Town of Lenox Hazard Mitigation & Climate Adaptation Plan

November 2020 (Pending MEMA/FEMA review and Town adoption)

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CHAPTER 1: INTRODUCTION

Purpose

The purpose of hazard mitigation planning is to reduce or eliminate the need to respond to hazardous conditions that threaten human life and property. Hazard mitigation can be an action, activity, process, or physical project designed to reduce or eliminate the long-term risks from hazards.

The Town of Lenox Hazard Mitigation and Climate Adaptation Plan (HMCAP) was prepared to meet the goals laid out in this plan and to meet the requirements of 44 CFR § 201.6 pertaining to local hazard mitigation plans. 44 CFR § 201.6(a)(1) states that a local government must have a mitigation plan approved pursuant to this section in order to receive federal hazard mitigation grants. A local government must have a mitigation plan approved to be eligible for and receive mitigation project grants under all Federal Emergency Management Agency (FEMA) mitigation grant programs. In accordance with 44 CFR § 201.6, the local mitigation plan is the representation of Lenox's commitment to reduce risks from natural hazards and serves as a guide for decision makers as they commit resources to reducing the effects of natural hazards. The HMCAP is meant to serve as the basis for the Commonwealth of Massachusetts to provide technical assistance and to prioritize project funding.

This plan was also prepared to meet requirements of the Massachusetts Executive Office of Energy and Environmental Affair's (EEA) Municipal Vulnerability Preparedness (MVP) Planning Grant, which enabled Lenox to complete this plan, and to integrate local effects of climate change into their hazard mitigation action plan. By completing the Community Resilience Building (CRB) process, Lenox will be an MVP community eligible for MVP Action Grants to adapt to the impacts of climate change on the community.

The Town of Lenox has laid out the following mission statement for their hazard mitigation planning process: To identify observed and projected risks and applicable sustainable cost-effective actions to mitigate the impact of hazards in order to protect life, property and the environment.

Background

Mitigation Planning

The Town of Lenox was included in a regional hazard mitigation plan with 18 other Berkshire County municipalities approved by FEMA Region I in 2012. This Hazard Mitigation and Climate Adaptation Plan is considered an update of the Berkshire County Hazard Mitigation Plan, dated November 5, 2012. This HMCAP is a single jurisdictional plan.

Location

Lenox is located in central Berkshire County in Western Massachusetts. The Town is bordered by the City of Pittsfield to the north, the Town of Richmond to the west, the Towns of Washington and Lee to the east and southeast respectively, and the Town of Stockbridge to the south.

CHAPTER 2: PLANNING PROCESS

Introduction

This chapter outlines the development of the Lenox Hazard Mitigation and Climate Change Adaptation Plan. It identifies who was involved in the process, how they were involved, and the methods of public participation that were employed. An open public involvement process during the drafting stage was essential to the development of the HMCAP. A discussion of how the community will continue public participation in the plan maintenance process (44 CFR § 201.6(c)(4)(iii)) will be discussed in Chapter 4.

The Town retained the Berkshire Regional Planning Commission (BRPC), an MVP Provider, to aid them in developing the Hazard Mitigation and Climate Change Adaptation Plan. The essential deliverable was to develop a set of Actions for addressing Priority Hazards, using the CRB Workshop process and methodology as a key stakeholder tool. The Plan is a compilation of data collected by BRPC, information gathered from the planning committee during meetings, and interviews conducted with key stakeholders outside of working meetings. The Lenox HMCAP reflects comments provided by participants and the public through the MVP planning process, the MVP Core Team, local officials and citizens, neighboring towns, and ultimately MEMA and FEMA. Making the document available to the public for review meets requirements of 44 CFR § 201.6(b)(1).

Planning Meetings and Participation

During the HMCAP planning process there was ample opportunity for public comment by residents as well as by neighboring communities, local and regional agencies or partners involved in hazard mitigation activities, including those agencies that have the authority to regulate development. In addition, input was sought from businesses, academics and other private and non-profit interests, during the planning process. Making the document available to the public for review meets requirements of 44 CFR § 201.6(b)(1), and solicitation of comment from neighboring towns meets requirements of 44 CFR § 201.6(b)(2), pertaining to involvement of regional partners.

The Town formed a Hazard Mitigation / Municipal Vulnerability Preparedness Committee to steer the process in July of 2019. Members of the Committee included municipal department heads and representatives from various town boards and committees. The committee members are listed in Table 2.1. The Committee held a series of meetings to assemble data on the Town's infrastructure, identify known hazards to residents, including seasonal visitors, and review existing plans, procedures, bylaws, and protections already in place. Meetings of committee members were help approximately twice a month from August 2019 to April 2020.

On Friday, November 1, 2019 an all-day Community Resilience-Building Workshop, attended by 24 town officials, residents, neighboring town representatives, emergency responders and others, was held at the Lenox Town Hall Auditorium. Lenox utilized the CRB workshop to collect input from as diverse a group of community residents and stakeholders as possible given time and resources available. Invitations were sent to residents and stakeholders electronically, and planning team members contacted invitees directly to encourage participation and ensure receipt of an invitation. A selection of maps and an overview of workshop discussion topics and goals were sent with invitations. Workshop participants are listed in table 2.3.

Table 2.1: Planning Committee Members

Name	Affiliation	Role
Marybeth Mitts	Town of Lenox Select Board	Core Team Member
Neal Carpenter	Conservation Commission	Core Team Member
Bob Horn	Lenox Water Department	Core Team Member
Bill Gop	Town of Lenox Public Works Department	Core Team Member
Gwen Miller	Town Planner, Lenox	Core Team Member
Stephen E. O'Brien	Chief of Police	Core Team Member
Pam Kueber	Town of Lenox Planning Board	Core Team Member

Table 2.2: BRPC Staff

Name	Affiliation	Role
Caroline Massa	BRPC	Lead Facilitator
Allison Egan	BRPC	Facilitator
Philip Arnold	BRPC	Facilitator
Peg McDonough	BRPC	Facilitator
Justin Gilmore	BRPC	Facilitator

Table 2.3: Municipal Vulnerability Preparedness Workshop Attendees

Name	Affiliation	Role
Marybeth Mitts	Town of Lenox Select Board	Project Coordinator
Dan Clifford	Retired Fire Chief – Town of Lenox	Core Team Member
Neal Carpenter	Conservation Commission	Core Team Member
Jim Wilusz	Public Health – Tri-Town Health Department	Core Team Member
Bob Horn	Lenox Water Department	Core Team Member
Gary Schiff	Town Resident	Core Team Member
Cindy Weiss	Town of Lenox Historical Commission/Town Resident	Core Team Member
Bill Gop	Town of Lenox Public Works Department	Core Team Member
Pat Jaouen	Town of Lenox Historic District Commission	Core Team Member

