 2017
 - Town of Norwood, Zoning Bylaws
 - Town of Norwood Open Space and Recreation Plan
 - Town of Norwood 2014 Annual Report
 - Town of Norwood Community Resilience Building Workshop, Summary of Findings June 2018
 - Massachusetts State Hazard Mitigation Plan, 2013
 - FEMA, Local Mitigation Plan Review Guide, October 2011
 - FEMA, Flood Insurance Rate Maps for Norfolk County, MA, 2012
 - Massachusetts State Hazard Mitigation Plan, 2013
 - Metropolitan Area Planning Council, GIS Lab, Regional Plans and Data.
 - New England Seismic Network, Boston College Weston Observatory, <http://aki.bc.edu/index.htm>
 - NOAA National Centers for Environmental Information, <http://www.ncdc.noaa.gov/>
 - Northeast States Emergency Consortium, <http://www.nesec.org/>
 - USGS, National Water Information System, <http://nwis.waterdata.usgs.gov/usa/nwis>
 - US Census, 2010 and American Community Survey 2015 5-Year Estimates
3. **Review Existing Mitigation** – Municipalities in the Boston Metropolitan Region have an active history in hazard mitigation as most have adopted flood plain zoning districts, wetlands protection programs, and other measures as well as enforcing the State building code, which has strong provisions related to hazard resistant building requirements. All current municipal mitigation measures must be documented.
4. **Develop Mitigation Strategies** – MAPC works with the local municipal staff to identify new mitigation measures, utilizing information gathered from the hazard identification, vulnerability assessments, and the community’s existing mitigation efforts to determine where additional work is necessary to reduce the potential damages from hazard events. Additional information on the development of hazard mitigation strategies can be found in Section 7.
5. **Plan Approval & Adoption** – Once a final draft of the plan is complete it is sent to MEMA for the state level review and, following that, to FEMA for approval. Typically, once FEMA has approved the plan the agency issues a conditional approval (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 E.

- 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.

2011 PLAN IMPLEMENTATION & MAINTENANCE

The 2011 Town of Norwood Hazard Mitigation Plan contained a risk assessment of identified hazards for the town and mitigation measures to address the risk and vulnerability from these hazards. Since approval of the plan by FEMA and local adoption, progress has been made on implementation of the measures. The Town has advanced a number of projects for implementation, including numerous drainage and culvert improvements and, open space purchases.

THE LOCAL MULTIPLE HAZARD COMMUNITY PLANNING TEAM

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

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

Name	Representing
Paul Halkiotis	Planning and Economic Development Director
Pat Deschenes	Assistant Town Planner
Bernard Cooper	Assistant General Manager
Ron Maggio	Deputy Fire Chief
Andrew Murphy	Assistant Town Engineer
Christopher Padden	Police Lieutenant
Al Goetz	Conservation Agent
Mark Ryan	Public Works Director
Tony Greeley	Fire Chief

The Norwood Planning Board and the Norwood Conservation Commission, are the primary entities responsible for regulating development in town. Feedback from the Planning Board and the Conservation Commission was assured through the participation of the Planning and Economic Development Director, Conservation Agent and the Assistant General Manager. In addition, MAPC, the State-designated regional planning authority for Norwood, works with all agencies that regulate development in the region, including the listed municipal entities and state agencies, such as the MassDOT and the MBTA.

The Local Hazard Mitigation Planning Team met on the following dates: November 14, 2017; January 31, 2018; and May 21, 2018. 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 2011 hazard mitigation plan, and potential new or revised mitigation measures. The agendas for these meetings are included in Appendix A.

PUBLIC MEETINGS

Public participation in the hazard mitigation planning process is important, both for plan development and for later implementation of the plan. Residents, business owners, and other community members are an excellent source for information on the historic and potential impacts of natural hazard events and particular vulnerabilities the community may face from these hazards. Their participation in this planning process also builds understanding of the concept of hazard mitigation, potentially creating support for mitigation actions taken in the future to implement the plan. To gather this information and educate residents on hazard mitigation, the Town hosted two public meetings, one during the planning process and one after a complete draft plan 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 Norwood hazard mitigation planning process during a meeting of the Planning Board on March 12, 2018 held at Norwood Town Hall. It was broadcast on local cable television and covered by two local newspapers. The draft plan update was presented at a Board of Selectmen meeting on July 10, 2018 at Norwood Town Hall. Both meetings were publicized in accordance with the Massachusetts Public Meeting Law. The attendance list for each meeting can be found in Table 5. See public meeting notices in Appendix C.

At the March 12, 2018 meeting, comments included: 1) protect downstream condominiums, by installing an automated outlet control system and/or management system for the Martin Curran (Ellis Pond) dam; 2) reduce impervious surfaces to address stormwater flooding and address this issue on a regional basis in cooperation with the Neponset River Watershed Association; 3) set aside additional green space; 4) look into drainage issues at Rt. 1 at Meadow Brook, and Rt. 1 and Dean Street; 5) support state takeover of Willett Pond dam to ensure safety upgrades are implemented.

Table 5 Norwood Public Meetings	
Meeting #1 March 12, 2018	
Total Attendance: 20	
Name	Representing
Paul Halkiotis	Planning and Community Development
Patrick Deschenes	Planning and Community Development
Members of the Planning Board and approximately 12 representatives of the public.	
Meeting #2 July 10, 2018	
Members of the Board of Selectmen	
Paul Halkiotis	Planning and Community Development
Bernie Cooper	Assistant General Manager
Tony Maccuzzo	General Manager
Approximately 6 representatives of the public	

LOCAL STAKEHOLDER INVOLVEMENT

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

- Neponset Valley Chamber of Commerce
- Norwood Housing Authority
- Norwood - Dedham Medical Center
- Analog Devices
- Advanced Resourcing
- Norwood Hospital
- Town of Westwood
- Town of Canton
- Town of Sharon
- Town of Walpole

See Appendix C for public meeting notices. The draft Norwood Hazard Mitigation Plan 2018 Update was posted on the Town's website for the second public meeting. Members of the public could access the draft document and submit comments or questions to the Town. No public comments were received.

CONTINUING PUBLIC PARTICIPATION

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

PLANNING TIMELINE

November 14, 2017	Meeting of the Norwood Local Hazard Mitigation Planning Team
January 31, 2018	Meeting of the Norwood Local Hazard Mitigation Planning Team

March 12, 2018	First Public Meeting with the Norwood Planning Board
April 25, 2018	Climate resilience workshop
May 21, 2018	Meeting of the Norwood Local Hazard Mitigation Planning Team
July 10, 2018	Second Public Meeting with the Norwood Board of Selectmen
August 14, 2018	Draft Plan Update submitted to MEMA
October 26, 2018	FEMA Notice of Approvable Pending Adoption
November 6, 2018	Plan Adopted by the Town

SECTION 4: RISK ASSESSMENT

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

In order to update Norwood’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

The Massachusetts Hazard Mitigation Plan provides an in-depth overview of natural hazards in Massachusetts. Previous state and federal disaster declarations since 1991 are summarized in Table 2. Table 6 below summarizes the hazard risks for Norwood. This evaluation takes into account the frequency of the hazard, historical records, and variations in land use. This analysis is based on the vulnerability assessment in the Massachusetts State Hazard Mitigation Plan. The statewide assessment was modified to reflect local conditions in Norwood using the definitions for hazard frequency and severity listed below. Based on this, the Town set an overall priority for each hazard.

Table 6: Hazard Risks Summary

Hazard	Frequency		Severity	
	Massachusetts	Norwood	Massachusetts	Norwood
Flooding	High	Medium	Serious to extensive	Serious
Dam failures	Low	Very 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	Minor
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
Ice Jams	Low	N/A	Serious	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 Norwood

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 some of the hazards listed in the 2013 Massachusetts State Hazard Mitigation plan are not applicable to the Town of Norwood. Due to its inland location, coastal hazards including tsunamis are not applicable to Norwood. Major urban fires are also not applicable to Norwood, due to the lack of significant wildfire hazards that could pose a significant threat of major urban fires. In addition, The US Army Corps Ice Jam Database shows no record of ice jams in Norwood.

FLOOD-RELATED HAZARDS

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

REGIONALLY SIGNIFICANT FLOODS

There have been a number of major floods that have affected the Metro Boston region over the last fifty years. Significant flood events that have impacted Norwood include:

- The Blizzard of 1978
- January 1979
- April 1987
- October 1991
- October 1996
- June 1998
- March 2001
- April 2004
- May 2006
- April 2007
- March 2010

Local data for previous flooding occurrences are not collected by the Town of Norwood. The best available local data is for Norfolk County through the National Centers for Environmental Information (see Table 7). Norfolk County, which includes the Town of Norwood, experienced 51 flood events from 1996 to 2016. No deaths or injuries were reported and the total reported property damage in the county was \$26.2 million dollars. Of that total, \$24.9 million is attributed to the two major events of March 2010.

Table 7: Norfolk County Flood Events, 1996 to 2017

Date	Deaths	Injuries	Property Damage
01/27/1996	0	0	0.00K
09/18/1996	0	0	0.00K
10/21/1996	0	0	0.00K
05/12/1998	0	0	0.00K
06/13/1998	0	0	570.00K
06/15/1998	0	0	0.00K
03/05/2001	0	0	0.00K
03/22/2001	0	0	0.00K
03/22/2001	0	0	0.00K
04/01/2001	0	0	0.00K
03/28/2005	0	0	0.00K
10/15/2005	0	0	30.00K
10/15/2005	0	0	40.00K
10/15/2005	0	0	200.00K
10/15/2005	0	0	60.00K
10/15/2005	0	0	40.00K
10/15/2005	0	0	140.00K
10/25/2005	0	0	35.00K
05/13/2006	0	0	5.00K
06/07/2006	0	0	20.00K
06/07/2006	0	0	0.00K
06/07/2006	0	0	0.00K
10/28/2006	0	0	8.00K
11/24/2006	0	0	0.00K
03/02/2007	0	0	5.00K
04/18/2007	0	0	5.00K
02/13/2009	0	0	10.00K
07/02/2009	0	0	5.00K
08/15/2009	0	0	3.00K
05/24/2009	0	0	0.00K
06/27/2009	0	0	15.00K
03/14/2010	0	0	16.64M

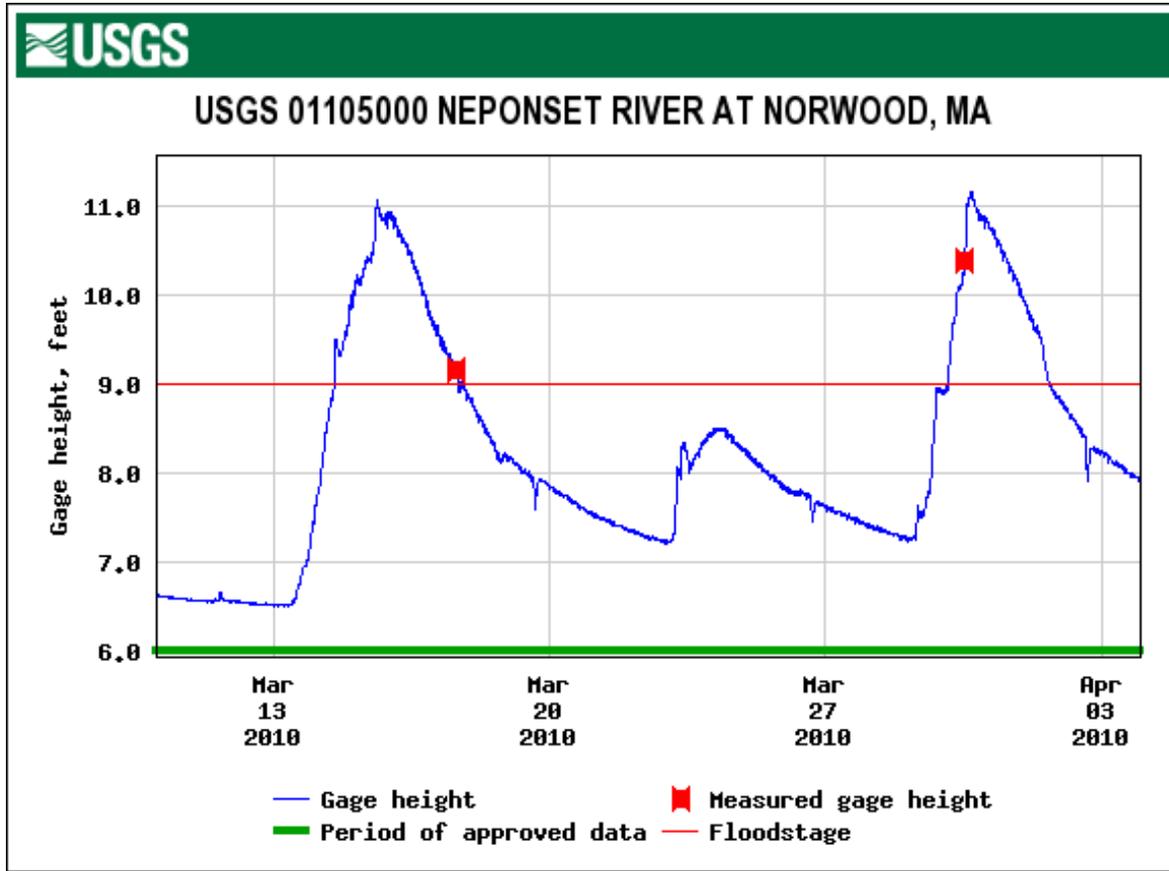
Date	Deaths	Injuries	Property Damage
03/29/2010	0	0	8.320M
04/01/2010	0	0	0.00K
07/24/2010	0	0	20.00K
08/05/2010	0	0	0.00K
08/25/2010	0	0	8.00K
08/28/2011	0	0	0.00K
08/15/2012	0	0	0.00K
10/29/2012	0	0	0.00K
06/07/2013	0	0	0.00K
07/29/2013	0	0	0.00K
08/09/2013	0	0	15.00K
10/22/2014	0	0	0.00K
10/23/2014	0	0	0.00K
8/15/2015	0	0	0.00K
8/18/2015	0	0	0.00K
8/18/2015	0	0	0.00K
6/07/2016	0	0	0.00K
6/07/2016	0	0	5.00K
8/14/2016	0	0	5.00K
4/1/2017	0	0	5.00K
7/12/2017	0	0	0.00K
7/18/2017	0	0	1.00K
8/2/2017	0	0	0.00K
9/30/2017	0	0	10.00K
10/25/2017	0	0	0.00K
10/29/2017	0	0	0.00K
Total	0	0	26.2 M

Source: NOAA, National Centers for Environmental Information

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

One indication of the extent of flooding is the gage height at the nearest USGS streamflow gauging station, which is on the Neponset River in Norwood. The USGS gage height, shown in Figure 2, reached 11 feet on March 17, 2010 and again on March 31, 2010. Flood stage at this gage is 9 feet.

Figure 2 USGS Flow Gage Data for Neponset River, March 2010



OVERVIEW OF TOWN-WIDE FLOODING

As with most of eastern Massachusetts the natural hazard threat that is most prevalent in the town of Norwood, and therefore the focus of most of the town’s hazard mitigation efforts is flooding. The town is located within the Neponset River watershed. The Neponset enters Norwood from Walpole in the southwest and forms Norwood’s eastern border with Canton. The Neponset and its tributaries, including Hawes Brook, Purgatory Brook, Meadow Brook, Plantingfield Brook, and Ellis Pond are sources of flooding. A primary concern for major flooding is the potential of a dam breach at the Willett Pond Dam on the Walpole/Norwood border.

Virtually all of the 100-year and 500-year flood zones in town are located near major bodies of water, including those named above. However, in many of those zones the flood frequency is greater than the 100-year flood event. Though the flood zones have not been properly studied as a system, town officials believe that many of the town’s more frequent flooding problems are related to insufficient or inoperable flood management structures, such as culverts, dams and drain pipes that are not large enough to quickly transport flood waters away from town streets and neighborhoods and toward the nearby wetlands. With its combined water sources, areas in Norwood can accumulate a great deal of water in a short amount of time during heavy rains, severe storms and in the spring season.

POTENTIAL FLOOD HAZARD AREAS

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

Flood Insurance Rate Map Zone Definitions

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

Zone AE (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.

LOCALLY IDENTIFIED AREAS OF FLOODING

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

Table 8: Other Locally Identified Areas of Flooding

Map ID	Name	Description
1	Willett Pond Dam	The dam is owned by the non-profit Neponset River Watershed Association. It is considered a high hazard dam that would severely impact Norwood downstream of the dam if it were to fail. There hasn't been any flooding of the dam in the past, however, a potential breach of the Willett Pond Dam and Dike are among the most serious flooding threats facing the town. Work has been done to remove vegetation and boards were replaced on the outlet control structure. Ownership of the dam may change hands in the future. Norwood officials consider this a high priority.
2	The Tannery site at Hawes Brook	This is a moderate flooding hazard according to Norwood officials. The water source here is Hawes Brook, an outlet from Ellis Pond, which sits upstream. There is an existing dam and spillway area at this site. The building and debris that contribute to flooding in this location have been removed. However, the banks of Hawes Brook are restrained by

		<p>cemented stone walls causing flooding.</p> <p>Ellis Pond has a dam that now operates properly and the DPW lowers water level if rain is forecasted. This area remains a priority as the tannery still has a restricting effect on the brook.</p>
3	Bridge at Washington Street	<p>This was a high flooding hazard related to a culvert under the Washington Street Bridge. The area used to flood almost annually but has been controlled with improved maintenance and monitoring of the culvert and drainage channel.</p>
4	Norwood Industrial Park	<p>Moderate flooding at this site occurs every five or ten years and mostly effects a commercial/industrial site along Hawes Brook. The bridge has been reconstructed and channel improvements have increased capacity. As there are still some restrictions, this area remains a flooding risk. Release of water from upstream dams will cause flooding in this location.</p>
5	Dean Street	<p>Moderate flooding in this neighborhood is related to drainage issues in a developed low-lying area where the drainage pipes are likely inadequate. Flooding is infrequent, once every ten years or so. Drainage has been improved, but additional downstream capacity is still needed. A culvert project to alleviate the flooding will be completed in 2019.</p>
6	Norwood Airport	<p>The airport is located in the floodplain of the Neponset River. The area is noted for both fire and floods. Fires here are rare, and do not endanger homes or roadways, but the area does include peat bogs, which can be very difficult to extinguish when they catch fire. Flooding is much more frequent, affecting the runways and taxiways every two to three years. Vegetation and mosquito management, and maintaining the culverts has helped. Beavers are a new flooding issue.</p>
7	Westover Parkway to Nichols	<p>This area floods approximately every ten years. There is an existing drainage/culvert system. Future mitigation could include maintenance and possible culvert upgrades. Maintenance work has been done.</p>
8	Purgatory Brook	<p>This area floods infrequently according to local officials. Expanded culverts, and excavation of sediments from the bottom of the drainage system would improve capacity. However, access challenges make this a very difficult place to clear sediments. This location is also related to airport flooding.</p>
9	Plantingfield Brook	<p>Drainage and flooding is an occasional problem in the vicinity of Upland Road. Flooding areas for Purgatory Brook and Plantingfield Brook are adjacent to private property. They are overgrown with trees and brush and difficult to access to remove debris and sediment.</p>
10	Nahatan Street Underpass	<p>This is a high severity flooding threat, because it closes Nahatan Street when the roadway under the RR trestle floods. The area floods every three to five years in heavy rains, as the water has nowhere to go. Some work has been done in relation to this problem. Previously, the flooding issue had extended down Nahatan Street to behind the police station and then south through residential neighborhoods and toward Meadow Brook. Town officials feel the only way to really alleviate this problem once and for all, is to increase flow and storage capacity all the way downstream to Meadow Brook and then improve Meadow Brook as well. Construction of a relief line or storage for this entire stretch was estimated at \$2.3 million. This area will need comprehensive study before moving forward..</p>

16	Meadow Brook, Sunnyside, Lawndale	Moderate flooding is related to drainage issues in a low-lying neighborhood. Flooding here is infrequent, once every ten years or so. As noted in item #10, town officials believe existing infrastructure is insufficient and recommend either increasing the size and capacity of pipes flowing to Meadow Brook or constructing/creating some type of storage area to handle the excess water in high water events. Work has been done that has reduced flooding.
19	Elm Street at Lincoln Street	Moderate flooding at this site used to occur every two or three years. Drainage work was done that has reduced the problem.
20	Pleasant Street near Summer Street	This is a low-lying area that experiences short-term flooding on the roadway.

Potential flooding damages in Norwood have been estimated using HAZUS-MH. Total direct building-related economic losses are estimated at \$20.9 million for a 100-year flood event and \$31.6 million for a 500-year flood event. Other potential impacts on the town are detailed in Table 33.

REPETITIVE LOSS STRUCTURES

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 2 repetitive loss properties in Norwood: both are non-residential properties. These properties are shown on the maps in Appendix A. These repetitive loss properties had a total of 6 losses between 1998 and 2010, totaling \$476,300 in damages. For more information on repetitive losses see https://www.fema.gov/txt/rebuild/repetitive_loss_faqs.txt and <https://www.fema.gov/repetitive-flood-claims-grant-program-fact-sheet>.

Table 9 summarizes the number and type of repetitive loss structures located within Norwood and the number of losses and total claims associated with them.