Michael King	VFW	Core Team Member
Lucy Kennedy	Lenox	Core Team Member
Gwen Miller	Town Planner, Lenox	Core Team Member
Chuck Koscher	Town Resident	Core Team Member
Susan Wolf	Town Resident	Core Team Member
Stephen E. O'Brien	Chief of Police	Core Team Member
Pam Kueber	Town of Lenox Planning Board	Core Team Member
Mary Jo Piretti	Town Resident	Core Team Member
Bruce Peeples	Grounds Supervisor, Tanglewood	Core Team Member
Becky Cushing	Mass Audubon – Berkshires	Core Team Member
Kate McNulty Vaughan	Town of Lenox Planning Board	Core Team Member
Jan Chague	Town of Lenox Historical Commission/HS	Core Team Member
Alison Dixon	HVA	Core Team Member
Jim Harwood	Town of Lenox Planning Board	Core Team Member
Olga Weiss	Town of Lenox Historical Commission	Core Team Member
Caroline Massa	BRPC	Lead Facilitator
Allison Egan	BRPC	Facilitator
Philip Arnold	BRPC	Facilitator
Peg McDonough	BRPC	Facilitator
Justin Gilmore	BRPC	Facilitator

The central objective of the workshop was to first review regional weather events from the past and climate change data and projections, then collect local data from attendees to help:

1. Define top local natural and climate-related hazards of concern;
2. Identify existing and future strengthen and vulnerabilities;
3. Develop prioritized actions for the Community;
4. Identify immediate opportunities to collaboratively advance actions to increase resilience.

Categories of Concerns and Challenges

Major themes that came out of the initial public participation in Lenox highlighted the common vision residents and stakeholders have for the resilience of the entire region. These themes were about more than specific concerns or challenges, but about how they wanted to address vulnerabilities and build upon existing strengths. The following summarizes categories that will be discussed in further detail throughout the plan with specific steps to accomplishing the vision in the Action Plan detailed in the Mitigation Strategy.

Emergency Preparedness Education

When hazardous conditions arise, it is important to get information out to all the residents in the community. The town may need to inform residents of an ongoing hazard or resources available to them. Effective communication is also needed for emergency preparedness education. One medium will not reach everyone in town. Older generations of residents may not have internet or email, younger generations may not have a landline phone or a television. Multiple communication outlets are essential to getting the word out, but some residents will not be reached unless someone reaches out to them directly. A socially connected community is better prepared to be a resilient one. The residents and stakeholders of Lenox want to strive to improve communication networks and even set up a former system to check in on isolated residents when disaster hits.

The Town of Lenox subscribes to CodeRED, a system for quickly disseminating messages through text alerts. For example, CodeRED was used to get the word out on meal delivery services during the COVID-19 emergency. One shortfall of this system is the need for residents to register themselves. Therefore, a major goal of the Town is to increase advertising of CodeRED and get more residents signed up. However, it may be less likely for seasonal residents to sign up for this local alert system.

Lenox has many destinations in and around the town that draw large crowds. These destinations include Tanglewood, the summer home for Boston Symphony Orchestra that hosts outdoor music events. The population of Lenox increases significantly in the summer with seasonal residents and visitors, which introduces new challenges to communications the Town seeks to find solutions to.

In addition to communication needs, Lenox stakeholders want greater shelter preparedness including knowledge of the locations, and investment in training for volunteers to run these shelters.

Energy Planning

Lenox stakeholders want to see more renewable energy. Special emphasis was placed on solar for individual homes, solar fueled micro grids, and solar emergency energy back up to replace gas fueled generators, and geothermal heating and cooling for critical facilities.
To prevent power outages, stakeholders would also like to see prevention of downed powerlines with tree trimming and the planting of smaller trees along powerlines.

Water Management Systems

Stakeholders in the vulnerability identification process elevated the need to protect and bolster local water resources. Lenox owns and maintains a drinking water plant, wastewater plant, and extensive municipal water distribution and sewage systems throughout Town. These systems are both strengths and vulnerability for Lenox, and require focused resilience planning.

Municipal water infrastructure must also incorporate the management of stormwater and flooding. Stakeholders would like to see resources for homeowners on flood education, flood insurance, and methods for dealing with stormwater such as landscaped raingardens for private property. Additionally, issues with septic system leaks were prioritized by Lenox, an issue that is exacerbated during heavy precipitation.

Transportation

Culverts and Bridges, or road-stream crossings that convey coldwater fisheries are a major priority for the Town. With increased intense precipitation events and freeze thaw cycles with changing winter temperatures, these critical infrastructure points need to be designed to withstand the changes. Heavy precipitation also leads to road erosion, particularly where there are dirt roads.

Also within the transportation planning sector, stakeholders would also like to see more transportation options for tourists and residents.

Housatonic River Restoration and Resilience

The Housatonic River traverses through the east side of Lenox. The River is the subject of debate for residents and neighbors because of the General Electric PCB pollution that remains to this day. Luckily, the floodplain of the Housatonic has largely remained undeveloped, and the benefits of the floodplain and wetlands are still intact. There are a few industrial type land uses in the floodplain that need focused hazard planning. Lenox stakeholders would like to see the Housatonic cleaned up so that it can provide safe habitat and so that residents and visitors can enjoy the recreational potential of the Housatonic.

Volunteering & Philanthropy

During the planning process the difficulty of recruiting and retaining volunteers became apparent. Volunteers are needed in steady-state times by the Fire Department, but they are also needed during emergencies for providing essential services. The Town plans on building their volunteer recruitment and training to be better prepared for emergency situations.

Age-Friendly / Accessibility

With an aging population and changing needs of the residents, Lenox is looking for ways to plan age friendly. This means planning the built environment to have sidewalks and buildings that are accessible and ADA compliant, providing housing that is affordable on a fixed-income, and responding to needs of older residents as they are identified.

Ecosystem Health

Ecosystem health is an essential element of resilience. Ecosystem health requires preserving habitat for and learning to live with native species. A balanced system will allow for a healthy beaver population, keep ticks in check, and increase the ability of forest to adapt to climate change while sequestering carbon.

Cybersecurity

While cybersecurity is not a natural hazard, it is a growing threat for small towns that can have major impacts such as the shut down of critical facilities.

Cultural Resources

Major cultural resources in Lenox include historic homes including the home of writer Edith Warton, as well as the summer home of the Boston Symphony Orchestra at Tanglewood. These cultural resources are important for education and enrichment, they are part of the history of this region, and they are important for bringing visitors to Lenox. Special considerations are needed for protecting these assets, such as ensuring artifacts will be safe during flood, fire or other hazardous event.

The Categories of Concerns and Challenges described above were presented to the public at a virtual Public Listening Session on May 7th, 2020. The virtual Public Listening Session was recorded and available upon request. The Town also launched a comprehensive survey to prioritize actions for resident and stakeholder participation. The results from that survey are help by the Town and projects with the highest ranking in each category can be seen in Appendix: F.