Table 9 Summary of Repetitive Losses and Claims

	Single Family Residential	Multi Family Residential	Commercial	Total
Number of Properties	0	0	2	2
Number of Losses	0	0	6	6
Total Claims	\$0	\$0	\$476,300	\$476,300

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

The state plan indicates that Massachusetts is one of the 10 states that cumulatively account for 76% of all repetitive loss buildings in the United States. Based on the record of previous occurrences flooding events in Norwood are a High frequency event as defined by the 2013 Massachusetts State Hazard Mitigation Plan. This hazard may occur more frequently than once in five years, or a greater than 20% chance per year.

DAMS AND DAM FAILURE

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

In the event of a dam failure, the energy of the water stored behind even a small dam can cause loss of life and property damage if there are people or buildings downstream. The number of fatalities from a dam failure depends on the amount of warning provided to the population and the number of people in the area in the path of the dam's floodwaters. An issue for dams in Massachusetts is that many were built in the 19th century without the benefits of modern engineering or construction oversight. In addition, some dams have not been properly maintained.

Dam failure is a highly infrequent occurrence but a severe incident could result in loss of lives and significant property damage. According to the Association of State Dam Safety Officials, three dams have failed in Massachusetts since 1984, one of which resulted in a death. There have been no recorded dam breaches in Norwood.

According to data provided by the Massachusetts Department of Conservation and Recreation and the Town, there are four dams in Norwood of various sizes. Willett Pond and Ellis Pond dams are classified as high hazard dams. Fishing Club Pond and Soap Mill Pond dams are small unregulated dams. Hollingsworth & Vose dam is located in Walpole, but failure would have significant impact in Norwood. None of the town's dams were listed in the State Auditor's report that identified dams in unsafe or poor condition.

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.

Based on the record of previous occurrences, dam failure in Norwood is a very low frequency event as defined by the 2013 Massachusetts State Hazard Mitigation Plan. This hazard may occur less frequently than once in 50 years to once in 100 years (1% to 2% per year). There have been no dam failures in Norwood to date.

WIND-RELATED HAZARDS

Wind-related hazards include hurricanes, tropical storms, and tornadoes, as well as high winds during nor'easters and thunderstorms. As with many communities, falling trees that result in downed power lines and power outages are an issue in Norwood. Information on wind related hazards can be found on Map 5 in Appendix B.

HURRICANES AND TROPICAL STORMS

A hurricane is a violent wind and rainstorm with wind speeds of 74 to 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 land. Given its location not too distant from the coast, the Town of Norwood'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, 39 tropical storms have impacted New England (NESEC). Massachusetts has experienced approximately 32 tropical storms, nine Category 1 hurricanes, five Category 2 hurricanes and one Category 3 hurricane.

As shown in the hazard mapping in Appendix B, one tropical depression tracked through Norwood in 1944. A hurricane or storm track is the line that delineates the path of the eye of a hurricane or tropical storm. The town also experiences the impacts of the wind and rain of hurricanes and tropical storms regardless of whether the storm track passed through the town. The hazard mapping indicates that the 100 year wind speed in Norwood is 110 miles per hour.

Table 10: Hurricane Records for Massachusetts, 1938 to 2012

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

Source: National Oceanic and Atmospheric Administration

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

Table 11: Saffir/Simpson Scale

Scale No. (Category)	Winds (mph)	Surge (ft)	Potential Damage
1	74 – 95	4 - 5	Minimal
2	96 – 110	6 - 8	Moderate
3	111 – 130	9 - 12	Extensive
4	131 – 155	13 - 18	Extreme
5	> 155	>18	Catastrophic

Source: NOAA

Hurricanes typically have regional impacts beyond their immediate tracks. Falling trees and branches are a significant problem because they can result in power outages when they fall on power lines or block traffic and emergency routes. Hurricanes are a town-wide hazard in Norwood. Potential hurricane damages to Norwood have been estimated using HAZUS-MH. Total damages are estimated at \$24.3 million for a Category 2 hurricane and \$108.4 million for a Category 4 hurricane. Other potential impacts are detailed in Table 31.

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

TORNADOS

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

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

Tornado damage severity is measured by the Fujita Tornado Scale, in which wind speed is not measured directly but rather estimated from the amount of damage. As of February 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 EF-scale is summarized below:

Table 12: Enhanced Fujita Scale

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

An F2 tornado touched down in the Town of Norwood on November 21, 1956 in the vicinity of Route 95 and Neponset Street. Since 1950, there have been eleven tornadoes in Norfolk County recorded by the Tornado History Project. There have been one F3 and one F2, and three F1 tornadoes. These eleven tornadoes resulted in a total of one fatality and 23 injuries and up to \$6.6 million in damages, as summarized in Table 13.

Table 13: Tornado Records for Norfolk County

Date	Fujita	Fatalities	Injuries	Width	Length	Damage
June 1953	3	0	17	667	28	\$500K – 5M
11/21/1956	2	0	0	17	0.1	\$500-\$5000
8/9/1972	1	1	6	30	4.9	\$5K-\$50K
9/6/1973	1	0	0	10	1.1	\$5K-\$50K
7/10/1989	0	0	0	23	0.1	\$500-\$5000
5/18/1990	0	0	0	10	0.2	\$500-\$5000
5/18/1990	0	0	0	10	0.2	\$500-\$5000
6/30/2001	0	0	0	80	0.1	-
8/21/2004	1	0	0	40	6	\$1,500,000
5/9/2013	0	0	0	50	0.38	\$20,000
06/23/2015	0	0	0	200	0.48	-

Source: The Tornado History Project

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

Although tornadoes are a potential town-wide hazard in Norwood, tornado impacts are relatively localized compared to severe storms and hurricanes. Damages from any tornado in Norwood would greatly depend on the track of the tornado.

Based on the record of previous occurrences since 1956, Tornado events in Norwood are a low frequency event as defined by the 2013 Massachusetts State Hazard Mitigation Plan. This hazard may occur from once in 50 years to once in 100 years (1% to 2% per year).

NOR'EASTERS

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

Table 14: Nor'easter Events for Massachusetts, 1978 to 2011

Nor'easter Event	Date
Blizzard of 1978	February 1978
Severe Coastal Storm ("Perfect Storm")	October 1991
Great Nor'easter of 1992	December 1992
Blizzard/Nor'easter	January 2005
Coastal Storm/Nor'easter	October 2005
Severe Storms, Inland & Coastal Flooding/Nor'easter	April 2007
Winter Storm/Nor'easter	January 2011
Severe Storm/Nor'easter	October 2011
Severe Storm/Nor'easter	February 2013
Severe Storm/Nor'easter	January 2015
Severe Storm/Nor'easter	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. More recently, blizzards in February 2013, January 2015, and in March 2018 were large nor'easters that caused significant snowfall amounts.

Norwood is vulnerable to both the wind and precipitation that accompany nor'easters. High winds can cause damage to structures, fallen trees, and downed power lines leading to power outages. Intense rainfall can overwhelm drainage systems causing localized flooding of rivers and streams as well as urban

stormwater ponding and localized flooding. Fallen tree limbs as well as heavy snow accumulation and intense rainfall can impede local transportation corridors, and block access for emergency vehicles.

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

SEVERE THUNDERSTORMS

While less severe than the other types of storms discussed, thunderstorms can lead to localized damage and represent a hazard risk for communities. A thunderstorm typically features lightning, strong winds, 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 Norwood is for Norfolk County through the National Centers for Environmental Information (NCEM). Between the years 1995 and 2016, NCEM records show 63 thunderstorm events in Norfolk County (Table 15). These storms resulted in a total of \$1,055,500 in property damages. There were no injuries or deaths reported.

Table 15: Norfolk County Thunderstorm Events, 1995 to 2016

Date	Magnitude*	Deaths	Injuries	Damage (\$)
4/4/1995	53	0	0	0
7/15/1995	55	0	0	0
10/28/1995	0	0	0	0
5/21/1996	60	0	0	0
5/31/1998	50	0	0	0
6/26/1998	50	0	0	20000
7/20/1998	50	0	0	0
7/23/1998	50	0	0	0
7/6/1999	70	0	0	0
7/24/1999	50	0	0	0
8/5/1999	50	0	0	0
4/9/2000	61	0	0	0
6/2/2000	50	0	0	0
6/27/2000	50	0	0	0
7/18/2000	55	0	0	0
8/10/2000	50	0	0	0
6/30/2001	50	0	0	0
8/10/2001	50	0	0	20000
6/16/2002	50	0	0	5000

Date	Magnitude*	Deaths	Injuries	Damage (\$)
7/15/2002	62	0	0	25000
7/23/2002	50	0	0	7000
8/21/2004	50	0	0	25000
8/5/2005	50	0	0	25000
8/14/2005	50	0	0	20000
5/21/2006	52	0	0	35000
6/1/2006	50	0	0	15000
6/23/2006	50	0	0	15000
7/4/2006	50	0	0	40000
7/21/2006	50	0	0	15000
7/28/2006	50	0	0	20000
8/2/2006	50	0	0	55000
6/28/2007	50	0	0	0
7/28/2007	50	0	0	0
8/17/2007	50	0	0	0
6/24/2008	50	0	0	5000
7/2/2008	54	0	0	20000
8/3/2008	50	0	0	1000
9/9/2008	50	0	0	1000
5/24/2009	50	0	0	1000
6/27/2009	50	0	0	10000
7/7/2009	50	0	0	500
7/8/2009	50	0	0	1000
7/31/2009	50	0	0	26000
6/6/2010	53	0	0	10000
6/20/2010	58	0	0	113000
6/24/2010	50	0	0	1000
8/19/2011	50	0	0	7000
6/23/2012	50	0	0	41000
8/10/2012	50	0	0	5000
8/15/2012	40	0	0	500
6/17/2013	50	0	0	11000
7/29/2013	50	0	0	20500
7/3/2014	50	0	0	20000
7/28/2014	60	0	0	50000
6/23/2015	50	0	0	5000
8/4/2015	50	0	0	30000
8/15/2015	50	0	0	35000
2/25/2016	56	0	0	94000
6/7/2016	50	0	0	10000
7/18/2016	50	0	0	90000
7/22/2016	50	0	0	65000

Date	Magnitude*	Deaths	Injuries	Damage (\$)
7/23/2016	40	0	0	35000
8/14/2016	50	0	0	5000
Total		0	0	\$1,055,500

*Magnitude refers to maximum wind speed

Source: NOAA, National Centers for Environmental Information

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

WINTER STORMS

Winter storms, including heavy snow, blizzards, and ice storms, are the most common and most familiar of the region's hazards that affect large geographic areas. The majority of blizzards and ice storms in the region cause more inconvenience than they do serious property damage, injuries, or deaths. However, periodically, a storm will occur which is a true disaster, and necessitates intense large-scale emergency response. The impacts of winter storms are often related to the weight of snow and ice, which can cause roof collapses and also causes tree limbs to fall. This in turn can cause property damage and potential injuries. Power outages may also result from fallen trees and utility lines.

Winter storms are a potential town-wide hazard in Norwood. Map 6 in Appendix A indicates that the average annual average snowfall in most of Norwood is between 36 and 48 inches. However, the northeastern corner of the town does experience average annual snowfall of between 48 and 72 inches. A number of public safety issues can arise during snow storms. Impassible streets are a challenge for emergency vehicles and affect residents and employers. 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. Refreezing of melting snow can cause dangerous roadway conditions. In addition, transit operations may be impacted, as they were in the 2015 blizzards which caused the closure of the MBTA system for one day and limited services on the commuter rail for several weeks. The Town of Norwood provides standard snow plowing operations, and clearing snow has been a challenge along heavily travelled roads. The Town does make plowing of roads a priority near emergency routes.

HEAVY SNOW AND BLIZZARDS

A blizzard is a winter snow storm with sustained or frequent wind gusts to 35 mph or more, accompanied by snow which reduces visibility to or below ¼ mile. These must be the predominant condition over a three hour period. Extremely cold temperatures are often associated with blizzard conditions, but are not a formal part of the definition. The hazards related to the combination of snow, wind, and low visibility

significantly increases when temperatures drop below 20 degrees. Winter storms are a combination hazard because they often involve wind, ice, and heavy snow fall. The National Weather Service defines “heavy snow fall” as an event generating at least 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.

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

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. In Norwood, blizzards and severe winter storms have occurred in the following years:

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
2018	January 2018

Source: National Oceanic and Atmospheric Administration

The Town of Norwood does not keep local records of winter storms. Data for Norfolk County, which includes Norwood, is the best available data to help understand previous occurrences and impacts of heavy snow events. According to National Climate Data Center (NCDC) records, from 1996 to 2017, Norfolk County experienced 75 heavy snowfall events, resulting in two deaths, one injury, and \$6.4 million dollars in property damage. See Table 18 for heavy snow events and impacts in Norfolk County.

Table 18: Heavy Snow Events and Impacts in Norfolk County, 1996 to 2017

Date	Deaths	Injuries	Property Damage (\$)
1/2/1996	0	0	-
1/7/1996	0	0	1,400,000
1/7/1996	0	0	2,000,000
1/10/1996	0	0	-
2/2/1996	0	0	-
2/16/1996	0	0	-
3/2/1996	0	0	-
3/7/1996	0	0	-
4/7/1996	0	0	-
4/9/1996	0	0	-
12/6/1996	0	0	-
1/11/1997	0	0	-
2/16/1997	0	0	-
3/31/1997	0	0	-
4/1/1997	0	1	2,500,000
12/23/1997	0	0	-
1/15/1998	0	0	-
12/24/1998	0	0	-
1/14/1999	0	0	-
2/25/1999	0	0	-
3/6/1999	0	0	-
3/15/1999	0	0	-
1/13/2000	0	0	-
2/18/2000	0	0	-
12/30/2000	0	0	-
1/20/2001	0	0	-
2/5/2001	0	0	-
3/5/2001	0	0	-
3/9/2001	0	0	-
3/26/2001	0	0	250,000
12/8/2001	0	0	-
12/5/2002	0	0	-
3/16/2004	0	0	-
2/21/2005	0	0	-
2/24/2005	0	0	-
12/13/2007	0	0	-
12/16/2007	0	0	7,500
12/19/2007	0	0	-
1/14/2009	0	0	36,000
1/14/2009	0	0	30,000
1/14/2009	0	0	55,000
1/27/2009	0	0	-
2/22/2009	0	0	-
12/19/2009	0	0	10,000

Date	Deaths	Injuries	Property Damage (\$)
12/19/2009	0	0	3,000
12/31/2009	0	0	-
1/18/2009	0	0	-
1/19/2009	0	0	-
2/3/2009	0	0	-
3/1/2009	0	0	-
3/2/2009	0	0	-
12/19/2009	0	0	-
2/16/2010	0	0	-
12/20/2010	0	0	-
1/12/2011	0	0	-
1/26/2011	0	0	-
1/21/2012	0	0	-
12/29/2012	0	0	5,000
2/8/2013	0	0	-
3/7/2013	0	0	-
3/18/2013	0	0	-
12/14/2013	0	0	-
12/17/2013	0	0	-
1/2/2014	0	0	-
1/21/2014	0	0	-
2/5/2014	0	0	-
2/15/2014	0	0	5,000
01/26/2015	0	0	-
02/02/2015	0	0	-
02/08/2015	0	0	-
02/14/2015	0	0	-
01/23/2016	0	0	-
02/05/2016	2	0	100,000
02/08/2016	0	0	-
04/04/2016	0	0	-
3/14/2017	0	0	-
Total	2	1	6,401,500

Source: NOAA, National Centers for Environmental Information

Potential Heavy Snow and Blizzard Hazard Areas

There are several areas that have been identified as being hazardous do to challenges of snow removal during large storms.

These areas are shown on Map 8, “Hazard Areas”.

- 11. Route 1 rotary and overpass
- 12. Route 95 rotary and overpass
- 21. Dean Street

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

ICE STORMS

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

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 Norwood. The best available local data is for Norfolk County through the National Centers for Environmental Information. Norfolk County, which includes the Town of Norwood, experienced five events from 1965 to 2017.

Table 20: Norfolk County Hail Events, 1965 to 2015

Date	Magnitude*	Deaths	Injuries	Damage
6/8/1965	1.5	0	0	0
4/19/1969	2	0	0	0
9/6/1973	1.75	0	0	0
6/13/1987	0.75	0	0	0
7/7/1994	1.75	0	0	0
5/24/2004	1	0	0	0
8/02/2006	0.75	0	0	0
7/02/2008	0.75	0	0	0
5/24/2009	0.75	0	0	0
6/01/2011	1.0			
6/23/2012	0.88	0	0	0
9/01/2013	0.75	0	0	0

8/7/2014	1	0	0	0
5/12/2015	0.75	0	0	0
8/04/2015	1.0	0	0	0

*Magnitude refers to diameter of hail stones in inches

Source: NOAA, National Centers for Environmental Information

Ice storms are considered to be medium frequency events based on past occurrences, and as defined by the 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 codes 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 Norwood can be found on Map 4 in Appendix B.

EARTHQUAKES

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

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

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
MA - Nantucket	4/12/12	4.5
ME - Hollis	10/17/12	4.0

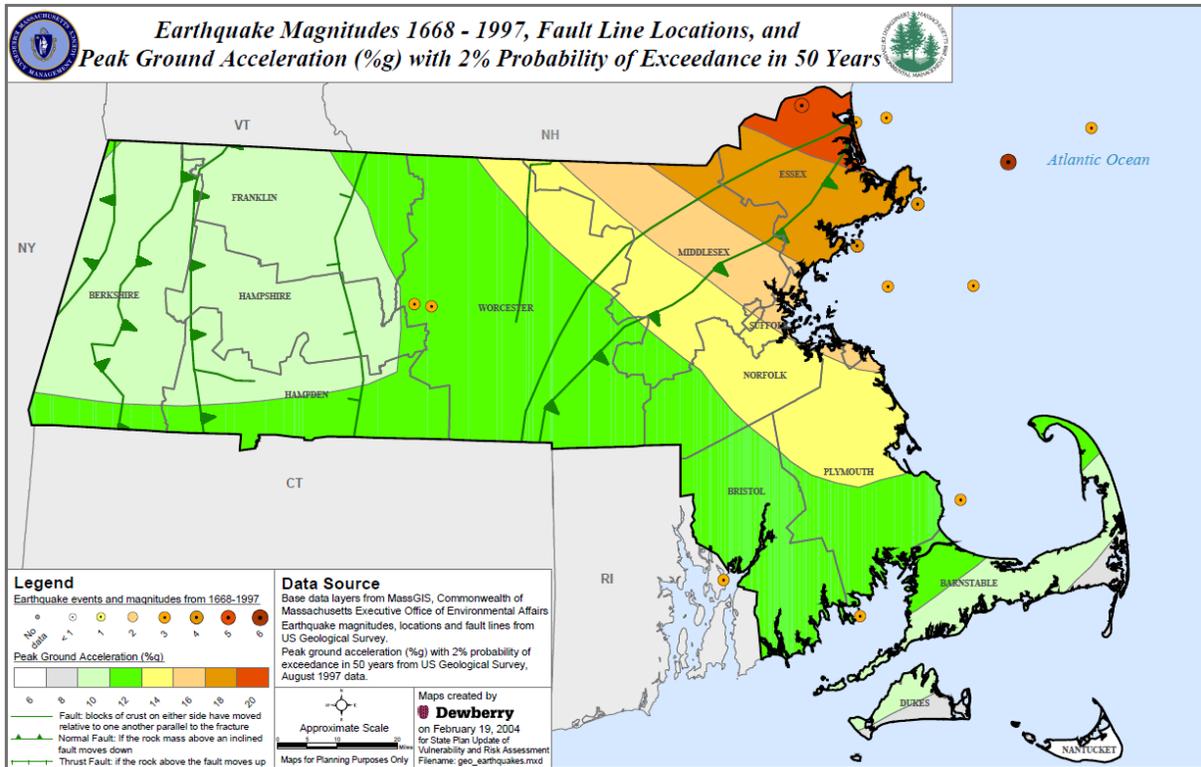
Source: Boston HIRA

One measure of earthquake risk is ground motion, which is measured as maximum peak horizontal acceleration, expressed as a percentage of gravity (%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. Norwood is in the middle part of the range for Massachusetts, at 14 %g to 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 recorded earthquake epicenters within Norwood.

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 (Figure 3). Earthquakes occur without warning and may be followed by aftershocks. The majority of older buildings and infrastructure were constructed without specific earthquake resistant design features.

Figure 3: State of Massachusetts Earthquake Probability Map



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.

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. Earthquakes are a potential town-wide hazard in Norwood.

Although new construction under the most recent building codes generally will be built to seismic standards, much of the development in the town pre-dates the most recent building code. Potential earthquake damages to Norwood have been estimated using HAZUS-MH. Total building damages are estimated at \$641 million for a 5.0 magnitude earthquake and \$4.5 billion for a 7.0 magnitude earthquake. Other potential impacts are detailed in Table 32.

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. The table 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.