Source: edithwharton.org

Incorporation of Existing Information

44 CFR § 201.6(b)(3)

No plan should be created in a silo, particularly a hazard mitigation plan because of its applicability to land use, town services, and vulnerable people. The Town of Lenox reviewed and incorporated existing plans, studies, reports and technical information into their hazard mitigation and climate adaptation plan with the assistance of BRPC. This plan should be used in conjunction with other local and regional plans. Lenox is fortunate in have a Town Planner and several other fulltime staff that assist in the long-term vision of the Town. Lenox is currently updated their Master Plan with the assistance of BRPC. The planning teams wanted to ensure the plans aligned, particularly in the Master Plan land use section by accounting for hazard prone areas when determining areas with potential for development.

During the planning process existing studies, plans and guidance were collect pertaining to the Town. Plans referenced included the Open Space and Recreation Plan from 2015, the 1999 Lenox Master Plan, the Lenox Housing Production Plan for 2017 to 2021, the 1999 Economic Development Plan, Source Water Protection Plan and Watershed Forestry Management Plant.

These documents provided important insight into the value of historic and natural resources in Lenox and a path forward for protecting the community's assets. Additionally, other hazard mitigation plans in the region were consulted during the development of this plan, many of which are currently in formulation.

The next chapter of this plan will dive into the risk assessment, profiling each hazard with potential to affect Lenox. Table 2.1 illustrates part of the process of prioritizing hazard mitigation actions in addition to the profiling of local impacts during the risk assessment. The method of prioritization meets requirements of 44 CFR § 201.6(c)(3)(iii).

Table 2.1: Hazard Prioritization for the Town of Lenox

Hazard	Area of Impact Rate	Frequency of Occurrence Rate	Magnitude / Severity Rate	Hazard Ranking
	1=small 2=medium 3=large	0 = Very low frequency 1 = Low 2 = Medium 3 = High Frequency	1=limited 2=significant 3=critical 4=catastrophic	
Change in Average/Extreme Temperature	3	3	4	**10**
Invasive Species	3	3	3	**9**
Hurricane & Tropical Storms	3	3	3	**9**
Pests/Vector-borne Disease	3	3	3	**9**
Tornado	1	3	3	**7**
Severe Storms (High Wind, Thunderstorm)	3	3	1	**7**
Severe Winter Event (Ice Storm, Blizzard, Nor'easter)	3	3	1	**7**
Drought	3	2	2	**7**
Cyber Security	3	0	3	**6**
Flooding (include Ice Jam, Beaver Activity)	2	3	1	**6**
Earthquake	3	2	1	**6**
Dam Failure	2	0	2	**4**
Urban & Wildfire	1	1	1	**3**
Landslide/Erosion	1	0	1	**2**

Area of Impact	
1=small	isolated to a specific area of town during one event
2=medium	occurring in multiple areas across town during one event
3=large	affecting a significant portion of town during one event

Frequency of Occurrence	
0=Very low frequency	events that have not occurred in recorded history of the town, or that occur less than once in 1,000 years (< 0.1% per year
1=Low frequency	events that occur from once in 100 years to once in 1,000 years (0.1% to 1% per year)
2=Medium frequency	events that occur from once in 10 years to once in 100 years (1% to 10% per year)
3=High frequency	events that occur more frequently than once in 10 years (greater than 10% per year)

Magnitude/Severity	
1=limited	injuries and/or illnesses are treatable with first aid; minor" quality or life" loss; shutdown of critical facilities and services for 24 hours or less; property severely damaged < 10%
2=significant	injuries and/or illnesses do not result in permanent disability; shutdown of several critical facilities and services for more than one week; property severely damaged < 25% to > 10%
3=critical	injuries and/or illnesses result in permanent disability; complete shutdown of critical facilities for at least two weeks; property severely damaged < 50% to > 25%
4=catastrophic	multiple deaths; complete shutdown of facilities for 30 days or more; property severely damaged> 50%

Plan Structure

The next chapter of this plan is the Risk Assessment for Lenox. After a general profile of the Town, each hazard analyzed includes a hazard profile and vulnerability assessment. Hazard profiles consist of likely severity, probability, geographic areas likely impacted, and historic data. The vulnerability Assessment includes hazard effects on people including vulnerable groups, the built environment including infrastructure, the natural environment, the economy, and future conditions to the extent reasonably foreseen in consideration of climate change.

Hazard Mitigation Goals

In developing this plan, the Town of Lenox is taking action to reduce or avoid long-term vulnerabilities to the hazard identified in the following chapter. The following are the Town's goals for this hazard mitigation plan:

1. Identify the present and future risks that threaten life, property and environment in Lenox.
2. Develop and implement sustainable, cost-effective, and environmentally sound mitigation projects.
3. Protect lives, health, safety, and property of fulltime residents, seasonal visitors, and future generations from the impacts of hazards.
4. Protect critical facilities and essential public services from disruption during or after hazardous conditions.
5. Promote the hazard mitigation and climate adaptation plan and involve all stakeholders to enhance the local capacity to mitigate, prepare for, and respond to the impacts of natural hazards.
6. Integrate the risks and mitigation actions identified through this planning process into all plans for the town and region and ensure its consideration in all land use decisions.

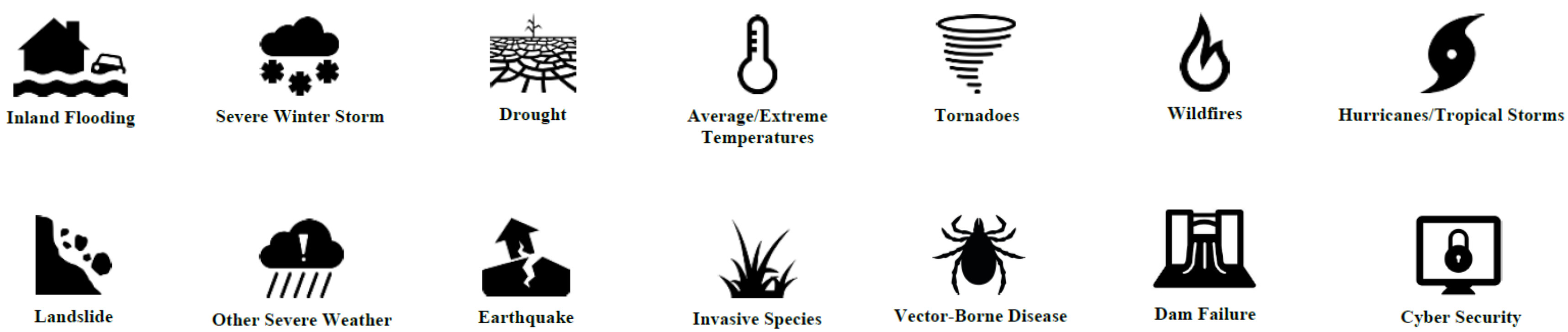
CHAPTER 3: RISK ASSESSMENT

FEMA Requirements

In accordance with 44 CFR § 201.6 (c)(2), this risk assessment provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. The risk assessment is an analysis of the hazards and risks facing the Town of Lenox and contains detailed hazard profiles and loss estimates to serve as the scientific and technical basis for mitigation actions. This chapter also describes the decision-making and prioritization processes to demonstrate that the information analyzed in the risk assessment enabled the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards. This section also provides information on previous occurrences of hazard events and on the probability of future hazard events with consideration of climate change (44 CFR § 201.6(c)(2)(i).

Hazard Identification and Risk Assessment Processes

Several resources were utilized in order to identify potential hazards that can affect the Town of Lenox. The 2012 Berkshire County Hazard Mitigation Plan served as a foundation to build from. The hazards identified in the 2012 plan were Flooding, Structurally Deficient Bridges over Waterways, Dam Failure, Wildfire, Snow, High Wind, and Other Natural hazards (i.e. severe storms and tornadoes). To build upon this list, the 2018 State Hazard Mitigation and Climate Adaptation Plan (SHMCAP) for the Commonwealth of Massachusetts[1] was consulted. Accounting for the location, natural and built environments, history, and scientific studies of the area, it was determined that Lenox must plan for the following hazards:



[1] Massachusetts Emergency Management Agency & the Executive Office of Energy and Environmental Affairs developed the MA State Hazard Mitigation and Climate Adaptation Plan, 2018 https://www.mass.gov/service-details/massachusetts-integrated-state-hazard-mitigation-and-climate-adaptation-plan

People

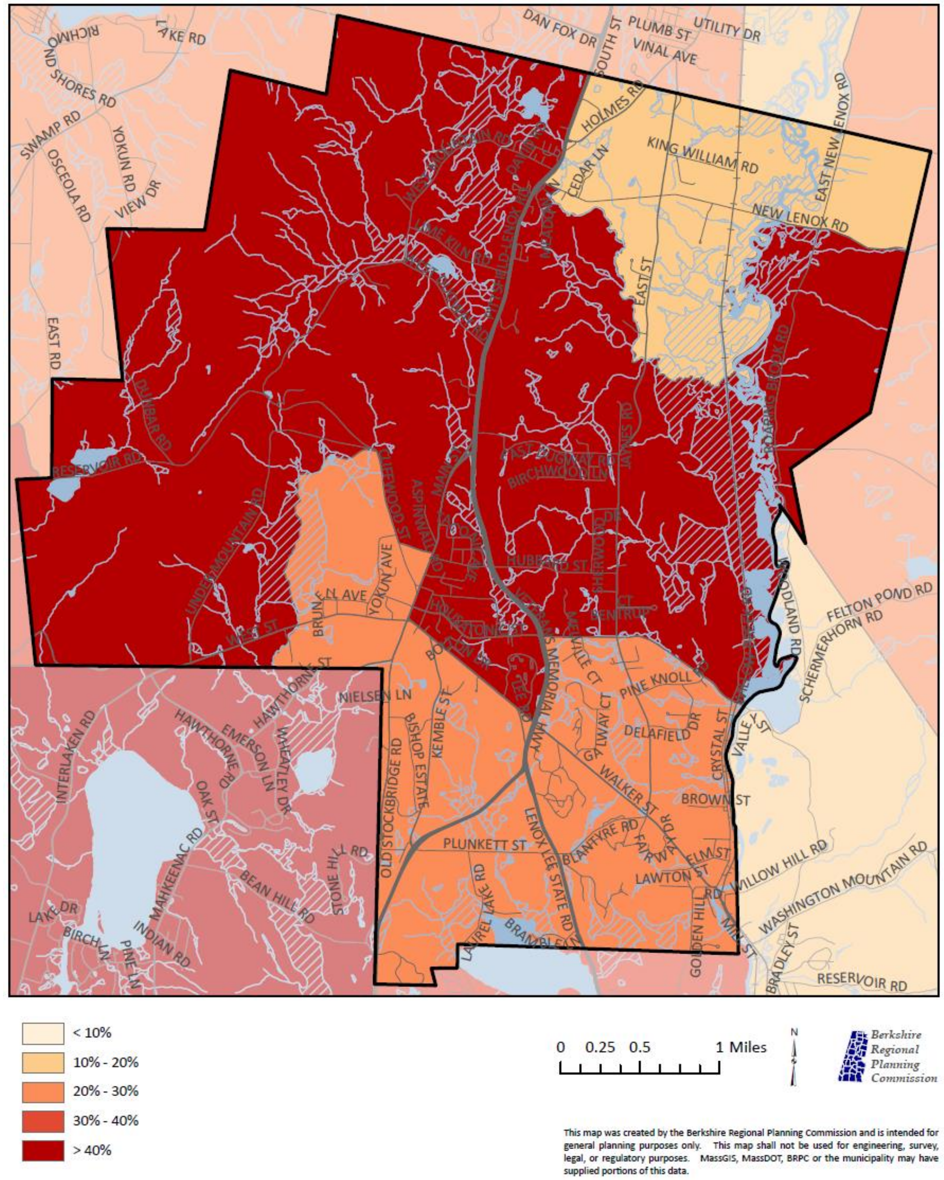
The population of Lenox from the 2018 American Community Survey was 4,979. The population is projected to continue declining. Since the year 2000 the Town's population has aged steadily. Median age has climbed from 46 years old to 55. Moreover, the majority of the Town's residents, 50.3%, are aged 55 or older while school-aged children now comprise only 17.2% of the population. About 94% of the population is white. Two percent of the population identifies as black, and about one percent as Asian. Four percent of the population identifies as Hispanic or Latino, primarily from Mexico or the Commonwealth of Puerto Rico. Over time, the number of foreign born residents in Lenox has increased, though the figure dropped dramatically in 2017 With this increase has come an increase in the number of residents who report speaking a language other than English at home. The Lenox School Department notes on its website that "Lenox continues to see a growing number of English Language Learners in our school system. The number of students meeting this criterion has nearly doubled in the last several years."

Out of the 1,450 households whose incomes are below 100% AMI:

- 20% are moderate income;
- 21% are considered low-income;
- 27% are very low-income; and
- 32% are extremely low-income.

Based on the data available, 47% of Lenox households are considered low-income by HUD standards.