Table 23: Landslide Volume and Velocity

Estimate 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

Norwood has been classified as having a low risk for landslides (see Map 4, Appendix B). The town does not have records of any damages caused by landslides. 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 Norwood. Based on past occurrences and the Massachusetts Hazard Mitigation Plan, landslides are low frequency events that can occur once in 50 to 100 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, brush fires typically burn no more than the underbrush of a forested area. There are three different classes of wildfires:

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

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

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

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

Potential Brushfire Hazard Areas

There are several causes for brush fires depending on the areas where they occur. Although fires have happened in several locations, the greatest threat in town is the area surrounding Norwood Memorial Airport, as it includes large tracts of peat bog that when dry, can catch fire and burn for a long period of time. Peat bog fires are notoriously hard to fight, because the peat can burn beneath the overgrowth, making it hard to track the fire's path. Other potential fire areas in town include grassy patches of open land adjacent to train tracks, especially near the Middle School and beneath high-tension wires.

These areas are shown on Map 8, "Hazard Areas".

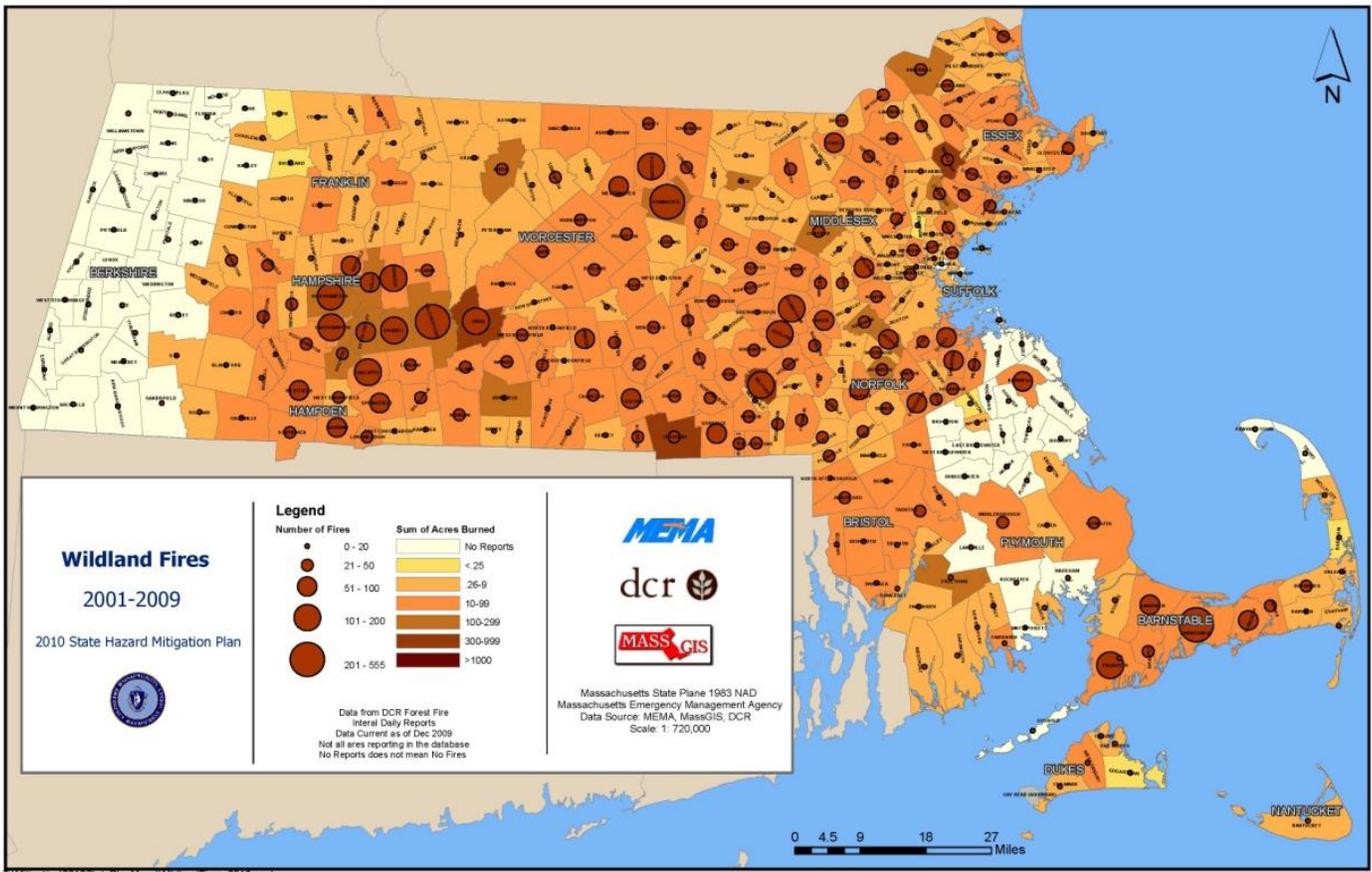
6. Norwood Airport

17. Middle School

18. Beneath the high-tension wires

Wildfires in Massachusetts are measured by the number of fires and the sum of acres burned. The most recent data available for wildfires in Massachusetts, shown in Figure below, indicates that the wildfire extent in Norwood consists of 101 to 200 acres burned, with 21 to 50 recordable fires from 2001 to 2009. Less 1% of fires results in significant property damage. There have been no deaths as a result of brush fires.

Figure 4: Massachusetts Wildfires, 2001 to 2009



Source: Massachusetts State Hazard Mitigation Plan

Wildfires have not caused significant damage in Norwood. Potential damages from wildfires in the town would depend on the extent and type of land affected. There could be the need for post-fire revegetation to restore a burned property, which could cost from a few thousand dollars to tens of thousands for an extensive area. However, there are no data on actual wildfire damages in the town.

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

EXTREME TEMPERATURES

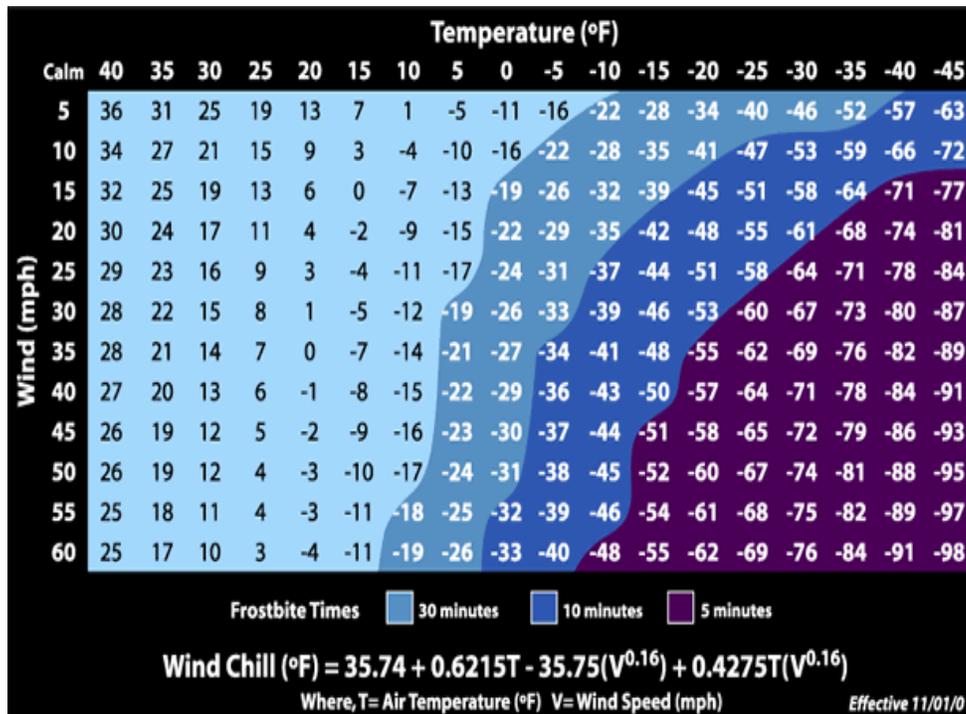
Extreme temperatures occur when either high temperature or low temperatures relative to average local temperatures occur. These can occur for brief periods of time and be acute, or they can occur over long periods of time where there is a long stretch of excessively hot or cold weather.

Norwood 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 below. 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.

Figure 5: Wind Chill Temperature Index and Frostbit Risk



Source: National Weather Service

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. In Norwood 6.7% of the population is disabled, and 17.2% is over the age of 65.

The Town of Norwood does not collect data for previous occurrences of extreme cold. The best available local data are for Norfolk County, through the National Centers for Environmental Information (NCEI). There are three extreme cold events on record in February 2015 and 2016 for the county, which caused no deaths, no injuries, or property damage.

Table 24: Norfolk County Extreme Cold and Wind Chill Occurrences

Date	Deaths	Injuries	Damage (\$)
2/16/2015	0	0	0
2/13/2016	0	0	0
2/14/2016	0	0	0

Source: NOAA, National Centers for Environmental Information

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 6) 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 6: Heat Index Chart

		Temperature (°F)															
		80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
Relative Humidity (%)	40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
	45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
	50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
	55	81	84	86	89	93	97	101	106	112	117	124	130	137			
	60	82	84	88	91	95	100	105	110	116	123	129	137				
	65	82	85	89	93	98	103	108	114	121	128	136					
	70	83	86	90	95	100	105	112	119	126	134						
	75	84	88	92	97	103	109	116	124	132							
	80	84	89	94	100	106	113	121	129								
	85	85	90	96	102	110	117	126	135								
	90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127											
100	87	95	103	112	121	132											
Category		Heat Index		Health Hazards													
Extreme Danger		130 °F – Higher		Heat Stroke or Sunstroke is likely with continued exposure.													
Danger		105 °F – 129 °F		Sunstroke, muscle cramps, and/or heat exhaustion possible with prolonged exposure and/or physical activity.													
Extreme Caution		90 °F – 105 °F		Sunstroke, muscle cramps, and/or heat exhaustions possible with prolonged exposure and/or physical activity.													
Caution		80 °F – 90 °F		Fatigue possible with prolonged exposure and/or physical activity.													

Extreme heat poses a potentially greater risk to the elderly, children, and people with certain medical conditions, such as heart disease. However, even young and healthy individuals can succumb to heat if they participate in strenuous physical activities during hot weather. Hot summer days can also worsen air pollution. With increased extreme heat, urban areas of the northeast are likely to experience more days that fail to meet air quality standards. In Norwood 17.2% of the population is over 65, and 5.7% is under the age of 5.

The Town of Norwood does not collect data on excessive heat occurrences. The best available local data are for Norfolk County, through the National Centers for Environmental Information. From 1999 to 2011, there have been a total of nine excessive heat days, one of which resulted in two reported deaths, but no additional deaths, injuries, or property damage (see Table 25).

Table 25: Norfolk County Extreme Heat Occurrences

Date	Deaths	Injuries	Damage (\$)
6/7/1999	0	0	0
7/5/1999	2	0	0
7/16/1999	0	0	0
7/17/1999	0	0	0

7/18/1999	0	0	0
9/7/1999	0	0	0
9/8/1999	0	0	0
7/6/2010	0	0	0
7/22/2011	0	0	0
Total	2	0	0

Source: NOAA, National Centers for Environmental Information

Extreme temperatures are medium frequency events based on past occurrences, and as defined by the 2013 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.

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

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

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 amounts to historic 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.

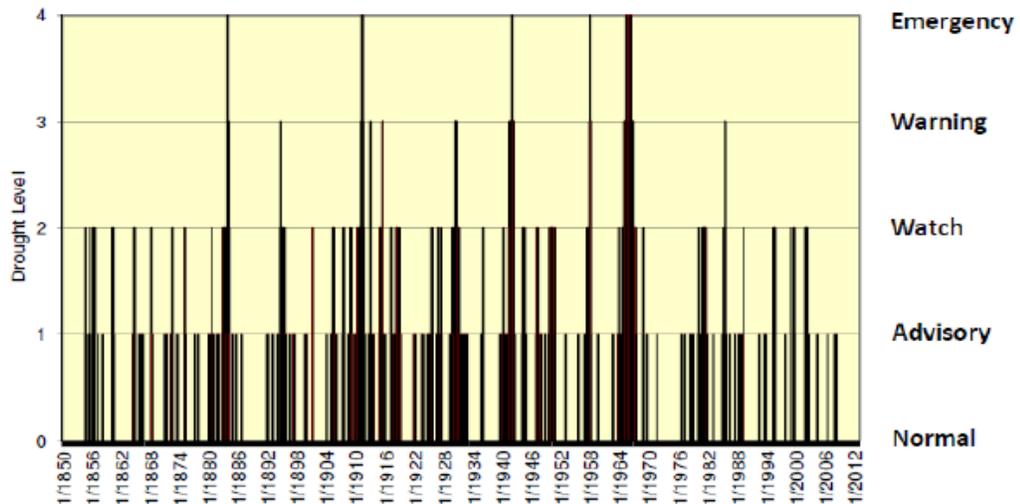
Determinations regarding the end of a drought or reduction of the drought level focus on two key drought indicators: precipitation and groundwater levels. These two factors have the greatest long-term impact on stream flow, water supply, reservoir levels, soil moisture, and potential for forest fires.

Norwood does not collect data relative to drought events. Because drought tends to be a regional natural hazard, this plan references state data as the best available data for drought. The statewide scale is a composite of 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 7 depicts the incidents of drought levels' occurrence in Massachusetts from 1850 to 2012 using the Standardized Precipitation Index (SPI) parameter alone. On a monthly basis, the state would have been in a Drought Watch to Emergency condition 11% of the time between 1850 and 2012. Table 26 summarizes the chronology of major droughts since the 1920s.

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.

Figure 7: Statewide Drought Levels using SPI Thresholds, 1850 to 2012



Source: Massachusetts State Drought Management Plan 2013

Drought warning levels not associated with drought emergencies have occurred four times, in 1894, 1915, 1930, and 1985. On a monthly basis over the 162-year period of record, there is a 2% chance of being in a drought warning. Norwood was under a Drought Warning from August to November 2016 (see Table 26).

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 26: Chronology of Major Droughts in Massachusetts

Date	Area Affected	Recurrence Interval (years)	Remarks
1929 to 1932	Statewide	10 to >50	Water-supply sources altered in 13 communities. Multistate.
		15 to >50	More severe in eastern and extreme western Massachusetts. Multistate.
1957 to 1959	Statewide	5 to 25	Record low water levels in observation wells, northeastern Massachusetts.
1961 to 1969	Statewide	35 to >50	Water-supply shortages common. Record drought. Multistate.
1980 to 1983	Statewide	10 to 30	Most severe in Ipswich and Taunton River basins; minimal effect in Nashua River basin. Multistate.
1958 to 1988	Housatonic River Basin	25	Duration and severity unknown. Streamflow showed mixed trends elsewhere.

2016-2017	Statewide	N/A	Drought declaration began in July 2016 with a Drought Watch which was upgraded to a Drought Warning in August 2016. The Central and Northeast regions were the most severely affected. Norwood is in the SE region.
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Potential damages of a severe 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 Norwood, 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 from several million to tens of millions of dollars. Another potential vulnerability of droughts could be increased risk of wildfires.

The state has experienced emergency droughts five times between 1850 and 2012. 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 Massachusetts State Hazard Mitigation Plan, 2013.

Impacts of Climate Change

Many of the natural hazards that Norwood has historically experienced are likely to be exacerbated by climate change in future years. This is particularly true for flooding caused by extreme precipitation and extreme heat. These are described in more detail below.

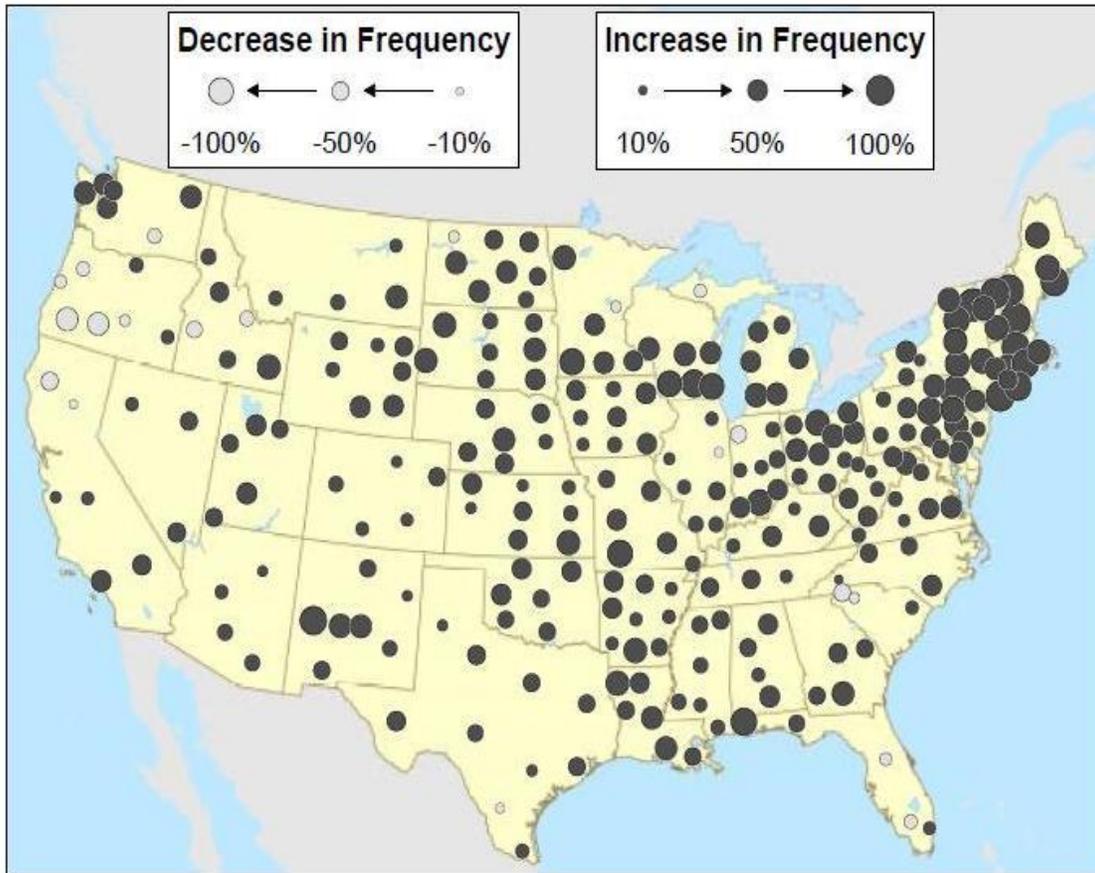
Climate Change Impacts: Extreme Precipitation

Norwood's average annual precipitation is 42 inches. While total annual precipitation has not changed significantly, according to the 2012 report *When It Rains It Pours – Global Warming and the Increase in Extreme Precipitation from 1948 to 2011* intense rainstorms and snowstorms have become more frequent and more severe over the last half century in the northeastern United States. Extreme downpours are now happening 30 percent more often nationwide than in 1948 (see Figure 8). In other words, large rain or snow storms that happened once every 12 months, on average, in the middle of the 20th century, now happen every nine months.

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

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

Figure 8 Changes in Frequency of Extreme Downpours, 1948 – 2011



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

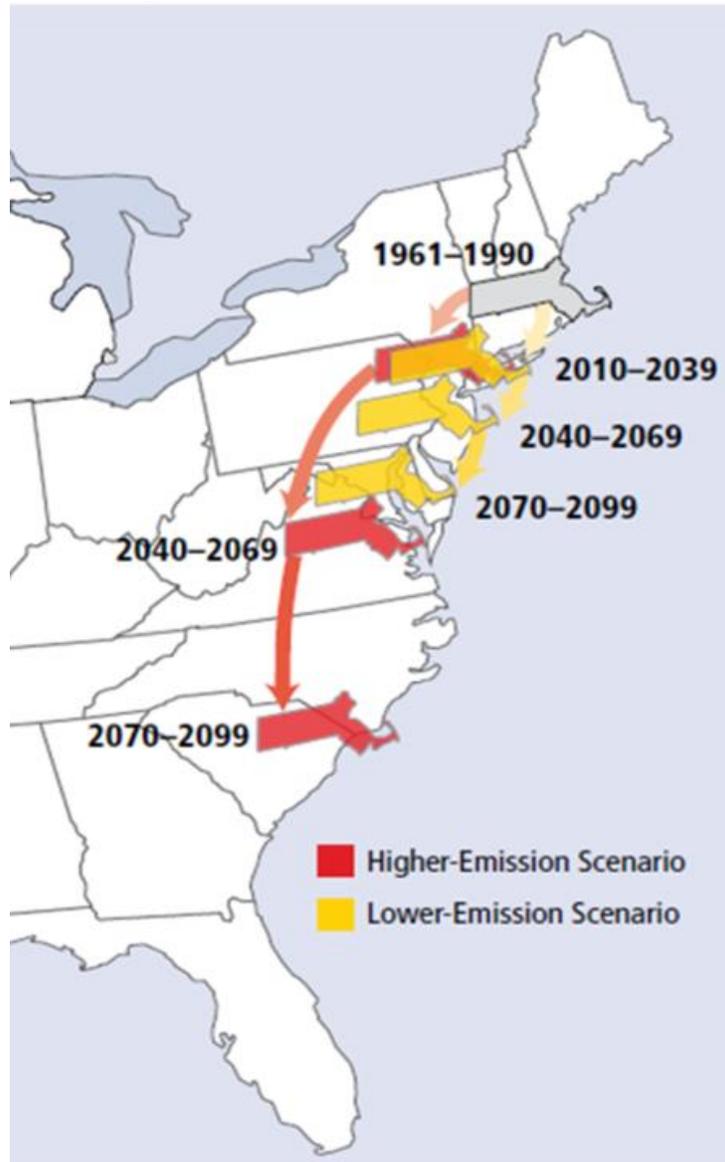
Climate Change Impacts: Extreme Heat

Recent temperature trends suggest greater potential impacts to come due to climate change. In the report “Confronting Climate Change in the U.S. Northeast,” (2007), the Union of Concerned Scientists presented temperature projections to 2099 based on two scenarios, one with lower carbon dioxide emissions, and the other with high emissions.

Between 1961 and 1990, Boston experienced an average of 11 days per year over 90°F. That could triple to 30 days per year by 2095 under the low emissions scenario, and increase to 60 days per year under the high emissions scenario. Days over 100°F could increase from the current average of one day per year to 6 days with low emissions or 24 days with high emissions.

By 2099, Massachusetts could have a climate similar to Maryland's under the low emissions scenario, and similar to the Carolinas' with high emissions (Figure 9). Furthermore, the number of days with poor air quality could quadruple in Boston by the end of the 21st century under higher emissions scenario, or increase by half under the lower emissions scenario. These extreme temperature trends could have significant impacts on public health, particularly for those individuals with asthma and other respiratory system conditions, which typically affect the young and the old more severely.

Figure 9 Mass. Extreme Heat Scenarios



LAND USE AND DEVELOPMENT TRENDS

EXISTING LAND USE

The most recent land use statistics available from the state are from aerial photography done in 2005. Table 27 shows the acreage and percentage of land in 21 categories. If the five residential categories are aggregated, residential uses make up 39% of the area of the town (2,622 acres). Commercial and industrial combined make up 16.4% of the town, or 1,102 acres. Recreation, urban public, and golf courses comprise a total of 6.1%, or 418 acres.

For more information on how the land use statistics were developed and the definitions of the categories, please go to <https://docs.digital.mass.gov/dataset/massgis-data-land-use-2005>.

Table 27: Town of Norwood, MA 2005 Land Use

Land Use Type	Acres	Percent
Crop Land, Pasture	19.6	0.3%
Forest	920.4	13.7%
Non-Forested Wetlands	622.7	9.3%
Forested Wetland	547.1	8.1%
Brushland/Successional	17.4	0.3%
Open & Urban Open Land	48.7	0.7%
Participation Recreation	103.3	1.5%
Water-based Recreation	2.2	0.0%
Multi-family Residential	425.7	6.3%
High Density Residential	228.6	3.4%
Medium Density Residential	1556.2	23.2%
Low Density Residential	404.4	6.0%
Very Low Density Residential	7.0	0.1%
Commercial	339.6	5.1%
Industrial	762.2	11.3%
Transportation	289.1	4.3%
Water	56.0	0.8%
Golf Course	109.9	1.6%
Urban Public	202.6	3.0%
Cemetery	46.8	0.7%
Powerlines	10.1	0.2%
Total Acres	6719.6	100.0%

Economic Elements

The Town of Norwood is a nearly fully developed suburb. It is situated on two major transportation routes, Route 1 and 1A and is near Routes 128 and I-95. The Route 1 business corridor powerfully impacts the community, largely giving Norwood its regional identity, providing job benefits to the region and tax benefits and some service convenience for the Town. Norwood serves as a regional hub for jobs and commerce (excerpted from the Norwood Open Space plan).

NATURAL, CULTURAL, AND HISTORIC RESOURCE AREAS

The Norwood Open Space and Recreation Plan is in the process of being updated. The 2010-2017 plan identified over 1,400 acres of public protected open space although only 27.5 % was considered highly protected. Notable natural resources include the Neponset River and the Fowl Meadow and Ponkapoag Bog Area of Critical Environmental Concern. Tributaries to the Neponset include Plantingfield, Purgatory, Hawes, Meadow and Traphole Brooks. Ponds include Ellis, Guild, Willett, Mill and Factory Ponds. MA DEP identifies 19 potential vernal pools in Norwood. Norwood Town Hall and Lyman Smith House are on the National Register of Historic Places.

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. The database includes nine completed developments in the Town of Norwood since 2011.

The database also includes several attributes of the new development, including housing units, and commercial space. They are a mix of commercial and housing. The nine developments in Norwood include a total of 392 housing units and 623,825 square feet of commercial space.

Table 28: Summary of Norwood Developments, 2011-2017

Name	Status	Year	Housing Units	Commercial Square Feet	Project Type
Herb Chambers Volvo of Norwood	Completed	2016		52,600	Commercial
FM Global Campus Office	Completed	2017		14,025	Commercial
Upland Woods	Completed	2016	262	0	Residential
Benchmark Norwood	Completed	2017	90	0	Residential
Regal Lofts	Completed	2016	40	0	Residential
Subaru Warehouse	Completed	2016		217,000	Commercial
Asphalt Plant	Completed	2012		186,000	Residential
CarMax Auto Superstores	Completed	2016		135,200	Commercial
Verizon Maintenance Facility	Completed	2011		19,000	Commercial

All but one of these new developments are located outside of FEMA flood zones. The Car Max Auto Superstore is partially within a Zone X (0.2% annual chance of flooding, or "50 year" flood zone). However this was a redevelopment of an existing facility. Locations in Norwood do not vary for landslide risk or winds. The entire town is within the area of "Low Incidence" for landslides and within the zone of 100-year wind maximum speed of 110 miles per hour. Overall, the recent development and redevelopment in Norwood did not significantly increase the town's vulnerability to these hazards.

POTENTIAL FUTURE DEVELOPMENT

MAPC consulted with the Local Hazard Mitigation Planning Team to determine areas that may be developed in the future, based on the Town's comprehensive planning efforts and current trends and projects. These areas are listed below with their flood risk outlined in Table 29. 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 Potential future development projects:

- A) Endicott Woods – 110 condo units are under construction on Endicott Road.
- H) Power Lane- With most of Norwood being fully developed there are few if any new subdivisions proposed in Town. However, through various conversations it is expected that two new small subdivisions could be brought before the Planning Board in the next year. Power Lane off of Dean Street will likely be a 3 lot subdivision with duplexes on each lot.

Route 1 and Union Street - A 4 lot subdivision plan for property at the corner of Route 1 and Union Street will likely be submitted in the near future.

- I) Skating Club - The Skating Club of Boston is in the process of designing plans for an ice skating complex located at 720/750 University Avenue. The conceptual development plan calls for 3 sheets of ice (1 cool down sheet, 1 figure skating sheet, and 1 hockey sheet), offices, training rooms, a restaurant, and other related amenities.
- J) Forbes Hill - The Town purchased the Forbes Hill property located off of Upland Road. The location contains roughly 27 acres of land and a 23 thousand square-foot former mansion/office building. The Town is working out a plan of action to determine the best use of the land and building. Current Zoning for the location is Limited Manufacturing.
- K) Avalon Bay - AvalonBay is in the process of demolishing the old Plimpton Press factory and will then construct 198 apartment units on the site. Located at the corner of Lenox Street and Plimpton Avenue the site is near the downtown and abuts the commuter train station.

FUTURE DEVELOPMENT IN HAZARD AREAS

Table 29 shows the relationship between potential future development areas and two of the mapped hazards (flood zones and snowfall). This information is provided so that planners can ensure that development proposals comply with floodplain zoning and that careful attention is paid to drainage issues.

Table 29: Relationship of Potential Development to Hazard Areas

Map ID	Potential Future Project	Flood Zones
A	Endicott Woods – 110 condo units	94.5% in X Zone: 0.2% Annual Chance of Flooding
H	Power Lane, Union Street, total of 7 lots subdivisions	Not in flood zone
I	Skating Club and amenities	11.54% in X Zone: .2% Annual Chance of Flooding 28.96% in AE Zone: 1% Annual Chance of Flooding
J	Forbes Hill property	Not in flood zone
K	Avalon Bay, 198 apartments	0.13% in X Zone: .2% Annual Chance of Flooding

The table shows that just one of the developments is has significant area located within a “Zone X,” 0.2% chance of flooding per year (“500 year” flood zone). Two developments are completely outside of the FEMA flood zones, while the remaining two are located partially within and AE or X Zone, typically the portion of a site that is not built on.

With respect to other natural hazards, all of the development sites are located in the area designated as “Low Incidence” for landslides. Besides flooding, the only other hazard that varies with location within the town is snowfall. For average annual snowfall, all of the one development site is located in the area of 36 to 48 inches average annual snowfall (eastern Norwood, while the other four are in the zone of 48 to 72 inches of annual snowfall. With respect to wind, there is no variation across different sites in Norwood; the hazard map depicts the entire town in the same category, which is a 100-year wind maximum speed of

110 miles per hour (Appendix B). Overall, Norwood’s potential future development would not significantly increasing the town’s vulnerability

CRITICAL FACILITIES & INFRASTRUCTURE IN HAZARD AREAS

Critical facilities and infrastructure includes facilities that are important for disaster response and evacuation (such as emergency operations centers, fire stations, water pump stations, communications, and electricity) and facilities where additional assistance might be needed during an emergency (such as nursing homes, elderly housing, day care centers, etc.). There are 111 facilities identified in Norwood. These are listed in Table 30 and are shown on the maps in Appendix B.

Explanation of Columns in Table 30

- **Column 1: ID #:** The first column in Table 30 is an ID number which appears on the maps that are part of this plan. See Appendix B.
- **Column 2: Name:** The second column is the name of the site. If no name appears in this column, this information was not provided to MAPC by the community.
- **Column 3: Type:** The third column indicates what type of site it is.
- **Column 4: FEMA Flood Zone:** The fifth column addresses the risk of flooding. A “No” entry in this column means that the site is not within any of the mapped risk zones on the Flood Insurance Rate Maps (FIRM maps). If there is an entry in this column, it indicates the type of flood zone. as follows:
Zone AE (1% annual chance) - Zones AE is the flood insurance rate zone 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 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.
- **Column 5: Locally-Identified Area of Flooding:** The sixth column indicates the risk of flooding in local hazard areas. A “No” entry in this column means that the site is not within any of the mapped flood hazard zones. If there is an entry in this column, it indicates the local hazard area.
- **Column 7: Brush Fire Area:** The seventh column indicates the risk of brush fire in local hazard areas. A “No” entry in this column means that the site is not within any of the mapped brush fire hazard zones. If there is an entry in this column, it indicates the local hazard area.

Table 30: Critical Facilities and Relationship to Hazard Areas

ID	Name	Type	FEMA Flood Zone	Locally-Identified Flood Area
1	Fire Department	Fire Station	No	No
2	Police Department	Police Station	No	No
3	Emergency Operations Center	Emergency Operations Center	No	No
4	Norwood Town Hall	Municipal	No	No
5	Norwood Civic Center	Place of Assembly	No	No
6	EOC Secondary - Town Hall	Emergency Operations Center	No	No

ID	Name	Type	FEMA Flood Zone	Locally-Identified Flood Area
7	EOC Secondary - Civic Center	Emergency Operations Center	No	No
8	Department of Public Works	Municipal	No	No
9	Norwood Electric Light	Municipal	No	No
10	Verizon New England	Communication Tower	No	No
11	Saint Catherine of Siena Church	Church	No	No
12	Saint Catherine Siena School	School	No	No
13	United Church of Norwood	Church	No	No
14	Norwood Christian PreSchool	Child Care	No	No
15	Norwood Light and Broadband Div	Communication Tower	No	No
16	Ellis Pumping Station	Municipal	No	No
17	Norwood Animal Shelter	Municipal	No	No
21	Fuel Depot Municipal	Gas Distribution	No	No
22	Water Storage Tank	Water Storage Tank	No	No
24	AT&T Cell Tower	Communication Tower	No	No
25	Sprint Cell Tower	Communication Tower	No	No
32	Chapel Street Storage Facility: ELD	Municipal	No	No
34	Oldham Elem School	School	No	No
35	Savage Center	School	No	No
36	Norwood Public School Administration	Municipal	No	No
37	Norwood Senior Center	Senior Center	No	No
38	Norwood High School	School	No	Traphole Brook east of Route 1
39	Cleveland Elem School	School	No	Meadow Brook, Lawndale and Sunnyside
40	Willet School	School	No	No
41	Coakley Middle School	School	No	No
42	Balch Elem School	School	No	No
43	Prescott Elementary	School	No	No
44	Callahan Elementary School	School	No	No
46	Guild Medical Facility Offices	Medical Facility	No	No
47	Winslow Medical Facility Offices	Medical Facility	No	No
48	Eastern Massachusetts Surgery Center	Medical Facility	No	No
49	Dedham Medical Associates	Medical Facility	No	No
50	Courtyard by Marriott	Hotel	No	No

ID	Name	Type	FEMA Flood Zone	Locally-Identified Flood Area
51	Residence Inn	Hotel	No	No
52	Sheraton Four Points	Hotel	No	No
53	Steward Norwood Hospital	Hospital	No	No
54	Hampton Inn	Hotel	.2% chance	No
55	Elks Lodge	Place of Assembly	No	No
56	VFW Post 2052	Place of Assembly	No	No
57	National Grid Gas Distribution Facility	Gas Distribution	No	Dean Street Neighborhood
58	Algonquin Gas Control Facility	Gas Distribution	No	No
59	Morrill Memorial Library	Library	No	No
60	MBTA-Windsor Gardens Station	Transportation Facility	No	No
61	MBTA-Norwood Central Station	Transportation Facility	No	No
62	MBTA-Norwood Depot Station	Transportation Facility	No	No
63	Ellis Pond Dam	Dam	AE: Regulatory Floodway	Willett Pond dam and dike
64	Willett Pond Dam	Dam	AE 1% chance	Willett Pond dam and dike
65	Norwood Animal Hospital	Veterinary Facility	No	Willett Pond dam and dike
66	CVS Pharmacy	Pharmacy	No	No
67	Rite-Aid Pharmacy	Pharmacy	No	No
68	Rite-Aid Pharmacy	Pharmacy	No	No
69	Walgreen Pharmacy	Pharmacy	No	No
70	Charwell House Nursing home/Rehab	Nursing Home	No	No
71	Sunrise Assisted Living	Nursing Home	No	No
72	Victoria Haven Nursing Home	Nursing Home	No	No
73	Norwood Healthcare	Medical Facility	No	No
74	Ellis Nursing Home	Nursing Home	No	No
79	Housing Authority Brookview	Elder Housing	No	No
80	Housing Authority Nahatan Village	Elder Housing	No	No
81	Housing Authority Willow Wood Terrace	Elder Housing	No	No
82	Housing Authority Willow Wood Terrace	Elder Housing	No	No
83	Housing Authority Frank Walsh	Elder Housing	No	No
84	Norwood Housing Authority Offices	Municipal	No	No
85	SNARC-Residences	Special Needs	No	No
86	FAA Control Tower	Transportation Facility	No	Norwood Memorial Airport
87	Norwood Airport Manager Offices	Municipal	.2% chance	No

ID	Name	Type	FEMA Flood Zone	Locally-Identified Flood Area
88	Norwood Municipal Airport	Transportation Facility	.2% chance	Norwood Memorial Airport
89	Eastern Air Fuel Farm	Hazardous Material Site	.2% chance	Norwood Memorial Airport
90	First Congregational Church	Church	No	No
91	First Baptist Church	Church	No	No
92	First Baptist Church Community Hall	Church	No	No
93	Trinity Community Church	Church	No	No
94	Emmanuel Lutheran Church	Church	No	No
96	Knights of Columbus	Place of Assembly	No	Willett Pond dam and dike
97	Saint Timothy's Church	Church	No	Willett Pond dam and dike
98	Grace Episcopal Church	Church	No	No
99	Jain Center of Greater Boston	Place of Assembly	No	Willett Pond dam and dike
100	Saint George Orthodox Church	Church	No	No
101	Shaws Supermarket	Grocery Store	No	No
104	Big Y Supermarket	Grocery Store	No	No
105	Stop and Shop Supermarket	Grocery Store	No	No
106	Home Depot	Hardware Store	No	No
107	Hollingsworth & Vose Dam	Dam	AE: Reg. Floodway	No
108	Stock Building Supply	Lumber	No	No
109	Grainger Industrial Supply	Hardware Store	No	No
110	Norwood Hospital	Heliport	X500	No
111	Basic Rental and Supplies	Hardware Store	No	No
112	DPW Storage Garage	Municipal	No	No
113	DPW Storage Garage	Municipal	No	No
114	Workman's Hall	Place of Assembly	No	Willett Pond dam and dike
115	Norwood Italian Social Club	Place of Assembly	No	No
116	Norwood Portuguese Social Club	Place of Assembly	No	No
117	Norwood Theatre	Place of Assembly	No	No
118	Norwood Town Common	Place of Assembly	No	No
119	American Tower Corp Cell Tower #1, #2	Communication Tower	AE: 1% chance	No
120	Norwood Town Hall - Cell Tower	Communication Tower	No	No
121	Norwood Communication Tower	Communication Tower	No	No
122	Norwood Adult Day Health Center	Assisted Living	No	Dean Street Neighborhood
123	Riverside Community Care	Assisted Living	No	No
124	Urgent Care (Morse St.)	Medical Facility	No	No
125	Gulf Gas Station	Fuel Transfer Station	No	No

ID	Name	Type	FEMA Flood Zone	Locally-Identified Flood Area
126	A&J Auto	Fuel Transfer Station	No	No
127	Exxon Mobil Oil Corp	Fuel Transfer Station	No	No
128	Exxon Mobil Oil Corp	Fuel Transfer Station	No	No
129	Universal Technical Institute	College	No	No
130	Norwood Early Learning Center	Child Care	No	No
131	Mrs. Perry's Preschool	Child Care	No	No
132	Child Care	Child Care	No	No
133	Rama Kidstop Early Childhood Center	Child Care	No	No
134	Norwood Cooperative Nursery School	Child Care	No	No
135	Kid's Court Day Care	Child Care	No	No
136	Neponset Valley Child Care	Child Care	No	No
137	Kinderbook, Inc.	Child Care	No	No
138	Children of America	Child Care	No	No
139	Norwood Montessori School	Child Care	No	No
140	St. Catherine of Siena	Child Care	No	No
141	Ocean State Job Lot	Grocery Store	No	No
142	True Value Hardware Store	Hardware Store	No	No
143	Ashfield Cheyne Veterinary Services	Veterinary Facility	No	No
144	Heritage Baptist Church	Church	No	No
145	Church of the Redeemer	Church	No	No
146	Norwood Fellowship	Church	No	No
147	Kingdom Fire Ministries	Church	.2% chance	No
148	Revival Church for the Nations	Church	AE 1% chance	No
149	Shree Haridham Temple	Church	No	No
150	Norwood Seventh-Day Adventist	Church	.2% chance	Tannery site, Walpole St.
151	Greater Grace Evangelical	Church	.2% chance	Tannery site, Walpole St.
152	St. Denis Parish	Church	No	No
153	Waters Church	Church	No	No
154	Morse House	Historic	No	No
155	Norwood Historical Society, Day House	Historic	No	No
156	Forbes Mansion	Historic	No	No
157	First Church of Christ Scientist	Church	No	No
158	Jim Riley/Bay Communications	Communication Tower	.2% chance	Tannery site, Walpole Street

ID	Name	Type	FEMA Flood Zone	Locally-Identified Flood Area
159	Comcast Cell Tower	Communication Tower	AE 1% chance	No
160	AT&T Cell Tower	Communication Tower	AE 1% chance	No

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 Town of Norwood, it does not capture all relevant information. In fact, the HAZUS training manual notes that the default data is “subject to a great deal of uncertainty.”

However, for the purposes of this plan, the analysis is useful. This plan is attempting to generally indicate the possible extent of damages due to certain types of natural disasters and to allow for a comparison

between different types of disasters. Therefore, this analysis should be considered to be a starting point for understanding potential damages from the hazards.

ESTIMATED DAMAGES FROM HURRICANES

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

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

Table 31: Estimated Damages from Hurricanes

	Category 2	Category 4
Building Characteristics		
Estimated total number of buildings	9,000	
Estimated total building replacement value (2014 \$)	\$4,449,000,000	
Building Damages		
# of buildings sustaining minor damage	405	1,783
# of buildings sustaining moderate damage	51	423
# of buildings sustaining severe damage	2	31
# of buildings destroyed	0	10
Population Needs		
# of households displaced	0	44
# of people seeking public shelter	0	4
Debris		
Building debris generated (tons)	2,354	9,855
Tree debris generated (tons)	1,990	5,304
# of truckloads to clear building debris	95	394
Value of Damages		
Total property damage (buildings and content)	\$22,793,430	\$97,404,120
Total losses due to business interruption	\$1,512,940	\$ 10,968,380

ESTIMATED DAMAGES FROM EARTHQUAKES

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

Table 32: Estimated Damages from Earthquakes

	Magnitude 5.0	Magnitude 7.0
Building Characteristics		
Estimated total number of buildings	9,000	
Estimated total building replacement value (2014 \$)	\$4,449,000,000	
Building Damages		
# of buildings sustaining slight damage	2,602	202
# of buildings sustaining moderate damage	1,552	1,554
# of buildings sustaining extensive damage	502	2,382
# of buildings completely damaged	139	4,951
Population Needs		
# of households displaced	739	8,135
# of people seeking public shelter	357	3,961
Debris		
Building debris generated (tons)	170,000	1,150,000
# of truckloads to clear debris (@ 25 tons/truck)	6,640	46,040
Value of Damages		
Total property damage	\$641,230,000	\$4,466,040,000
Total losses due to business interruption	\$138,680,000	\$710,350,000

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 33: Estimated Damages from Flooding

	100-Year Flood	500-Year Flood
Building Characteristics		
Estimated total number of buildings	9,000	
Estimated total building replacement value (2014 \$)	\$4,449,000,000	
Building Damages		
# of buildings sustaining limited damage	27	42
# of buildings sustaining moderate damage	0	0
# of buildings sustaining extensive damage	0	0
# of buildings substantially damaged	0	0
Population Needs		
# of households displaced	118	165
# of people seeking public shelter	187	279
Value of Damages		
Total property damage	\$20,880,000	\$31,570,000
Total losses due to business interruption	\$80,000	\$130,000

SECTION 5: HAZARD MITIGATION GOALS

The Norwood Local Hazard Mitigation Planning Team reviewed and discussed the goals from the 2011 Hazard Mitigation Plan for the Town of Norwood. All of the goals are considered critical for the Town and they are not listed in order of importance. Concurrent with the Hazard Mitigation Plan update process, the Town of Norwood held a workshop to plan for future climate change. The local team chose to incorporate climate considerations as noted in Goal 9.