Figure 3.1: Population Over 65



Natural Environment

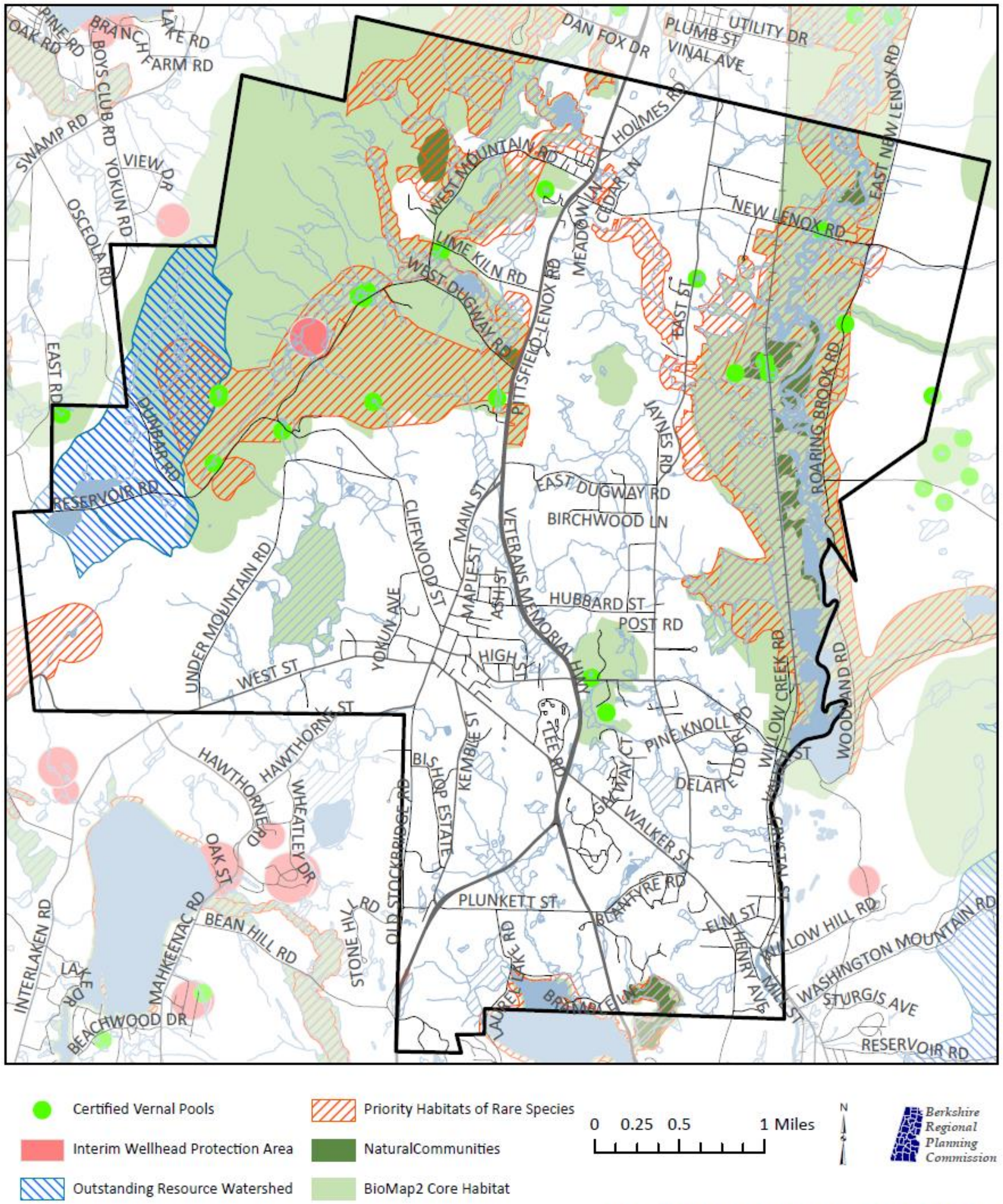

Kennedy Park

The natural environment provides benefits to a community that are not always quantifiable, many of which directly improve the resilience. Ecosystem benefits such as clean air, carbon sequestration, clean water, wildlife habitat, water retention, wind and heat mitigation, increased real estate value and mental health. The natural environment stands to be damaged by a disaster. Disruptions that allow for a forest to restart the succession process can be very beneficial to the ecosystem. However, the environment can be severely damaged by pollutant contamination or other impacts of human development. On the same note a community may want to replace or restore trees and other assets of the natural environment that are part of the built environment for their ecosystem benefits. Figure 3.2 shows areas of great environmental sensitivity and concern within Lenox.

As of 2016, the most recent year for which Mass GIS provides data, 42.9% of the Town's 13,861 total acres is undeveloped deciduous forest. Approximately 5.5% of Lenox is developed. Figure 3.3 shows land use for the Town of Lenox.

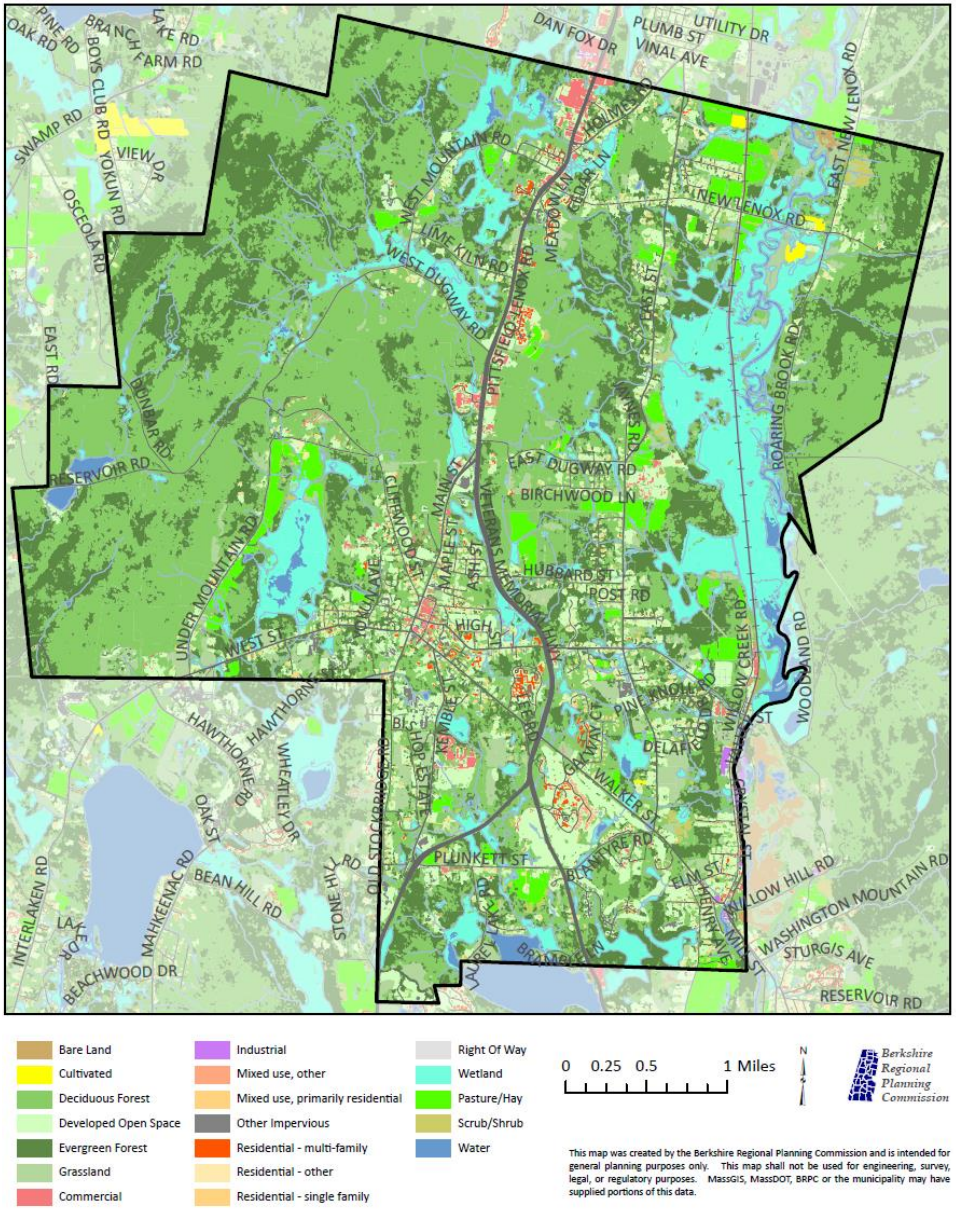
Lenox is part of the Housatonic Watershed. The Housatonic River traverses Lenox from Pittsfield south to Lee. There are several streams that feed into the river, including Yokun Brook, Mill Brook, Roaring Brook, Willow Creek, Sawmill Brook, Marsh Brook, and Sargent Brook. Lenox also has Woods Pond and Laurel Lake, which it shares with Lee, along with Upper and Lower Lenox Reservoir.