- GOAL 1:** Prevent and reduce the loss of life, injury, public health impacts and property damages resulting from all major natural hazards.
- GOAL 2:** Identify and seek funding for measures to mitigate or eliminate each known significant flood hazard area.
- GOAL 3:** Integrate hazard mitigation planning as an integral factor in all relevant municipal departments, committees and boards.
- GOAL 4:** Prevent and reduce the damage to public infrastructure resulting from all hazards.
- GOAL 5:** Encourage the business community, major institutions and non-profits to work with the Town to develop, review and implement the hazard mitigation plan.
- GOAL 6:** Work with surrounding communities, state, regional and federal agencies to ensure regional cooperation and solutions for hazards affecting multiple communities.
- GOAL 7:** Ensure that future development meets federal, state and local standards for preventing and reducing the impacts of natural hazards.
- GOAL 8:** Take maximum advantage of resources from FEMA and MEMA to educate Town staff and the public about hazard mitigation.
- GOAL 9:** Consider the potential impacts of future climate change and incorporate climate sustainability and resiliency in hazard mitigation planning.

SECTION 6: EXISTING MITIGATION MEASURES

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

The Town's existing mitigation measures, which were in place prior to the original 2011 Plan, are listed by hazard type here and are summarized in Table 34 below. Many upgrades to existing measures are noted in the following sections.

EXISTING TOWN-WIDE MITIGATION FOR FLOOD-RELATED HAZARDS

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

Participation in the National Flood Insurance Program (NFIP) – Norwood participates in the NFIP with 74 policies in force as of the June 30, 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 Norwood:

Flood insurance policies in force	73
Coverage amount of flood insurance policies	\$21,858,000
Premiums paid	\$121,967
Total losses (all losses submitted regardless of the status)	29
Closed losses (losses that have been paid)	21
Open losses (losses that have not been paid in full)	0
CWOP losses (losses that have been closed without payment)	8
Total payments (total amount paid on losses)	\$600,609.44

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 – The Town of Norwood owns a street sweeper and each street in town is swept 2 to 3 times per year. Other downtown areas such as main business district can be swept more frequently as needed from May through September. Poor draining streets can also be swept as needed following rainstorms.

Catch basin cleaning – The Town of Norwood cleans catch basins at least annually, with greater frequency for critical outfalls.

Roadway treatments – The town uses a mixture of two parts sand to one parts salt for de-icing purposes. This is done to minimize the amount of sand that enters catch basins and streams.

Zoning Regulations – The town’s Zoning Bylaw and Subdivisions Rules and Regulations contain a number of requirements that address flood hazard mitigation. Some of these provisions also relate to other hazards. The zoning by-law also includes provisions for the Flood Plain and Water Resource Protection Overlay Areas, Site Plan Approval and Open Space Requirements. The town also has a Wetlands Protection bylaw.

EXISTING DAM FAILURE MITIGATION MEASURES

The Comprehensive Emergency Management Plan – The CEMP addresses dam safety. The Town is in the process of updating the CEMP.

Permits required for construction – State law requires a permit for the construction of any dam.

DCR dam safety regulations – All dams are subject to the Division of Conservation and Recreation’s dam safety regulations.

EXISTING TOWN-WIDE MITIGATION FOR WIND-RELATED HAZARDS

Tree maintenance - The Public Works and the Light Departments have an effective tree trimming program in public areas and along Rights-of-Ways.

EXISTING TOWN-WIDE MITIGATION FOR WINTER-RELATED HAZARDS

Snow Plowing - The Public Works Department provides standard snow plowing operations, including salting and sanding, but with a restricted salt policy.

Parking Ban - Overnight parking bans are in effect from November 15 – April 1 during snowstorms.

Snow Disposal bylaw - The town has a Snow and Ice Disposal bylaw that states no person shall put any snow or ice in any public place or upon any part of a public street or sidewalk.

Snow storage - The town has sufficient snow storage.

EXISTING TOWN-WIDE MITIGATION FOR FIRE-RELATED HAZARDS

Opening Burning Permits - Town bylaws allow controlled open burning from January until May, in accordance with state regulations, but a permit is required from the Fire Chief for each day of intended burning.

Development Review - The Fire department reviews all subdivision and site plans for compliance with site access, water supply needs, fire protection, and all other applicable regulations.

Public Education - The town provides public education and notices during “drought watches.”

Firewise Program - Norwood is one of only two communities in the state to have successfully taken part in the nationally recognized Firewise Program, which in Massachusetts is operated through the DCR’s State Forest Fire Department.

EXISTING TOWN-WIDE MITIGATION FOR EARTHQUAKE HAZARDS

Shelter – The town has shelters and backup facilities.

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

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

Evacuation Plan - The town does have an evacuation plan as specified in its Comprehensive Emergency Management Plan (CEMP).

EXISTING TOWN-WIDE MITIGATION FOR LANDSLIDE HAZARDS

Slope requirements - The subdivision regulations do have maximum slope requirements for new roads.

Earth Removal – The town has an earth removal bylaw.

EXISTING MULTI-HAZARD MITIGATION MEASURES

Multi-Department Review of Developments – Multiple departments, such as Planning, Health, Public Works, Fire, Police, and Conservation, review all subdivision and site plans prior to approval.

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

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

Regional Emergency Management Planning Committee (REPC) – The town participates in the Central Norfolk REPC.

Public Education - Emergency Preparedness public education is available on the town’s website.

Reverse 911 - The town has a reverse 911 system and names can be added to the database via the town’s website.

Generators - The Police and Fire Stations and Light Department have backup generators.

COMPILATION OF EXISTING MITIGATION

The following table summarizes the many existing natural hazard mitigation measures already in place in Norwood when the first Hazard Mitigation Plan was adopted in 2011. Because of the number of entities,

public and private, involved in natural hazard mitigation, it is likely that this list is a starting point for a more comprehensive inventory of all measures. Pre-existing mitigation measures from the 2011 plan are summarized in Table 34 below.

Table 34: Existing Natural Hazard Mitigation Measures in Norwood

Type of Existing Mitigation Measure	Effective	Improvements/Changes Needed
FLOOD HAZARDS		
Participation in the National Flood Insurance Program	Yes	
Street sweeping is done 2-3 times per year. More frequently as needed.	Yes	
Catch basin cleaning is done annually and more often in critical areas.	Yes	
Drainage system maintenance as needed. The Conservation Commission requires annual maintenance reports.	Yes	Tracking maintenance reports is challenging and could be improved.
Roadway treatment is adjusted to minimize sand use	Yes	
Zoning subdivision regulations address flood hazards	Yes	
Zoning for Flood Plain Conservancy District, Ground Water Protection, Site Plan approval and Open Space requirements address flooding	Yes	
Wetland Protection regulations and local by-law	Yes	
DAM HAZARDS		
Comprehensive Emergency Mgmt Plan addresses dam safety. Town-owned Ellis Pond Dam is inspected every 2 years.	Yes	
Permits are required for dam construction	Yes	
DCR dam safety regulations	Partially	This state responsibility is underfunded.
WIND HAZARDS		
Tree Trimming Program by Public Works and Light Dept.	Yes	
WINTER HAZARDS		
Standard snow operations, restricted salt	Yes	
Overnight parking ban November 15 – April 1	Yes	
Snow and Ice Disposal Bylaw	Yes	
Sufficient space for municipal snow storage	Yes	
FIRE HAZARDS		
Open burning permits required	Yes	
Fire Department reviews all development plans	Yes	
The town provides public education and notice during drought watches.	Yes	
The town participated in the Firewise Program	Yes	
EARTHQUAKE HAZARDS		
Shelters and backup facilities available	Yes	
Building code has limited language	Yes	
Evacuation plan in CEMP	Yes	
LANDSLIDE HAZARDS		

Type of Existing Mitigation Measure	Effective	Improvements/Changes Needed
Maximum slopes for subdivision roads	Yes	
Earth removal bylaw	Yes	
MULTI-HAZARDS		
Multi-department review of developments	Yes	
Comprehensive Emergency Management Plan (CEMP)	Yes	
Enforcement of State Building Code	Yes	
Regional Emergency Planning Committee	Yes	
Emergency Preparedness public education on the town website	Yes	Materials could be expanded.
Reverse 911	Yes	
Police and Fire Stations and Light Department have backup generators	Yes	

MITIGATION CAPABILITIES AND LOCAL CAPACITY FOR IMPLEMENTATION

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

The Town of Norwood has recognized several existing mitigation measures that require implementation or improvements, and has the capacity within its local boards and departments to address these. The Norwood Department of Public Works will address the needs for maintenance and upgrades to drainage infrastructure. The Town’s Planning and Conservation Departments will work together on open space acquisition, stormwater regulations, and drought resistant landscaping. Town leadership in cooperation with key departments will address the Willett Pond Dam and, incorporating climate concerns into the Capital, Open Space, and Master Plans.

SECTION 7: MITIGATION MEASURES FROM PREVIOUS PLAN

IMPLEMENTATION PROGRESS ON THE PREVIOUS PLAN

At a meeting of the Norwood Hazard Mitigation Planning Committee, Town staff reviewed the mitigation measures identified in the 2011 Norwood Hazard Mitigation Plan and determined whether each measure had been implemented or deferred. Of those measures that had been deferred, the committee evaluated whether the measure should be deleted or carried forward into this Hazard Mitigation Plan 2018 Update. The decision on whether to delete or retain a particular measure was based on the committee's assessment of the continued relevance or effectiveness of the measure and whether the deferral of action on the measure was due to the inability of the Town to take action on the measure. Table 35 summarizes the status of mitigation measures from the 2011 plan that are being continued in the 2018 update.

Table 35: Mitigation Measures from the 2011 Plan

Mitigation Measure	Priority in 2011 Plan	Current Status	Include in 2018 Plan?
Channel maintenance beneath Washington Street Bridge	High	The drainage channel has been cleaned and is monitored. It is functioning adequately.	NO
Morse Street Bridge reconstruction	High	This project was completed.	NO
Drainage maintenance and upgrades at Norwood Airport	High	Much progress has been made on channel maintenance through Conservation Commission and mosquito control, although not all channels have been cleared. On-going maintenance is needed.	YES
Drainage maintenance, improvements at Purgatory Brook	High	Maintenance work has been done. Expanded culverts and dredging have not been done.	YES
Channel maintenance and drainage improvements at Plantingfield Brook	High	Maintenance work has been done. Further improvements have not been done.	YES
Increase capacity to Meadow Brook from Nahatan Street Underpass	High	Work has been done to increase capacity, but not the large scale work described in the plan. No comprehensive study has been done.	YES
Increase capacity of Hawes Brook at Tannery site	Medium	The building is gone and debris has been removed. Further work for additional capacity is desirable – although this would be a private project related to future development.	YES

Mitigation Measure	Priority in 2011 Plan	Current Status	Include in 2018 Plan?
Improve Dean Street drainage	Medium	A project to increase the size of the culvert is underway and will be completed in 2019.	YES
Channel maintenance/improvements at Westover Parkway	Medium	Maintenance has been done. Culvert upgrades have not been done.	YES
Maintenance of Winter Street culvert		This project is complete.	NO
Channel maintenance and improvements at Traphole Brook	Medium	This project is complete.	NO
Improve drainage capacity at Lincoln and Elm streets	Medium	The analysis for improving drainage was done, but the solution was cost-prohibitive. The town has been able to re-direct some of the runoff. It is functioning adequately.	NO
Continuation of open space protection and land acquisition	Unrated	The town made several significant open space purchases and adopted the Community Preservation Act in 2016.	YES
Regulatory revisions for stormwater management	Unrated	The town conducted a review of stormwater regulations and found they were up-to-date. The town intends further review to comply with MS4 requirements as they are adopted.	YES
Maintenance of existing infrastructure	Unrated	The DPW has completed this project.	NO
Maintenance and upgrades at Willett Pond Dam	High	The work has not been done. The dam is privately owned. The town is advocating for pending state legislation that would fund repair work and/or will advocate alternative funding solutions.	YES
Improve fire access to high priority fire hazards	Medium	Done. Appropriate equipment was purchased.	NO

As indicated in Table 35, Norwood made good progress implementing mitigation measures identified in the 2011 Hazard Mitigation Plan. Many flood protection projects have been completed, including: channel and drainage maintenance and improvements beneath the Washington Street bridge, and at the Norwood Airport, at Purgatory, Plantingfield, Meadow, Traphole, and Howes Brooks. The Morse Street bridge was reconstructed, culvert work at Winter Street was completed, and equipment to improve access to fire hazards was purchased. In addition, the Town made several significant open space purchases and adopted the Community Preservation Act, which will facilitate future purchases.

Several projects that were not completed will be continued into this plan update. In many cases where the town made drainage improvements, additional goals identified in the 2011 plan were not completed. As a result drainage projects at the Norwood Airport, and Purgatory, Plantingfield, Meadow, and Howes

Brooks are included in the 2018 plan. A project to increase the size of a culvert at Dean Street is underway and will be completed in 2019. Open space purchases are an ongoing priority. Progress on the dams is challenging as ownership is private and, the Hollingsworth & Vose dam is not located in Norwood.

Overall, ten mitigation measures from the 2011 plan will be continued in the plan update. Most retain the same priority in this 2018 update. Open space acquisition and stormwater regulation revisions were unrated in the last plan; in this plan they are high and medium priorities respectively. A number of these are ongoing projects such as drainage maintenance and public education. One project is not complete and will not be carried forward into current plan. Drainage solutions at Lincoln and Elm Street were analyzed and found to be cost prohibitive. However, the Town was able to re-direct runoff to achieve adequate function.

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 hazards through long-term strategies. These long-term strategies include planning, policy changes, education programs, infrastructure projects and other activities. FEMA currently has three mitigation grant programs: the Hazards Mitigation Grant Program (HGMP), the Pre-Disaster Mitigation program (PDM), and the Flood Mitigation Assistance (FMA) program. The three links below provide additional information on these programs.

<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)

REGIONAL AND INTER-COMMUNITY CONSIDERATIONS

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

REGIONAL PARTNERS

In densely developed urban communities such as the metropolitan Boston area, mitigating natural hazards, particularly flooding, is more than a local issue. The drainage systems that serve these communities are complex systems of storm drains, roadway drainage structures, pump stations and other facilities owned and operated by a wide array of agencies including the Town, the Department of Conservation and Recreation (DCR), the Massachusetts Water Resources Authority (MWRA), Massachusetts Department of Transportation (MassDOT) and the Massachusetts Bay Transportation Authority (MBTA). The planning, construction, operation and maintenance of these structures are integral to the flood hazard mitigation efforts of communities. These agencies must be considered the communities' regional partners in hazard mitigation. These agencies also operate under the same constraints as communities do including budgetary and staffing constraints and they must make decisions about numerous competing priorities.

Following, is a brief overview of regional facilities found in Norwood and a discussion of inter-municipal issues.

OVERVIEW OF REGIONAL FACILITIES WITHIN NORWOOD

Major facilities owned, operated and maintained by state or regional entities include:

- Interstate I-95 (MassDOT)
- State roads Routes 1 and 1A (MassDOT)
- High tension lines
- MBTA Commuter Rail Lines
- Norwood Memorial Airport

INTER-COMMUNITY CONSIDERATIONS

Mitigation measures for the following regional issues should be taken into account as Norwood develops its own local plan:

A) Coordinate and Review Developments on a Regional Basis

As Norwood and the surrounding communities are undergoing development, it is vital that these communities communicate and provide input during the review processes. When addressing housing, transportation, and economic development projects, the impacts to neighbors must be addressed.

B) Neponset River Watershed

Flooding and management of the watershed are key regional issues. As noted in this plan, dams located outside of the Town of Norwood or on the town border are critical concerns.

NEW DEVELOPMENT AND INFRASTRUCTURE

As part of the process of developing recommendations for new mitigation measures for this plan update, the Town considered the issues related to new development, redevelopment, and infrastructure needs in order limit future risks. Taking into consideration the Zoning and By-law changes adopted in recent years, the Wetlands Act enforced by the Conservation Commission, and the recent adoption of the Community Preservation Act, the town determined that existing regulatory measures are taking good advantage of local Home Rule land use regulatory authority to minimize natural hazard impacts of development. Priorities for the future include updating stormwater management bylaws.

PROCESS FOR SETTING PRIORITIES FOR MITIGATION MEASURES

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

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

Table 36 below demonstrates the prioritization of the Town’s potential hazard mitigation measures. For each mitigation measure, the geographic extent of the potential benefiting area is identified as is an estimate of the overall benefit and cost of the measures. The benefits, costs, and overall priority were evaluated in terms of:

Estimated Benefits	
High	Action will result in a significant reduction of hazard risk to people and/or property from a hazard event
Medium	Action will likely result in a moderate reduction of hazard risk to people and/or property from a hazard event
Low	Action will result in a low reduction of hazard risk to people and/or property from a hazard event
Estimated Costs	
High	Estimated costs greater than \$100,000
Medium	Estimated costs between \$10,000 to \$100,000
Low	Estimated costs less than \$10,000 and/or staff time

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

Table 36: Mitigation Measures Prioritization

Mitigation Action	Geographic Coverage	Estimated Benefit	Estimated Cost	Priority
Flood Mitigation				
Drainage maintenance at Norwood Airport	Site Specific	High	High	High
Drainage maintenance, improvements at Purgatory Brook	Site specific	High	High	High
Channel maintenance and drainage improvements at Plantingfield Brook	Site specific	High	High	High
Increase capacity to Meadow Brook from Nahatan Street Underpass	Site specific	High	High	High
Increase capacity of Hawes Brook off Endicott St.	Site specific	High	High	High
Improve Dean Street drainage	Site specific	Medium	High	High
Channel maintenance/ improvements at Westover Parkway	Site specific	High	Medium	Medium
Continuation of open space protection and land acquisition	Town-wide	High	High	High
Regulatory revisions for stormwater management	Town-wide	Medium	Low	Medium
Wind Mitigation				
Conduct a public tree assessment	Town-wide	Medium	Medium	Medium
Brushfire Mitigation				
Keep access to potential brushfire areas open	Brushfire areas	Medium	Low	Low/ Medium
Educate the public regarding brushfire hazards	Town-wide	Medium	Low	Medium
Winter Storm Hazard Mitigation				
Purchase snow removal equipment for highways and public facilities	Town-wide	High	High	Medium
Identify additional snow melt or snow storage areas outside of wetlands	Town-wide	Medium	High	Medium
Earthquake Mitigation				
Public building seismic assessments	Public Buildings	Low	Medium	Low
Dam Mitigation				
Willett Pond automated outlet control structure upgrades, and lobby for state funding for	Site Specific	High	High	High

Mitigation Action	Geographic Coverage	Estimated Benefit	Estimated Cost	Priority
reconstruction				
Ellis Pond dam installation of remote monitoring and control	Site Specific	High	High	High
Hollingsworth & Vose dam in Walpole – encourage owners to install emergency monitoring	Site Specific	High	High	High
Extreme Temperature Mitigation				
Site Design to increase tree plantings near buildings, increase the percentage of trees used in parking areas, and along public ways.	Town-wide	Medium	Medium	Medium
Promote Green Building and Cool Roof designs	Town-wide	Medium	Low	Low
Drought Mitigation				
Encourage drought resistant landscaping	Town-wide	Medium	Low	Medium
Develop a policy to restrict the use of public water for non-essential uses.	Town-wide	Low	Low	Low
Multihazard Mitigation				
Develop emergency outreach strategy, particularly for vulnerable, non-English speaking, and hard-to-reach populations	Town-wide	High	Medium	High
Climate Mitigation				
Educate the public regarding risk from Lyme and other diseases	Town-wide	Medium	Low	Medium
Incorporate climate concerns into capital, open space, and master planning	Town-wide	High	Low	High

DESCRIPTION OF MITIGATION MEASURES

Flooding, Drainage Infrastructure, and Dams

Conduct drainage maintenance and channel improvements in a number of locations including: the Neponset River at Norwood Airport, Purgatory, Plantingfield, Meadow, and Hawes Brooks. The team noted that work at Hawes Brook is likely to be undertaken privately when new development occurs. Culvert improvements are a priority for Dean Street and Westover Parkway. Implement regulatory revisions to stormwater requirements for MS4 compliance and climate projections, and continue open space purchases for flood protection. Encourage upgrades to two private dams (Willett and Hollingsworth & Vose). The challenge will be encouraging action for entities not within the Town’s control. For town-owned Ellis Pond, install an automated outlet control structure.