Figure 3.2: Environmental Concerns



This map was created by the Berkshire Regional Planning Commission and is intended for general planning purposes only. This map shall not be used for engineering, survey, legal, or regulatory purposes. MassGIS, MassDOT, BRPC or the municipality may have supplied portions of this data.

Figure 3.3: National Land Use Cover Data



Built Environment

44 CFR § 201.6 (c)(2)(ii)(C) asks that vulnerability in the risk assessment be addressed in terms of land uses and development trends within the community so that mitigation options can be considered in future land use decisions. Lenox will continue crafting and implementing land use policies aimed at enhancing the quality of life for residents and visitors by preserving the Town's community character and its natural, historical, and cultural resources while making Lenox an increasingly attractive place f new residents of all backgrounds, especially young families.

Lenox Dale Deli

Source: Gillian Jones - The Berkshire Eagle

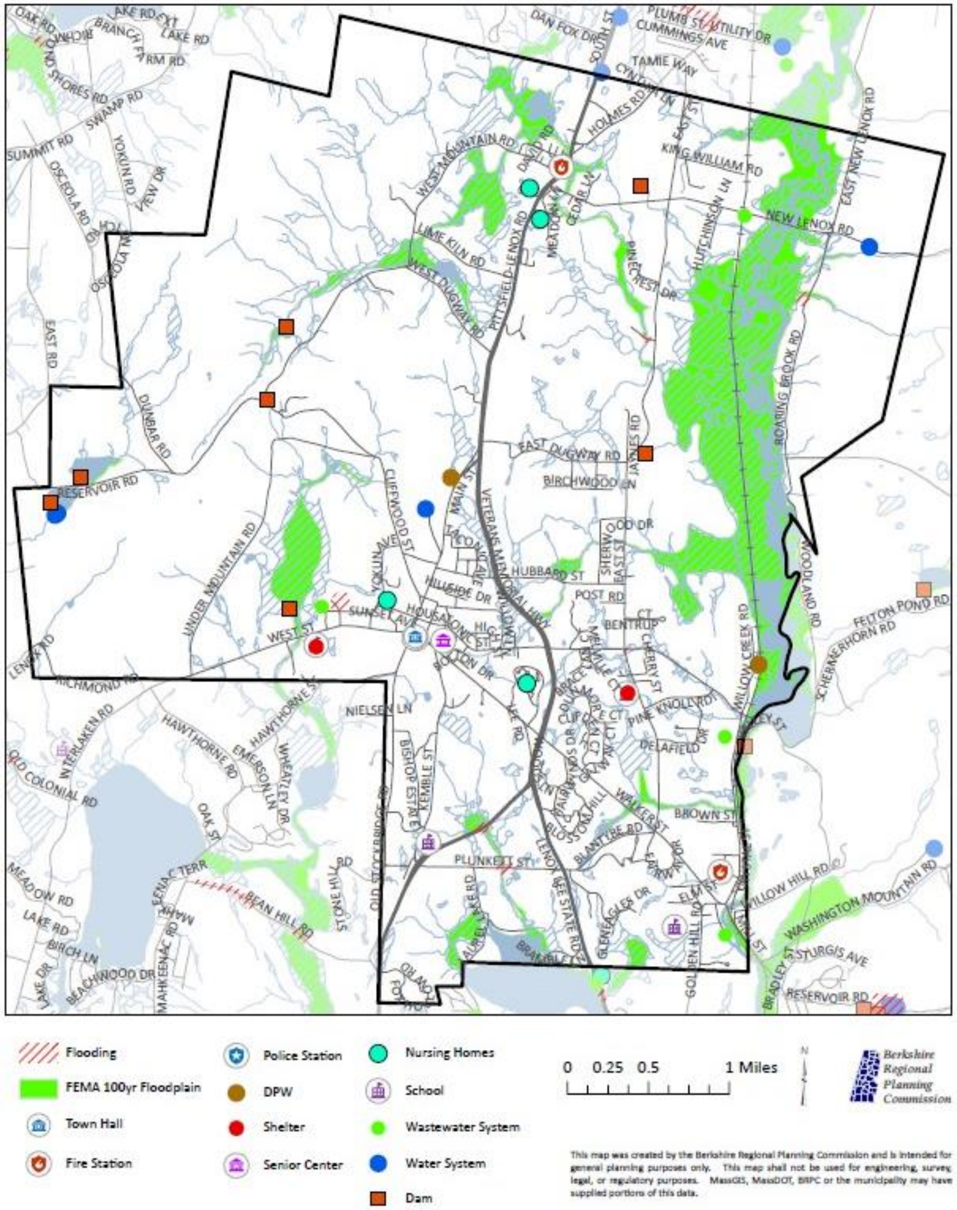
Approximately 5.5% of Lenox is developed. Of the 1,976.5 acres of developed land in the Town of Lenox, approximately 75.2% is in residential use, 6.3% is in commercial use, and 0.54% is in industrial use. Development in Lenox has been historically influenced by the Town's topography. The majority of development has occurred within the valley between October Mountain and the Housatonic River to the east and the Taconic Range to the west.