Wind Hazards

Conduct a public tree assessment to identify trees or tree limbs vulnerable to damage due to high winds.

Fire Hazards

Ensure fire roads are maintained for access to brushfire risk areas. Provide public education regarding brushfire hazards.

Winter Hazards

Purchase snow removal equipment for difficult to clear highways and public facilities. Identify additional areas for snow storage needed during significant storms. Consider snowmelt opportunities as an alternative. Assure storage areas comply with wetland protection requirements.

Earthquakes

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

Extreme Temperatures

Work on site design requirements to increase tree planting near buildings, in parking areas, and along public ways.

Drought

Work with the Planning Board and the Conservation Commission to encourage drought resistant landscaping. Promote green buildings and cool roof design.

Multihazard Mitigation

Create a task force to review current emergency outreach strategies. Consider new efforts to reach seniors, renters, low-income, non-English speaking, and isolated individuals.

Climate Change

Educate the public regarding the risk from Lyme disease and other illnesses that may become more common as temperature warm. Incorporate new climate concerns into capital plans, open space planning, and master planning. Many of the mitigation actions listed above will also address future climate risks.

INTRODUCTION TO POTENTIAL MITIGATION MEASURES TABLE

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

Priority – As described above and summarized in Table 36, the designation of high, medium, or low priority was done considering potential benefits and estimated project costs, as well as other factors in the STAPLEE (Social, Technical, Administrative, Legal, Economic, and Environmental) analysis.

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

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

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

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

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

Massachusetts Emergency Management Agency (MEMA) – The grants page <https://www.mass.gov/hazard-mitigation-assistance-grant-programs> describes the various Hazard Mitigation Assistance Program.

Table 37: Potential Hazard Mitigation Measures

Mitigation Action	Priority	Lead Implementation	Time Frame	Estimated Cost	Potential Funding Source
Flood Mitigation					
Drainage maintenance at Norwood Airport	High	Airport	2018-2023	>\$100,000	Norwood Airport
Drainage maintenance, improvements at Purgatory Brook	High	DPW	2022	>\$100,000	FEMA Grants
Channel maintenance and drainage improvements at Plantingfield Brook	High	DPW	2022	>\$100,000	FEMA Grants
Increase capacity to Meadow Brook from Nahatan Street Underpass	High	DPW	2023	>\$100,000	Grants
Increase capacity of Hawes Brook off Endicott Street	High	Planning and Conservation	2022	>\$100,000	FEMA Grants, Private funds
Improve Dean Street drainage	High	Engineering	2019	>\$100,000	Town General Fund
Channel maintenance/ improvements at Westover Parkway	Medium	DPW	2020	\$10,000 -- \$100,000	Town General Fund

Mitigation Action	Priority	Lead Implementation	Time Frame	Estimated Cost	Potential Funding Source
Continuation of open space protection and land acquisition	High	Planning and Conservation	2018-2023	>\$100,000	CPA Funds
Regulatory revisions for stormwater management	Medium	Planning, Conservation, and Engineering	2018-2023	<\$10,000	Town General Fund or state grants
Wind Mitigation					
Conduct a public tree assessment	Medium	DPW/Light Plant	2020	\$10,000 -- \$100,000	Town General Fund
Brushfire Mitigation					
Keep access to potential brushfire areas open	Low/ Medium	Fire/DPW	2018-2023	<\$10,000	Town General Fund
Educate the public regarding brushfire hazards	Medium	Fire	2018-2023	<\$10,000	Town General Fund
Winter Storm Hazard Mitigation					
Purchase snow removal equipment for highways and public facilities	Medium	DPW	2021	>\$100,000	Town General Fund or grant
Identify additional snow melt or snow storage areas outside of wetlands	Medium	DPW	2022	>\$100,000	Town General Fund
Earthquake Mitigation					
Public building seismic assessments	Low	DPW	2023	\$10,000 -- \$100,000	Town General Fund
Dam Mitigation					
Willett Pond automated outlet control structure, upgrades, and lobby for state funding for reconstruction	High	DPW, Town Leadership	2018-2023	>\$100,000	State grants
Ellis Pond dam installation of automated outlet control structure	High	DPW	2021	>\$100,000	Grant or Town General Fund
Hollingsworth & Vose dam – encourage owners to install emergency monitoring	High	Town leadership	2018-2023	<\$10,000	Private funding
Extreme Temperature Mitigation					
Site Design to increase tree plantings near buildings, increase the percentage of trees used in parking areas, and along public ways.	Medium	Planning	2018-2023	\$10,000 -- \$100,000	Town General Fund

Mitigation Action	Priority	Lead Implementation	Time Frame	Estimated Cost	Potential Funding Source
Promote Green Building and Cool Roof designs	Low	Planning	2023	<\$10,000	Town General Fund
Drought Mitigation					
Encourage drought resistant landscaping	Medium	Planning/Conservation	2020	<\$10,000	Town General Fund
Develop a policy to restrict the use of public water for non-essential uses.	Low	Planning, DPW, Selectmen	2020	<\$10,000	Town
Multihazard Mitigation					
Develop emergency outreach strategy, particularly for vulnerable or hard-to-reach populations	High	Police	2018-2019	<\$10,000	Town General Fund
Climate Mitigation					
Educate the public regarding risk from Lyme and other diseases	Medium	Public Health	2019	<\$10,000	Town General Fund
Incorporate climate concerns into capital, open space, and master planning	Medium	Planning	On-going	<\$10,000	Town General Fund

SECTION 9: PLAN ADOPTION & MAINTENANCE

PLAN ADOPTION

The Norwood Hazard Mitigation Plan 2018 Update was adopted by the Board of Selectmen on November 6, 2018. See Appendix D for documentation. The plan was approved by FEMA on [ADD DATE] for a five-year period that will expire on [ADD DATE].

PLAN MAINTENANCE

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

MAPC worked with the Norwood Hazard Mitigation Planning Team to prepare this plan. After approval of the plan by FEMA, this group will meet to function as the Hazard Mitigation Implementation Team, with the Planning and Economic Development Director designated as the coordinator. Additional members could be added to the local implementation team from businesses, non-profits and institutions. The Town will encourage public participation during the next 5-year planning cycle. As updates and a review of the plan are conducted by the Hazard Mitigation Implementation Team, these will be placed on the Town's web site.

IMPLEMENTATION AND EVALUATION SCHEDULE

Annual Review – The coordinator of the Hazard Mitigation Implementation Team will convene the team annually to consider changes or revisions to the plan that may be needed, progress and accomplishments, and any new hazards or problem areas that have been identified.

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

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

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

Prepare and Adopt an Updated Local Hazard Mitigation Plan – Once the resources have been secured to update the plan, the Hazard Mitigation Implementation Team may decide to undertake the update themselves, contract with the Metropolitan Area Planning Council to update the plan or to hire another consultant. However the Hazard Mitigation Implementation Team decides to update the plan, the group will need to review the current FEMA hazard mitigation plan guidelines for any changes. The Norwood Hazard Mitigation Plan Update will be forwarded to MEMA and DCR for review and to FEMA for approval.

INTEGRATION OF THE PLANS WITH OTHER PLANNING INITIATIVES

Upon approval of the Norwood Hazard Mitigation Plan 2018 Update by FEMA, the Local Hazard Mitigation Team will provide all interested parties and implementing departments with a copy of the plan and will initiate a discussion regarding how the plan can be integrated into that department's ongoing work. At a minimum, the plan will be reviewed and discussed with the following departments:

- Fire/Emergency Management
- Police
- Public Works
- Planning and Economic Development
- Conservation
- Light Department
- Building Department

Other groups that will be coordinated with include large institutions, Chambers of Commerce, land conservation organizations and watershed groups. The plans will also be posted on the Town's website with the caveat that a local team coordinator will review the plan for sensitive information that would be inappropriate for public posting. The posting of the plan on the website 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 Open Space and Recreation Plan, Comprehensive Emergency Management Plan, Master Plan, and Capital Plan.

SECTION 10: LIST OF REFERENCES

- Town of Norwood, Massachusetts. *Subdivision Rules and Regulations*
- Town of Norwood, Massachusetts, <http://www.norwoodma.gov/>
- Town of Norwood, Massachusetts. *Zoning Bylaw, May 12, 2014*
- Town of Norwood, *Open Space and Recreation Plan, 2010*
- FEMA, *Flood Insurance Rate Maps for Norfolk County, MA, 2012*
- FEMA, *Local Mitigation Plan Review Guide; October 1, 2011*
- MA Emergency Management Agency, *State Hazard Mitigation Plan, 2013*
- MA Geographic Information System, *McConnell Land Use Statistics, 2005*
- MA Office of Dam Safety, *Inventory of Massachusetts Dams*
- Metropolitan Area Planning Council, *Geographic Information Systems Lab*
- New England Seismic Network, Weston Observatory, <http://aki.bc.edu/index.htm>
- Northeast States Emergency Consortium, website <http://www.nesec.org/>
- NOAA, National Centers for Environmental Information, website
- U. S. Census, 2010, and American Community Survey, 2013
- USGS, National Water Information Center, website

APPENDIX A: MEETING AGENDAS

Norwood Hazard Mitigation Plan 2018 Update

Tuesday, November 14, 2017

Meeting #1

Norwood Town Hall

AGENDA

1. Introductions
2. Overview of Planning Process
3. Identify/update local hazards:
 - a) Flood Hazard Areas
 - b) Fire Hazard Areas (brushfires/wildfires)
 - c) Other hazards (snow)
4. Identify/Update Potential New Development Sites
5. Update Critical Facilities Inventory and Mapping
6. Integration with MVP program - schedule

Norwood Hazard Mitigation Plan 2018 Update

Wednesday, January 31, 2018

10:00 -11:30

Meeting #2

AGENDA

1. Introductions
2. Review original existing mitigation measures from 2011 plan
 - confirm effectiveness
 - note any needed changes
3. Review recommended mitigation measures from 2011 plan
 - current status
 - decide which to carry forward into 2018 plan
 - evaluate priority
4. Review Mitigation Goals and update as needed
5. Discuss Critical Infrastructure updates if necessary
6. Next Steps

AGENDA

Norwood Local Hazard Mitigation Planning Team Meeting #3

Monday, May 21st
10:00 am

UPDATE ON WHERE WE ARE IN THE PLANNING PROCESS

MVP REVIEW

PROPOSE NEW MITIGATION MEASURES FOR THE 2018 PLAN

Mitigation categories:

- Flood
- Brushfire
- Drought
- Earthquakes
- Extreme Temperatures
- Wind
- Winter Storms
- Climate Resilience/Adaptation (optional)

NEXT STEPS

Final meeting before the Board of Selectmen

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APPENDIX B: HAZARD MAPPING

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

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

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
Map 9.	Extreme Heat

Map 1: 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: Land Use – This map depicts existing land use, based on the MacConnell Land Use map series from University of Massachusetts, available from MassGIS . The map displays 33 categories of land use based on interpretation of aerial photos. 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>

Map 3: Flood Zones – The map of flood zones used the FEMA NFIP Flood Zones as depicted on the FIRMs (Federal Insurance Rate Maps) for Norfolk County dated July 17, 2012 as its source. This map is not intended for use in determining whether or not a specific property is located within a FEMA NFIP flood zone. The currently adopted FIRMs for Norwood are kept by the Town. For more information, refer to the FEMA Map Service Center website <http://www.msc.fema.gov>. The definitions of the flood zones are described in detail on this site as well. The flood zone map for each community also shows critical infrastructure and repetitive loss areas.

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

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

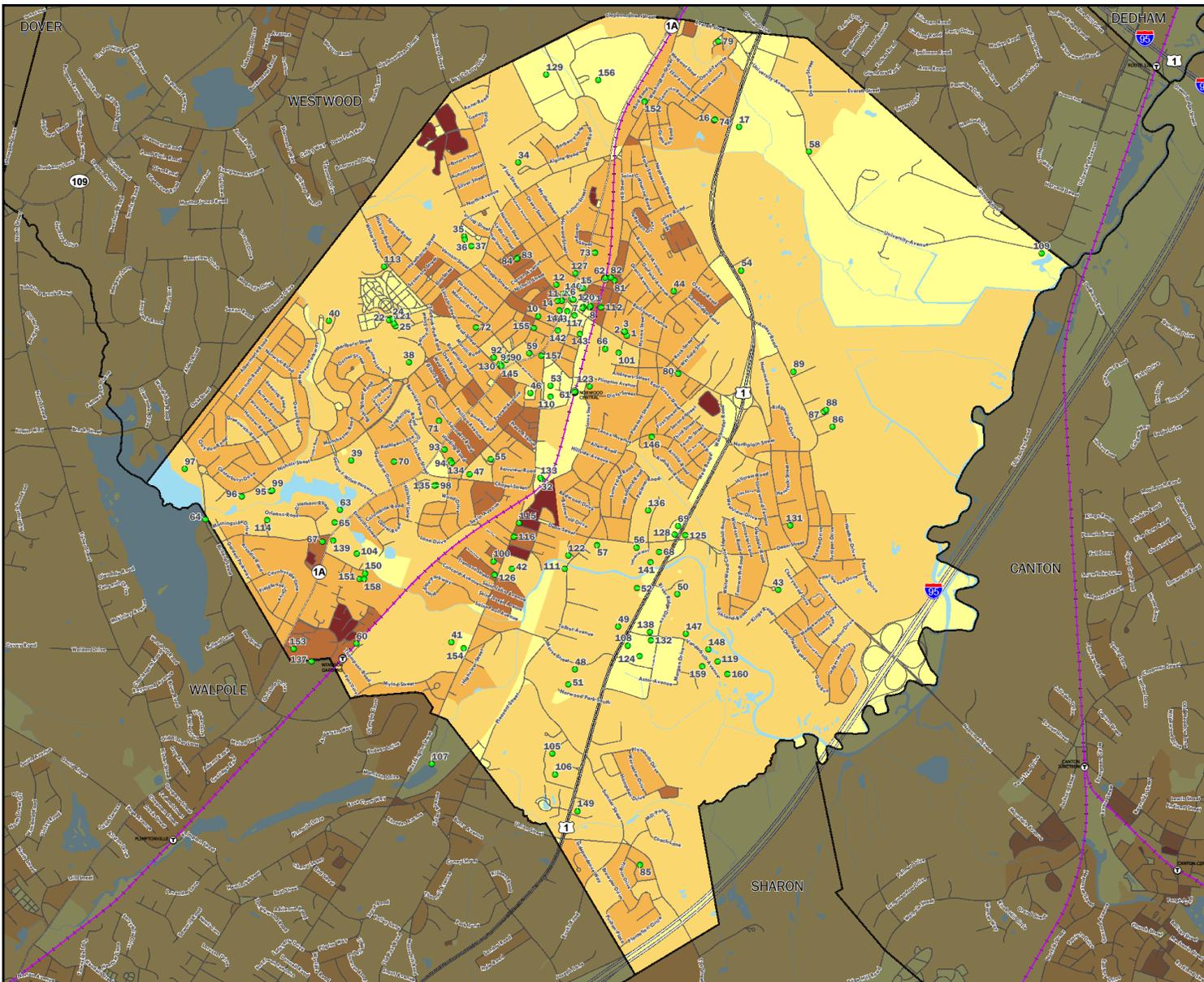
Map 5: Hurricanes and Tornadoes – This map shows a number of different items. The map includes the storm tracks for both hurricanes and tropical storms, if any occurred in this community. This information must be viewed in context. A storm track only shows where the eye of the storm passed through. In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

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

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

Map 8: Hazard Areas – For each community, locally identified hazard areas are overlaid on an aerial photograph dated April, 2009. The source of the aerial photograph is Mass GIS. This map also 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 9: Extreme Heat Areas. MAPC performs an urban heat island analysis using land surface temperature from LANDSAT then calculates the top 5% hottest areas in the Metropolitan Boston region to indicate areas of extreme heat and urban heat island. This analysis uses data from July and August 2016.

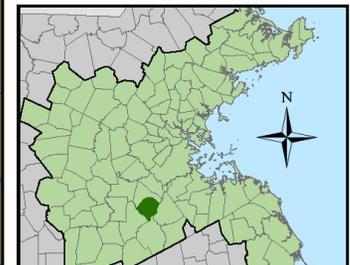


FEMA Hazard Mitigation Planning Grant
NORWOOD, MA

Map 1: Population Density

- Sites**
- Critical Infrastructure Sites*
 - Water Bodies
- * See details in separate table
- Population Density
 2010 Census Blocks
 People Per Acre**
- 0 or No Data
 - 0.1 - 5.0
 - 5.1 - 15.0
 - 15.1 - 30.0
 - More than 30
- All Roads**
- Interstate
 - U.S. Highway
 - State Route
 - Street
- Trains**
- Train Stations
 - Commuter Rail Lines
 - Trains

0 0.25 0.5 Miles

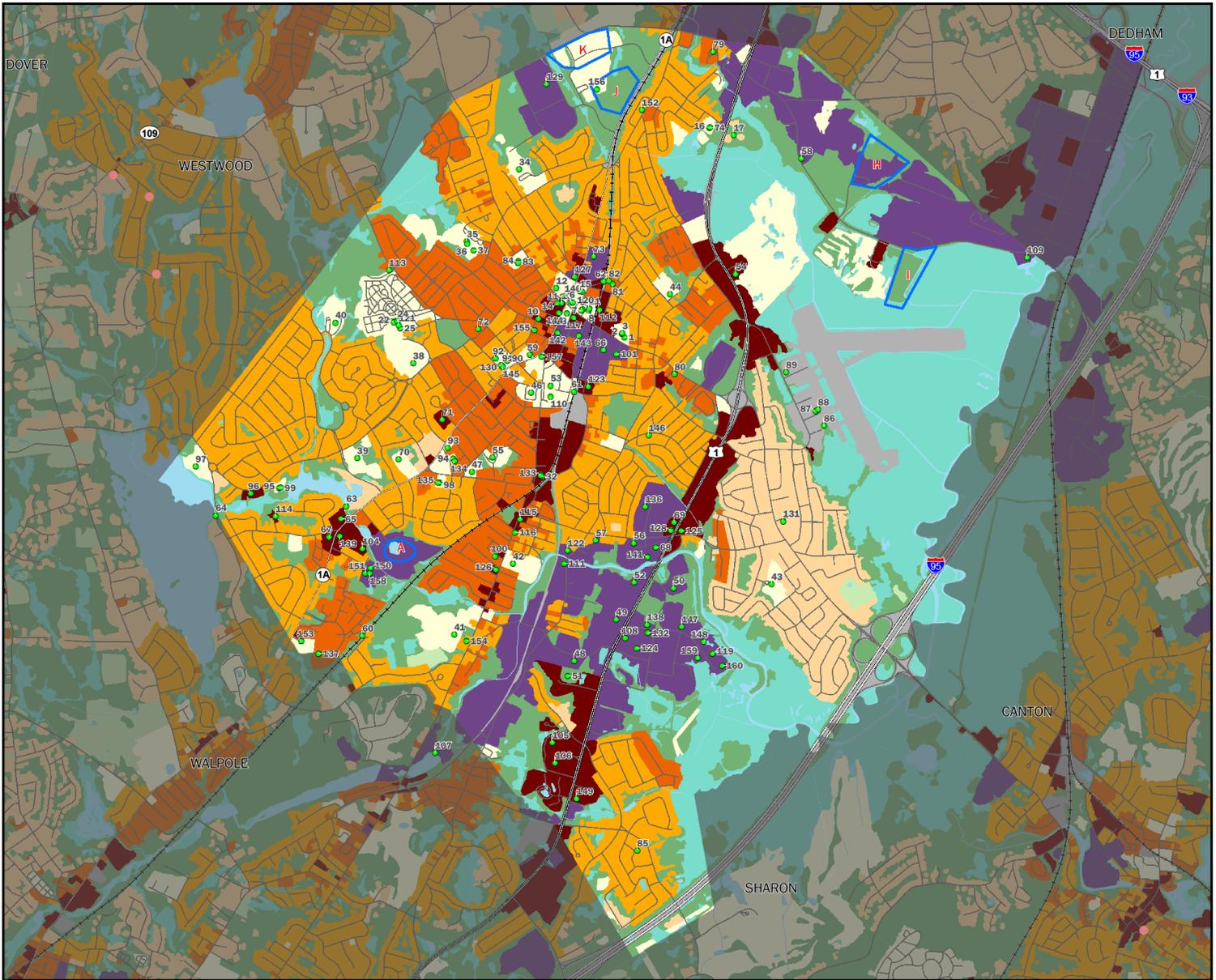


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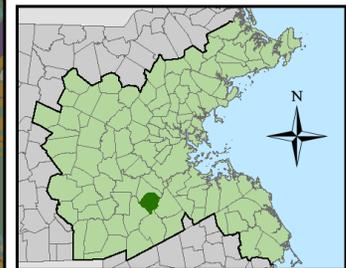
Data Sources:
 Metropolitan Area Planning Council (MAPC)
 Massachusetts Geographic Information System (MassGIS)
 Northeast States Emergency Consortium (NESEC)
 Massachusetts Emergency Management Agency (MEMA)
 Federal Emergency Management Agency (FEMA)
 NORWOOD, MA

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 Date: 8/10/2018



FEMA Hazard Mitigation Planning Grant
NORWOOD, MA
 Map 2: Land Use

- Sites
 - Critical Infrastructure Sites*
 - Repetitive Loss Sites
 - * See details in separate table
 - Development Areas
 - * See details in separate table
 - Land Use (2005)**
 - High Density Residential
 - Medium Density Residential
 - Low Density Residential
 - Non-Residential Developed
 - Commercial
 - Industrial
 - Transportation
 - Agriculture
 - Undeveloped
 - Undeveloped Wetlands
 - Train Stations
 - Commuter Rail Lines
 - Trains
 - All Roads**
 - Interstate
 - U.S. Highway
 - State Route
 - Street
 - Water Bodies
- 0 0.25 0.5 Miles

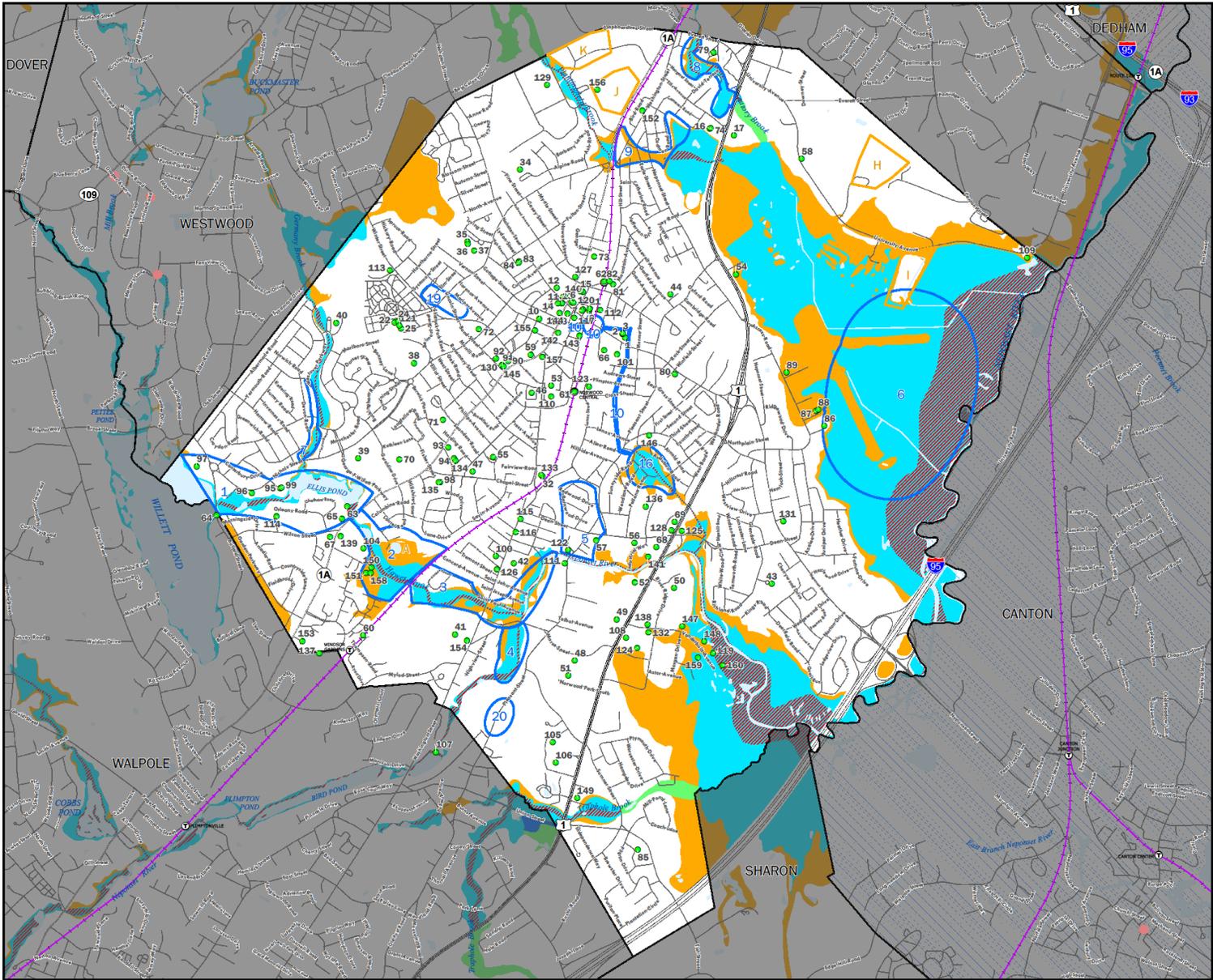


The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analyses.

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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)
 NORWOOD, MA

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 Date: 8/10/2018



FEMA Hazard Mitigation Planning Grant
NORWOOD, MA

Map 3: Flood Zones

Sites

- Critical Infrastructure Sites*
- Repetitive Loss Sites

* See details in separate table

Locally Identified Hazard Areas*

- Flooding
- Development Areas*

* See details in separate table

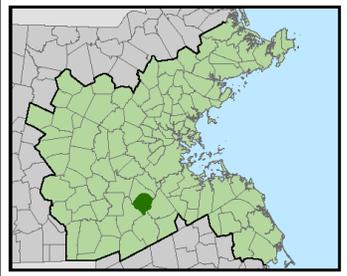
Flood Zones, 2017 (Annual Chance)

- A: 1% Annual Chance of Flooding, no BFE
- AE: 1% Annual Chance of Flooding, with BFE
- AE: Regulatory Floodway
- AO: 1% Annual Chance of 1-3ft Sheet Flow Flooding, with Depth
- X: 0.2% Annual Chance of Flooding
- Area Not
- Area with no DFIRM - Paper FIRMs in Effect

Other Features:

- Train Stations
- Commuter Rail Lines
- Trains
- All Roads: Interstate, U.S. Highway, State Route, Street
- Water Bodies

0 0.25 0.5 Miles



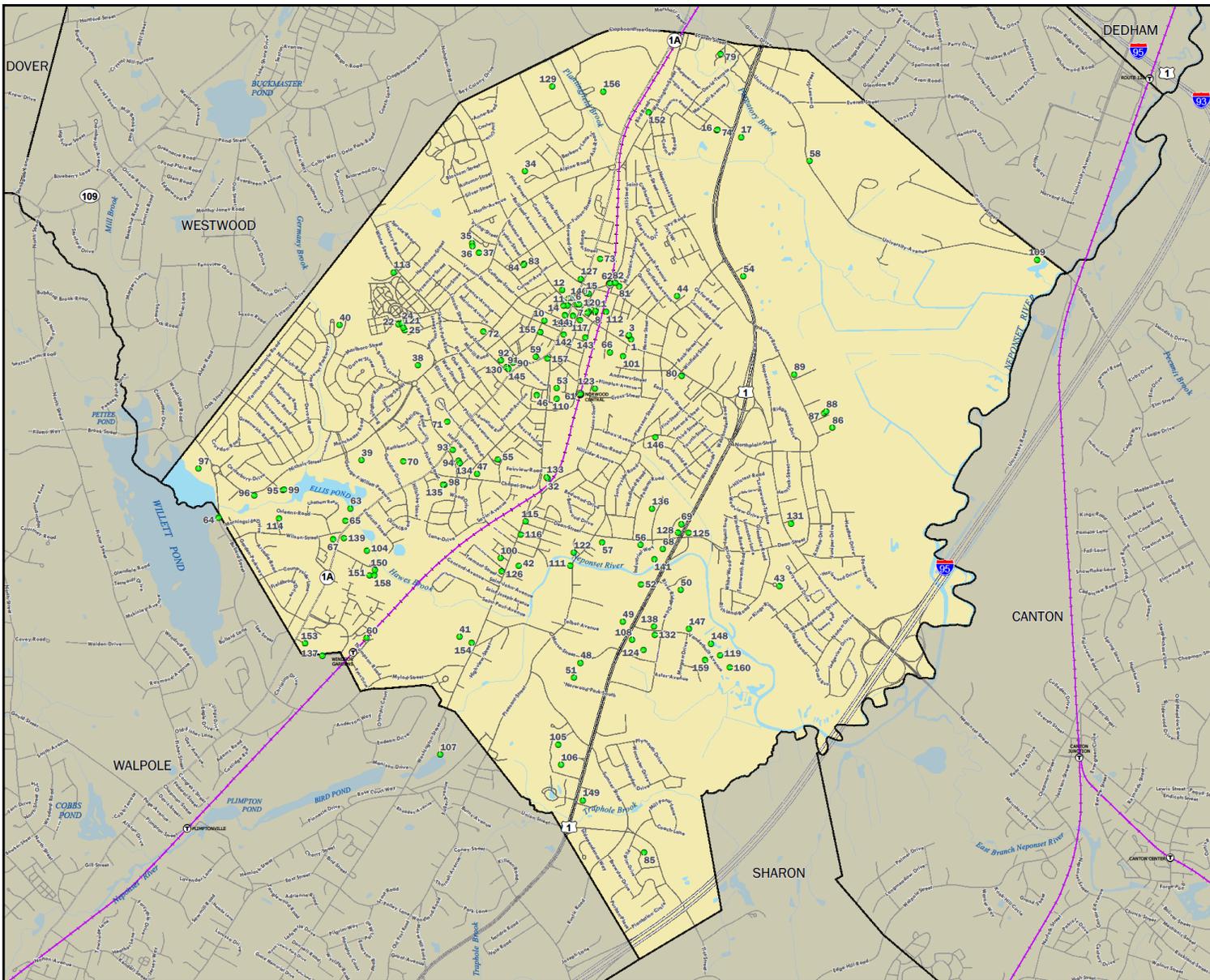
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analyses.

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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)

NORWOOD, MA
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 Date: 8/10/2018



FEMA Hazard Mitigation Planning Grant
NORWOOD, MA

Map 4: Earthquakes / Landslides

Sites

- Critical Infrastructure Sites* (Green dot with number)
- Water Bodies (Blue area)

*** See details in separate table**

Earthquakes

- Epicenters (Red dot)
- Train Stations (Circle with cross)
- Commuter Rail Lines (Purple line)
- Trains (Black line with cross-ticks)

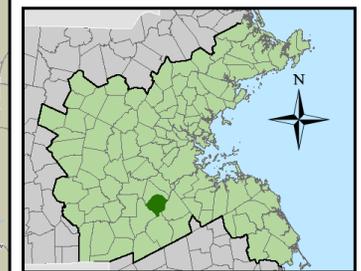
All Roads

- Interstate (Thick black line)
- U.S. Highway (Thin black line)
- State Route (Dashed black line)
- Street (Thin grey line)

Landslides

- High landslide incidence (greater than 15% of the area is involved in landsliding) (Dark brown)
- High susceptibility to landsliding and moderate incidence (Orange)
- High susceptibility to landsliding and low incidence (Light orange)
- Moderate susceptibility to landsliding and low incidence (Yellow-orange)
- Low landslide incidence (less than 1.5% of the area is involved in landsliding) (Light yellow)

0 0.25 0.5 Miles

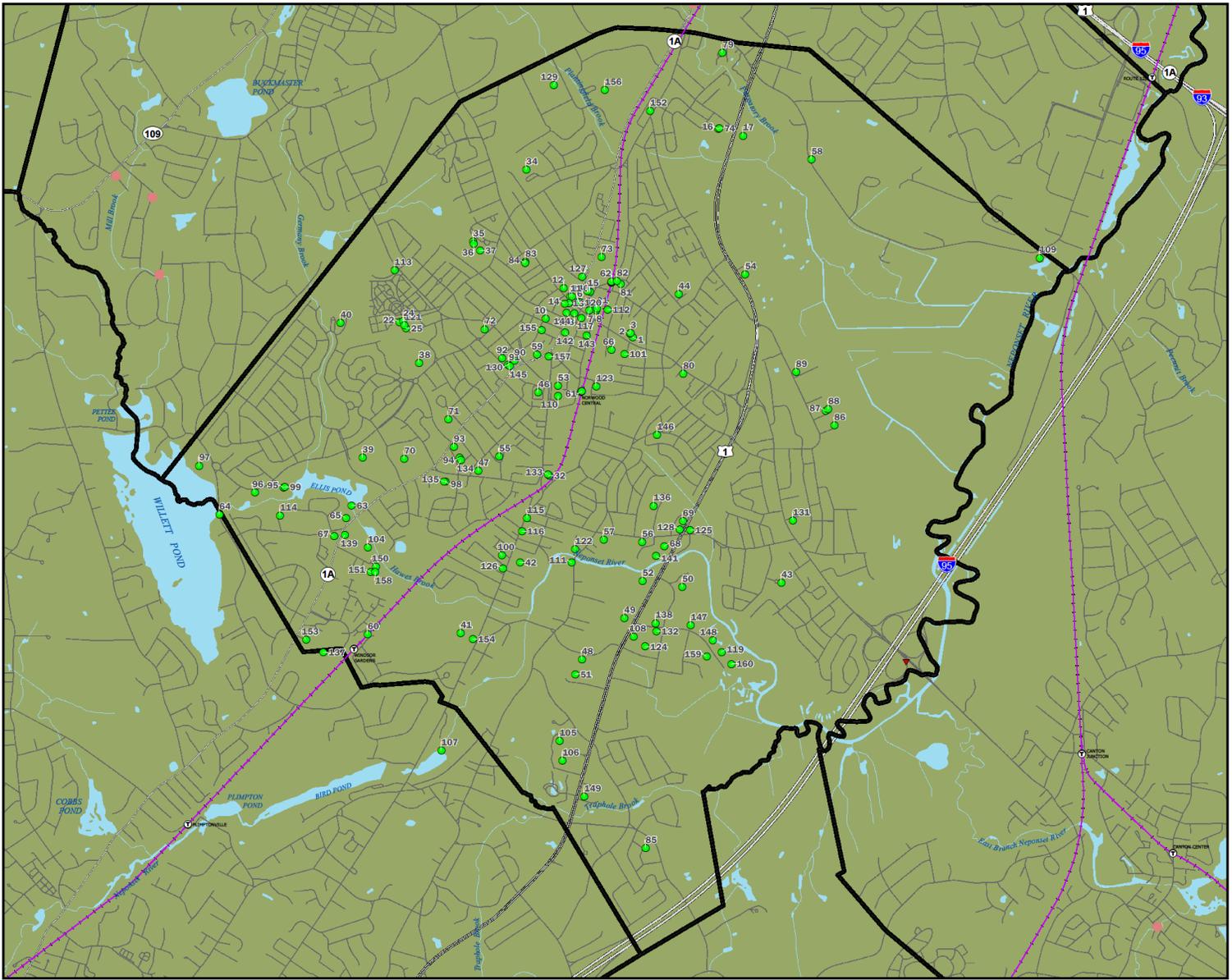


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Data Sources:
 Metropolitan Area Planning Council (MAPC)
 Massachusetts Geographic Information System (MassGIS)
 Northeast States Emergency Consortium (NESEC)
 Massachusetts Emergency Management Agency (MEMA)
 Federal Emergency Management Agency (FEMA)
 NORWOOD, MA

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 Date: 8/10/2018






FEMA Hazard Mitigation Planning Grant
NORWOOD, MA
 Map 5: Hurricanes / Tornadoes

Sites

- Critical Infrastructure Sites*
- Repetitive Loss Sites

* See details in separate table

Tornadoes

- ▼ Tornado

Storm Tracks

- Tropical Depression
- Tropical Storm
- Category 1 Hurricane
- Category 2 Hurricane
- Category 3 Hurricane

100 Year Wind Speeds

- 90 MPH
- 100 MPH
- 110 MPH
- 120 MPH
- 130 MPH

Year of storm noted on map

- ☒ Hurricane Surge Inundation Areas

Transportation

- Ⓜ Train Stations
- Commuter Rail Lines
- Trains

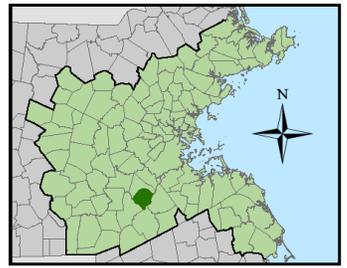
Roads

- Interstate
- U.S. Highway
- State Route
- Street

Water Bodies

- Water Bodies

0 0.25 0.5 Miles



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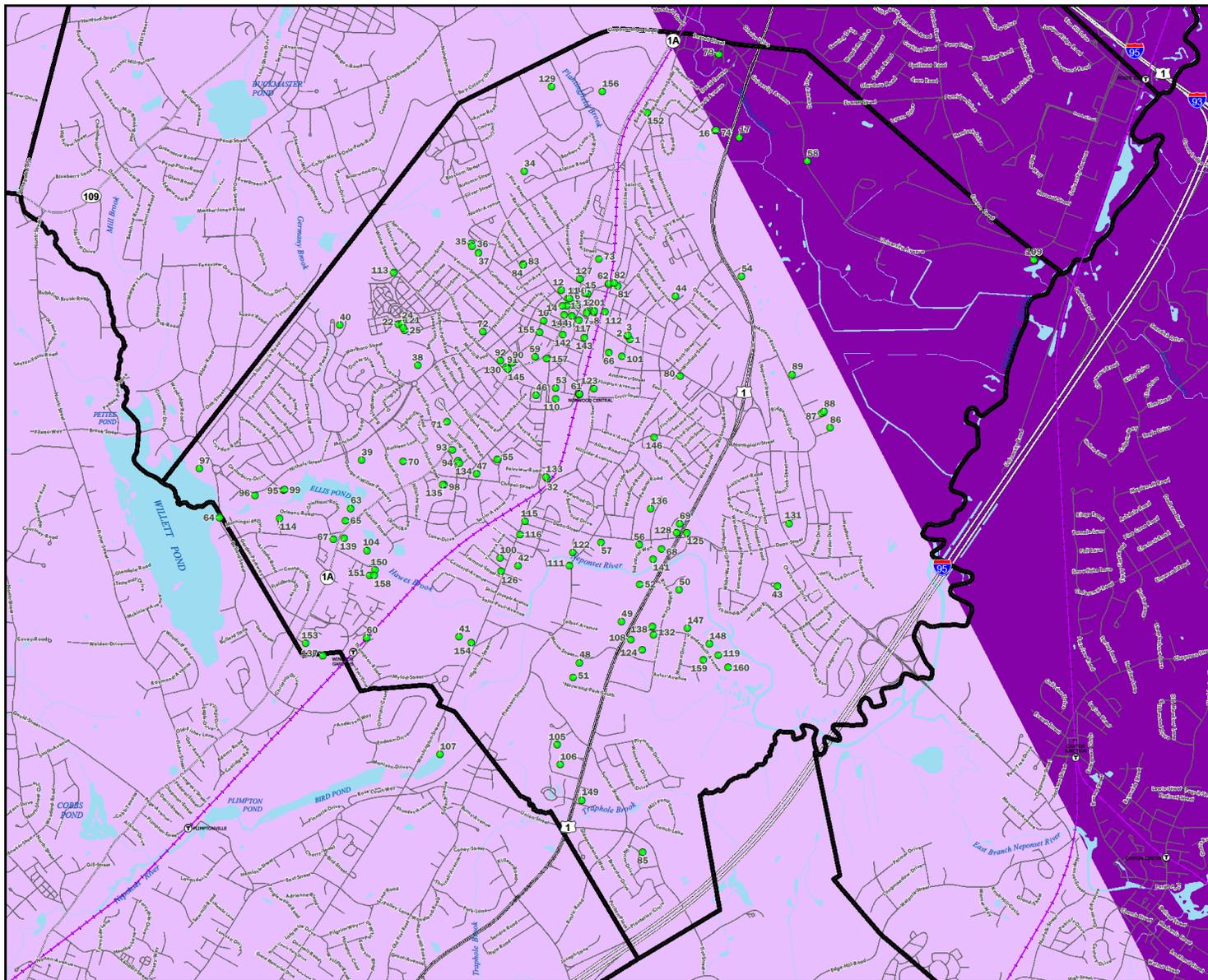
Produced by MAPC Data Services
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Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
NORWOOD, MA

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Date: 8/10/2018

FEMA Hazard Mitigation Planning Grant
NORWOOD, MA

Map 6: Average Snowfall



Sites
 ● Critical Infrastructure Sites*

* See details in separate table

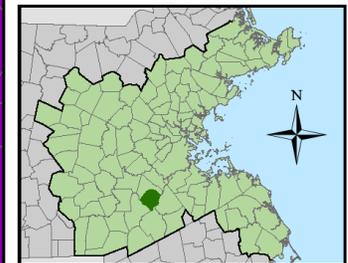
Average Annual Snowfall
 Light Purple: 36.1 to 48.0 inches
 Dark Purple: 48.1 to 72.0 inches