According to U.S. Census Bureau's 2017 ACS, there were an estimated 3,021 total housing units in Lenox. In 2017 there were a total of 2,390 occupied housing units in Lenox. Of those 2,390 units, 65% were owner occupied and 35% were renter occupied. Of the 828 total rental units in Lenox, 15% are seasonal rentals and about 6% are vacant.

Lenox has an elementary school and a combined middle and high school within the Town. The Lenox Memorial Middle and High School auditorium is often used for public meetings, and also serves as a shelter.

The Town's raw water source is from a mountain fed brook which fills the Town's two reservoirs. From the reservoirs the water enters the water treatment plant where it is treated using a Dissolved Air Flotation Treatment Process and is then disinfected with chlorine before it is pumped to Town. The treatment facility also includes a laboratory were both the raw and treated water is tested daily according to strict MASS DEP standards. In cases of extreme drought or emergency at the Lenox water treatment facility, there is an interconnection pump station which allows Lenox to utilize water from the City of Pittsfield.

Figure 3.4: Critical Facilities and Areas of Concern



Critical facilities are the buildings and infrastructure hubs that are necessary for continued operation during a hazardous event. Table 3.1 shows Lenox's Critical Facilities and figure 3.4 provides a map of the critical facilities and areas of concern.

Table 3.1: Lenox Critical Facilities

Facility	***Name***	***Address***
Emergency Operations Center	Central Fire Station	14 Walker Street
Alternative Emergency Operations Center	Lenox Dale Fire Station	26 Elm Street
	New Lenox Fire Station	399 Pittsfield Road
Police	Police Department	6 Walker Street
Health Services	Kimball Farms	235 Walker Street
	Central Fire Station	14 Walker Street
	Lenox Dale Fire Station	26 Elm Street
	New Lenox Fire Station	399 Pittsfield Road
	Kimball Farms Nursing Care Facility	40 Sunset Avenue
	Mount Carmel Care Center	320 Pittsfield Road
Town Offices	Town Hall	6 Walker Street
Public Works	Wastewater Treatment Plant	239 Crystal Street
	Water Treatment	471 Reservoir Road
	Brunell Wastewater Pump Station	42 Brunell Avenue
	Henry Wastewater Pump Station	35 Henry Avenue
	New Lenox Wastewater Pump Station	266 New Lenox Road
	Kennedy Tank	42.367941, -73.283740
	Washington Mountain Tank	42.338394, -73.221514
	New Lenox Water Booster Station	42.392484, -73.231199
	Department of Public Works	275 Main Street
State Public Works	MA Highway District One Garage	270 Main Street
Shelters	Lenox Middle & Senior High School	197 East Street
	Morris Elementary *(Potential shelter)*	129 West Street
Special Needs Facilities	Hillcrest Educational Center	242 West Mountain Road
	Devonshire Estates	329 Pittsfield Road
	Mount Carmel	320 Pittsfield Road

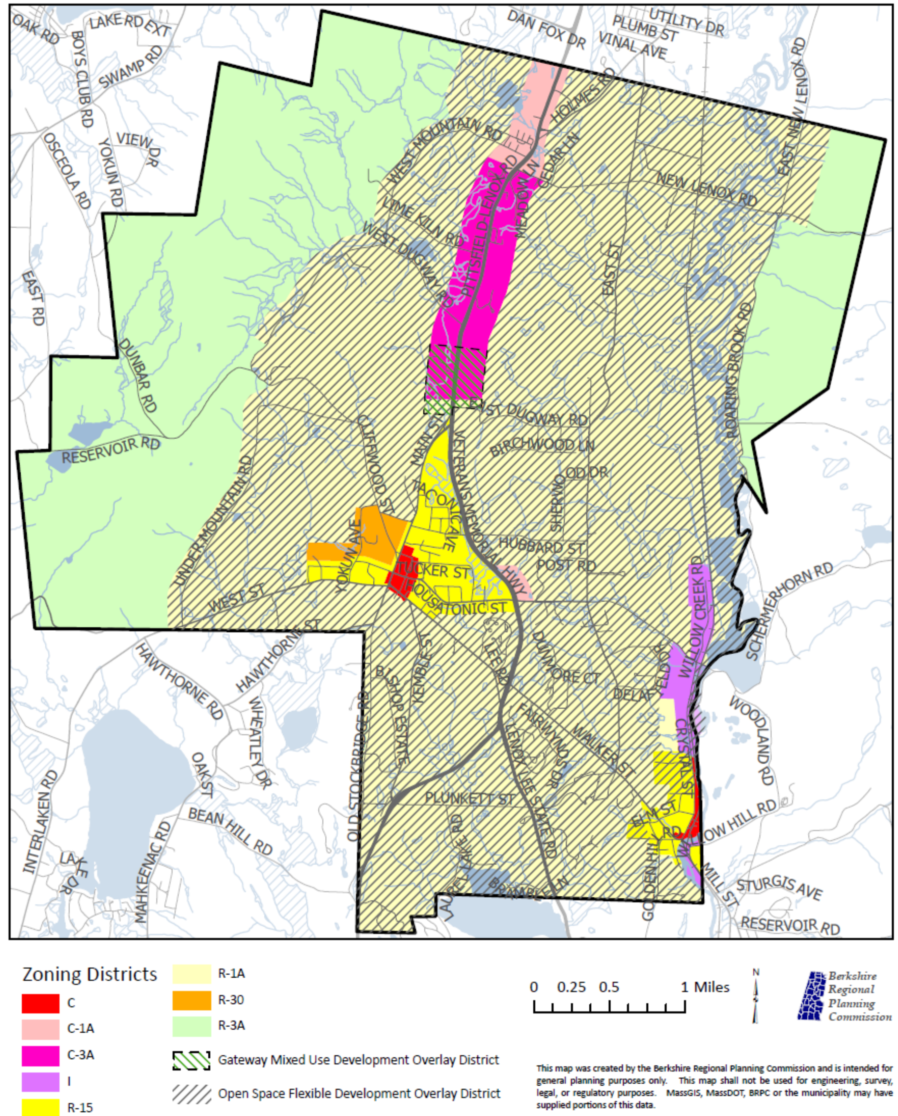
	Kimball Farms Nursing Care Facility	40 Sunset Avenue
	Morris School	129 West Street
	Curtis Housing	6 Main Street
	Curtis Family Housing	11 & 13 Church Street
	Lenox Housing Authority	25 West Street
	Lenox Children's Center	9 Old Center Street
	Nursing Care Center at Kimball Farms	235 Walker Street
	Kimball Farms	235 Walker Street
	Lenox Memorial Middle & Senior High School	197 East Street
	Lenox Hill Housing	45 Golden Hill Road
	Hillcrest Educational Center, Center Campus	349 Old Stockbridge Road
	Tunure Terrace Elderly Housing	32-34-36 Stockbridge Road
	Kimball Farms, Pine Hill Assisted Living	235 Walker Street
Communications	Church on the Hill Steeple Cell Tower	42.363535, -73.282333
	Cell Tower	90 Pittsfield Road
	Communication Tower	42.393519, -73.310902

Economy

Lenox's economy is concentrated in the Leisure/Hospitality sector. The next two most prevalent sectors are Education and Health Services and Trade, Transportation, and Utilities which both doubled in employment since the last Master Plan and which combined exceed the average monthly employment for Leisure/Hospitality in 2017. Two thirds of employment in the Lenox economy is concentrated within three subsectors: Accommodations and Food Service (36.6%), Health Care and Social Assistance (18.7%), and Retail Trade (10.7%).