Water Bodies

Trains
 ● Train Stations
 — Commuter Rail Lines
 — Trains

All Roads
 — Interstate
 — U.S. Highway
 — State Route
 — Street

0 0.25 0.5 Miles

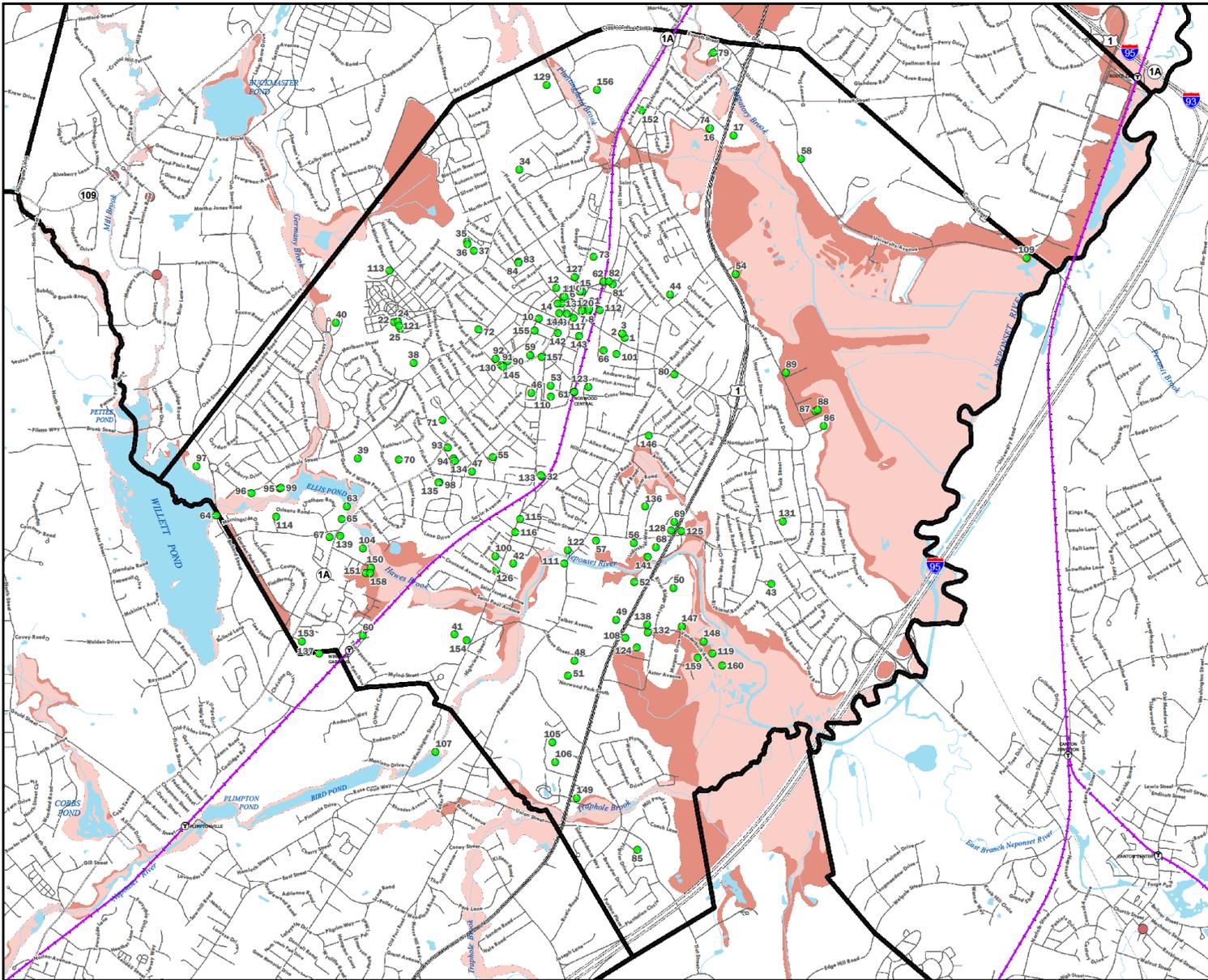


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Data Sources:
 Metropolitan Area Planning Council (MAPC)
 Massachusetts Geographic Information System (MassGIS)
 Northeast States Emergency Consortium (NESEC)
 Massachusetts Emergency Management Agency (MEMA)
 Federal Emergency Management Agency (FEMA)
 NORWOOD, MA

Path: K:\DataServices\Projects\Current_Progect\FEMA_project_files\FEMA_Map6.mxd
 Date: 8/10/2018

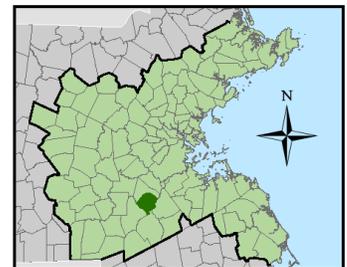


FEMA Hazard Mitigation Planning Grant
NORWOOD, MA

Map 7: Composite Natural Hazards

- Composite Natural Hazards**
- Low (2 Hazards)
 - Moderate (3 Hazards)
 - High (4 Hazards)
 - Very High (5 Hazards)
- Sites**
- Critical Infrastructure Sites*
 - Repetitive Loss Sites
 - * See details in separate table
- Water Bodies**
- Water Bodies
- 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 inundation areas
- All Roads**
- Interstate
 - U.S. Highway
 - State Route
 - Street
- Train Stations**
- Commuter Rail Lines
 - Trains

0 0.25 0.5 Miles



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Data Sources

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

Roads/Trains: MassDOT/ CTPS
 Repetitive Loss Sites: DCR/Office of Flood Hazard Management

Critical Infrastructure: Metropolitan Area Planning Council (MAPC) / NORWOOD, MA
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 Date: 8/10/2018

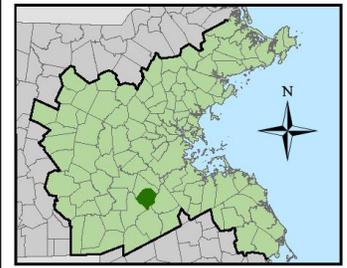


FEMA Hazard Mitigation Planning Grant
NORWOOD, MA

Map 8: Local Hazard Areas

- | | |
|--|--|
| <ul style="list-style-type: none"> ● Critical Infrastructure Sites* ● Repetitive Loss Sites * See details in separate table | <ul style="list-style-type: none"> ● Train Stations — Commuter Rail Lines — Trains |
| <p>Locally Identified Hazard Areas</p> <ul style="list-style-type: none"> ■ Brush Fires ■ Flooding ■ Historic ■ Development Sites * See Section IV Risk Assessment * See details in separate table | <p>All Roads</p> <ul style="list-style-type: none"> — Interstate — U.S. Highway — State Route — Street |

0 0.5 1 Miles



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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)
 Imagery © Google
 NORWOOD, MA
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 Date: 8/10/2018

APPENDIX C: PUBLIC MEETINGS

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

CALENDAR LISTING / MEDIA ADVISORY

NORWOOD'S DRAFT HAZARD MITIGATION PLAN TO BE PRESENTED AT MARCH 12 PUBLIC MEETING

Meeting to present the 2018 update of Norwood's Hazard Mitigation Plan and solicit public comments

- Who:** Norwood residents, business owners, representatives of non-profit organizations and institutions, and others who are interested in preventing and reducing damage from natural hazards.
- What:** At the Norwood Planning Board meeting on Monday, March 12 at 7:00 PM, a presentation will be made by the Metropolitan Area Planning Council (MAPC), which is assisting the Town on the 2018 update of its Hazard Mitigation Plan.
- The Town of Norwood adopted its first Hazard Mitigation Plan in 2011, which was approved by the Federal Emergency Management Agency (FEMA). This plan will update the 2011 plan. The plan identifies natural hazards affecting Norwood such as floods, hurricanes, winter storms, and earthquakes, as well as actions that the Town can take to reduce its vulnerability to these hazards.
- When:** Monday, March 12 at 7:00 PM
- Where:** Norwood Town Hall
500 Washington Street, Room 12

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

##



HAZARD MITIGATION PLAN PUBLIC MEETING

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



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

Date: Monday, March 12, 2018
Time: 7:00 PM
Location: Norwood Town Hall, Room 12
500 Washington Street, Norwood, MA

For more information, please contact Anne Herbst via phone at (617) 933-0781 or email aherbst@mapc.org



Norwood Planning Board

Ernie Paciorkowski, Chairman
Joseph F. Sheehan
Alfred P. Porro Jr.
Debbie Holmwood, Clerk



**Director of Community
Planning and Economic
Development**
Paul Halkiotis, AICP

Assistant Planner
Patrick Deschenes

NORWOOD PLANNING BOARD MEETING

AGENDA
March 12, 2018
7:00 P.M.

Norwood Town Hall, 566 Washington St. Room 12

- 7:00 P.M. Approval of Minutes from 2/26/2018
- 7:05 P.M. Minor Site Plan Approval – Sign for Elegant Orthodontics – 6 Central Street –Maureen Wheatley
- 7:10 P.M. Minor Site Plan Approval – Sign for Burn Boot Camp – 686 Washington Street –Emily Huebner, Burn Boot Camp & Makayla LeFebvre, Signs By Tomorrow
- 7:15 P.M. ANR Plan 1412-1420 Boston-Providence Highway, Wendy’s & BJ’s – Justin Ferris, Charles River Realty
- 7:20 P.M. Hazard Mitigation Plan Update –Anne Herbst, Senior Regional Environmental Planner, Metropolitan Area Planning Council
- 7:40 P.M. Bond Reduction – Upland Woods Subdivision – Russel Dion, Campanelli Co.
- Planning Board Business
1. Town Meeting Articles
 2. Zoning Bylaw 6.2.19 Sign Review Board
 3. Other Business

Next Meeting: March 26, 2018

This listing of items are those reasonably anticipated by the Chairman and may be discussed at the meeting. Not all matters may in fact be brought up and other items not listed may also be brought up for discussion to the extent permitted by Law.

Norwood Planning Board
781-762-1240 ext. 164

566 Washington Street
781-278-3033 (fax)

Norwood, Ma. 02062
phalkiotis@norwoodma.gov

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

CALENDAR LISTING / MEDIA ADVISORY

NORWOOD'S DRAFT HAZARD MITIGATION PLAN TO BE PRESENTED AT JULY 10 PUBLIC MEETING

Meeting to present the 2018 update of Norwood's Hazard Mitigation Plan and solicit public comments

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

What: At the Norwood Board of Selectmen meeting on Tuesday, July 10, at 7:00 PM, a presentation will be made by the Metropolitan Area Planning Council (MAPC), which is assisting the Town on the 2018 update of its Hazard Mitigation Plan.

The Town of Norwood adopted its first Hazard Mitigation Plan in 2011, which was approved by the Federal Emergency Management Agency (FEMA). This plan will update the 2011 plan. The plan identifies natural hazards affecting Norwood such as floods, hurricanes, winter storms, and earthquakes, as well as actions that the Town can take to reduce its vulnerability to these hazards.

When: Tuesday, July 10, at 7:00 PM

Where: Norwood Town Hall
566 Washington Street, Room 34

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##

HAZARD MITIGATION PLAN PUBLIC MEETING

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



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

Date: Tuesday, July 10, 2018
Time: 7:00 PM
Location: Norwood Town Hall, Room 34
566 Washington Street, Norwood, MA

For more information, please contact Anne Herbst via phone at (617) 933-0781 or email a Herbst@mapc.org



Selectmen's Meeting July 10, 2018

Room 34, Town Hall Meeting is Recorded

Pledge of Allegiance and Silent Moment of Prayer and Reflection

7:00 P.M. – Fourth of July Committee – Wrap up

7:05 P.M. – **Paul Halkiotis, Director, Planning & Economic Development:** Re: Hazard Mitigation Plan

7:20: P.M. – **Nancy J. Koury, President, Middlesex Integrative Medicine:** Submitting application that was submitted to the Zoning Board of Appeals and check for \$10,000 for license to operate as a registered Marijuana Dispensary in the Town of Norwood. This application requires a Special Permit from the Board of Appeal-hearing was held on June 19, 2018 at 7:15 p.m. (Tabled from May 8, May 22, 2018)

New Business

1. Community Preservation Committee: Submitting for reappointment, John Hall and Peter McFarland. They are one year terms-term to expire, August 1, 2019.
2. **Travis Farley, Superintendent of Recreation:** a. Submitting request to hold fireworks on Friday, September 7, 2018 at the Coakley Middle School in honor of Norwood Day. David Spiegel will be sponsoring the event. b. Submitting request to close Washington Street from Nahatan Street to Guild Square on Saturday, September 8, 2018 from 6 a.m. to 5 p.m. and to place a banner on poles on Washington Street between Vernon and Day Streets from August 17, to September 10, 2018. The banner will advertise the fireworks and Norwood Day.
3. **Sigalle Reiss, Supt./Director, Board of Health:** Submitting request to place banner on poles on Washington Street between Vernon and Day Streets from Monday, September 10 to September 24, 2018 to advertise Household Hazardous Waste Day on September 22, 2018.
4. Elizabeth Rodriguez, 1117 Hilltop Drive, Walpole, MA: Submitting request to hold bandstand wedding Friday, July 20, 2018 from 2 p.m. to 4 p.m.
5. Ethel Levangie, Hollie's Place, 61 Endicott Street: Submitting request for Special One Day Wine Only License for Thursday, August 2, 2018 from 6 p.m. to 9 p.m.
6. **Robert Sullivan, Mgr. Government Affairs, Verizon:** Submitting information on new video services being offered to customers.
7. Cemetery Deeds: For review and signature by the Board. Daniel P. Carroll, 37 Hillshire Lane to Lot C3-56 Edward Schaller, 3104 Brigadoon Drive, Clearwater FL, 33759 to Lot C3-57 Melanie L. Curran, 22 Elliott Street to Lot C3-47 Margaret Mary Folan, 185 Roosevelt Avenue to Lot C3-48 Patricia A. Cherella, 314 High Plain Street, Walpole, MA 02082 to Lot U-25
8. **Chief William G. Brooks III, NPD:** Submitting report of a call to Norwood Theatre to remove an intoxicated person from the premises. **No evidence of a violation by the license holder was found.**
9. **Elizabeth J. Wilson, Macchi & Macchi, LLC** Submitting on behalf of Charminar Spice, LLC, dba Paradise Biryani, application for Change of Manager from Stephen D. Yanoff to Daniel J. Curran.
10. **Stephen D. Yanoff, 16 Old Tavern Road, Wayland, MA 01778:** Submitting notice that he is no longer employed by or associated with Charminar Spice, LLC dba Paradise Biryani.
11. **Thomas McQuaid, Director of Finance & Accounting:** Requesting approval of Municipal Relief Requests as per the Director of Finance and Accounting.
12. **Tony Mazzucco, General Manager:** Requesting approval of Reserve Fund Transfer for COA parking garage.
13. **Jim Henry, Winged Foot Running:** Submitting request to reschedule Firecracker 5K road race to Sunday, July 15, 2018 at 9:00 a.m. at the Willett School. (Schools and Safety Officer notified and course map attached)

APPENDIX D: CLIMATE WORKSHOP

The Town of Norwood received a grant from the Commonwealth of Massachusetts to conduct a “Community Resilience Building Workshop”. Town leaders, staff, and citizen activists gathered for a one-day workshop to consider Norwood’s strengths and vulnerabilities with regard to projected climate changes. Listed below are all of the priorities that were identified by the workshop participants. As is evident, many of the suggested priorities are highly relevant to natural hazard mitigation.

RECOMMENDATIONS TO IMPROVE RESILIENCE

Highest Priorities

Dam Management: Focus on the Hollingsworth & Vose and Willett Pond dams. The concern is the potential for flooding and downstream impacts if they fail. A flood communication plan is needed. Cooperation across town lines and ownership will be necessary as the town does not own either dam, and the Hollingsworth & Vose dam is not located in Norwood. The Town should find funding, apply for grants, and engage support from the state for dam safety upgrades. Study Willett Pond to Hawes Brook to identify problem spots, engage NepRWA for assistance.

Stormwater Management: Focus on overall stormwater management and retrofits to address flooding and future higher rain events. Investigate establishing a stormwater utility or regional utility. Set higher standards for stormwater infiltration, review regulations, require replication of storage. Complete GIS mapping.

Emergency Notification: Identify vulnerable populations (seniors, those without landlines, immigrants, people who don’t speak English) who may not be receiving emergency notifications. Establish an interagency task force to address emergency outreach and planning. Provide resources to Public Safety and Council on Aging. Foster community and neighbor check-ins.

Tree Planting: Increase tree canopy town wide. Focus on “hot spots” identified in maps. Encourage new businesses to increase green space. Collaborate with the agricultural school to support tree planting.

Improve Shelter Capacity: Upgrade the high school to a full shelter. Address deficiencies in the civic and senior center shelters. Make sure shelters can be prepared for flooding, extreme heat and cold, power outages, and biohazards.

Electric Substations: Ensure that the electric substation on Dean Street can withstand a 500-year flood.

Address traffic light signal issues: Work with the state to find a resolution to traffic signal electrical issues at Route 1 and Morse Street. The lights malfunction during heavy rain and wind, requiring public safety resources.

Solar Energy: Utilize solar energy. Work on making it possible to tie solar in to the current system.

Fuel plan: Ensure that generators are available at key gas stations for access to fuel for the town and the public in the event of a power failure.

High Priorities

- Stormwater and wastewater infrastructure needs upgrades. Consider a stormwater partnership, outreach and education, use of green infrastructure, sump pump management.
- Senior housing does not have generators. Five locations identified. Provide backup power so seniors are not displaced in an emergency.
- Keep the Neponset River clear of downed trees to reduce airport flooding.
- Ensure cable television has backup power, utilize it for emergency notices, public service announcements, and develop the capacity for translation for non-English speaking populations.
- Create a working group for public outreach during storms.
- Prioritize open space acquisition in climate vulnerable locations.
- Provide education on building and health practices to address emerging pathogens (ticks, mosquitoes, Lyme disease). Work with the Neponset River Watershed Association (NepRWA) on these issues.

Medium Priorities

- Continue strong relationship with Massachusetts Water Resources Authority.
- Work with NepRWA on Neponset River low-flow issues related to drought.
- Address heat sinks with green infrastructure, white roofs, landscaping for parking lots and redevelopment, lot leasing bylaw.
- Plant more mature trees to address the preponderance of immature trees in new developments.
- Do regulatory/zoning review to find way to create more green space.
- Create a plan for bike and walking connectivity especially in the vicinity of the Norwood Depot commuter rail station. Consider a bike rental program.
- Make sure there is good communication between the Town, residents, and Norwood Hospital. Have a surge plan for large emergency events..
- Work with the state to assure they are requiring proper climate resilience for nursing homes and residential facilities.
- Do a feasibility study of underground utilities and solar panels at parking lots.
- Have a plan for emergency food and equipment. Work with Shaw's and local contractors.
- Establish an emergency volunteer corps. Work at the church and neighborhood level. Do practice drills. Apply for grants from FEMA and MEMA. Translate communication materials.
- Have a plan for backup power for nursing homes. Upgrade generators. Check on state licensure requirements for emergency power sources.
- Upgrade the medical reserve system. Have a local emergency surge plan.
- Focus on outreach to seniors and seniors who live alone. Do outreach for reverse 911 sign-up, utilize the Senior Center, phone trees, Community Emergency Response Team (CERT), and Town Meeting representatives.
- Do outreach to renters. Improve the Assessors Database for outreach. Do mailings through the Water Department. Gather cell numbers, text information.

Low Priorities

- Work on invasive species removal, public awareness. Work with the Department of Fish and Wildlife.
- Study options to elevate the airport.

- Upgrade the regional emergency plan for regional evacuation routes.
- Do targeted communication to low income housing residents to ensure they are prepared for emergencies.

No priority listed

- Lobby the state to adopt updated precipitation figures (Cornell).
- Buy land for open space; use CPA funding.
- Protect existing open space.
- Provide public education on causes of river pollution and algae blooms.
- Install automated outlet control gate systems for the Ellis Pond and Willet Pond Dams.
- Increase stormwater regulation, require more porous surfaces, install rain gardens, encourage elevation of basement utilities.
- Increase emergency identification of, and communication to, seniors.
- Encourage air conditioning upgrades for low-income residents.

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APPENDIX E: PLAN ADOPTION



The TOWN OF NORWOOD

Commonwealth of Massachusetts

THE SELECTMEN

Thomas F. Maloney, *Chairman*

William J. Plasko

Helen Abdallah Donohue

Paul A. Bishop

Allan D. Howard

Frances L. Jessoe, *Clerk*

CERTIFICATE OF ADOPTION BOARD OF SELECTMEN

TOWN OF NORWOOD, MASSACHUSETTS

A RESOLUTION ADOPTING THE TOWN OF NORWOOD HAZARD MITIGATION PLAN 2018 UPDATE

WHEREAS, the Town of Norwood established a Committee to prepare the *Town of Norwood Hazard Mitigation Plan 2018 Update*; and

WHEREAS, the *Town of Norwood Hazard Mitigation Plan 2018 Update* contains several potential future projects to mitigate potential impacts from natural hazards in the Town of Norwood, and

WHEREAS, duly-noticed public meetings were held by the LOCAL HAZARD MITIGATION PLANNING TEAM on March 12, 2018 and July 10, 2018 and

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

NOW, THEREFORE BE IT RESOLVED that the Town of Norwood BOARD OF SELECTMEN adopts the *Town of Norwood Hazard Mitigation Plan 2018 Update*, in accordance with M.G.L. 40 §4 or the charter and bylaws of the Town of Norwood.

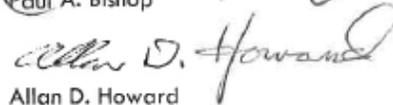
ADOPTED AND SIGNED this Date. November 6, 2018


Thomas F. Maloney, Chairman


William J. Plasko


Helen Abdallah Donohue


Paul A. Bishop


Allan D. Howard

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