Commerical areas are focused along Route 7 as shown in Figure 3.5. The Historic Downtown Lenox has a vibrant walkable business district, and is a popular tourist destination.

Figure 3.5: Zoning



Inland Flooding

Hazard Profile

Flooding was identified as a top hazard by participants in the CRB workshop held as part of the MVP planning process. Inland flooding is the result of moderate precipitation over several days, intense precipitation over a short period, or melting snowpack (U.S. Climate Resilience Toolkit, 2017). Developed, impervious areas can contribute to inland flooding (U.S. Climate Resilience Toolkit, 2017). Common types of local or regional flooding are categorized as inland flooding including riverine, ground failures, ice jams, dam overtopping, beaver activity (tree removal, dam construction, and dam failure), levee failure, and drainage from impervious areas such as downtown.

Overbank flooding occurs when water in rivers and streams flows into the surrounding floodplain or into "any area of land susceptible to being inundated by floodwaters from any source." Flash floods are characterized by "rapid and extreme flow of high water into a normally dry area, or a rapid rise in a stream or creek above a predetermined flood level" (EOEEA & MEMA, 2018) The hazards that produce these flooding events in the region include hurricanes, tropical storms, heavy rain events, winter rain-on-snow, thunderstorms, and a recovering beaver population.

Likely severity

In general, the severity level of flood damage is affected by flood depth and flood velocity. The deeper and faster flood flows become, the more power they have and the more damage they can cause. Shallow flooding with high velocities can cause as much damage as deep flooding with slow velocity. This is especially true when a channel migrates over a broad floodplain, redirecting high velocity flows and transporting debris and sediment[2]. However, flood damage to homes and buildings can occur even during shallow, low velocity flows that inundate the structure, its mechanical system and furnishings.

The frequency and severity of flooding are measured using a discharge probability, which is the probability that a certain river discharge (flow) level will be equaled or exceeded in a given year. The 100-year flood elevation or discharge of a stream or river has a 1% chance of occurring or being exceeded in any given year. In this case the statistical recurrence interval would be 100 years between the storm events that meet the 100-year discharge/flow. Such a storm, with a 1% chance of occurrence, is commonly called the 100-year storm. Similarly, the 50-year storm has a statistical recurrence interval of 50 years and an "annual flood" is the greatest flood event expected to occur in a typical year. It should be

[2] https://www.mass.gov/files/documents/2017/01/mp/massachusetts-state-hazard-mitigation-plan.pdf

understood, however, that these measurements reflect statistical averages only; it is possible for two or more floods with a 100-year flood discharge to occur in a short time period.

Severity is compounded by secondary impacts of flooding. Landslides on steep slopes can occur when soils are saturated and give way to sloughing, often dislodging trees and boulders that were bound by the soil. The damage from Hurricane Irene in 2011 to Route 2 in the Florida/ Charlemont area was a combination of fluvial erosion from the Cold and Deerfield Rivers and a landslide on the upland slope of the road.

Flood waters can increase the risk of the creation of and dislodging of ice dams during the winter months. Blocks of ice can develop in streams and rivers to create a physical barrier or dam that restricts flow, causing water to back up and overflow its banks. Large ice jam blocks that break away and flow downstream can damage culverts, bridges and roadways whose openings are too small to allow passage (MEMA, 2013).

Probability

The extent of the area of flooding associated with a 1% annual probability of occurrence (the base flood or 100-year flood), most commonly termed the 100-year floodplain area, is a tool for assessing vulnerability and risk in flood-prone communities. The 100-year flood boundary is used as the regulatory boundary by many agencies, including FEMA and MEMA. It is also the boundary used for most municipalities when regulating development within flood-prone areas. The FEMA Flood Insurance Rate Maps (FIRM) developed in the early 1980s for Berkshire County, typically serve as the regulatory boundaries for the National Flood Insurance Program (NFIP) and municipal floodplain zoning. A structure located within a the 100-year floodplain on the NFIP maps has on average a 26% percent chance of suffering flood damage during the term of a 30-year mortgage (MEMA, 2013). Increases in precipitation and extreme storm events will result in increased inland flooding.

Table 3.2: Recurrence Intervals and Probabilities of Occurances

Recurrence interval	Probability of	Percent chance
500	1 in 500	0.2
100	1 in 100	1
50	1 in 50	2
25	1 in 25	4
10	1 in 10	10
5	1 in 5	20
2	1 in 2	50

Due to high slopes and minimal soil cover, Western Massachusetts is particularly susceptible to flash flooding caused by rapid runoff that occurs during heavy precipitation in combination with spring snowmelt. These conditions contribute to riverine flooding. Frozen ground conditions can also contribute to low rainfall infiltration and high runoff events that may result in riverine flooding (MEMA, 2018). Berkshire County has frozen ground conditions for more of the year than most of Massachusetts. There is a 90% likelihood that the temperature will reach 28° by October 22nd, with the potential ground freezing conditions lasting until May 20th of the following year (NOAA, 1988 as cited by UMASS Extension accessed on March 12th, 2019).

Geographic areas likely impacted

In the Berkshire region rivers and streams tend to be dynamic systems, with stream channel and bank erosion common in both headwater streams and in the level, meandering floodplains of the Housatonic and Hoosic Rivers. Fluvial Erosion is the process where the river undercuts a bank, usually on the outside bend of a meander, causing sloughing and collapse of the riverbank. Fluvial erosion of stream and riverbanks can creep towards the built environment and threaten to undercut and wash away buildings, roads, and bridges. Many roads throughout the region follow streams and rivers, having been laid in the floodplain or carved along the slopes above the bank. Older homes, barns and other structures were also built in floodplain or just upgradient of stream channels in both rural and urban areas. Fluvial erosion can also scour and down cut stream and river channels, threatening bridge pilings and abutments. This type of erosion often occurs in areas that are not part of a designated floodplain (MEMA, 2013).

The Housatonic River traverses Lenox from Pittsfield south to Lee. There are several streams that feed into the river, including Yokun Brook, Mill Brook, Roaring Brook, Willow Creek, Sawmill Brook, Marsh Brook, and Sargent Brook. Lenox also has Woods Pond and Laurel Lake, which it shares with Lee, along with Upper and Lower Lenox Reservoir.

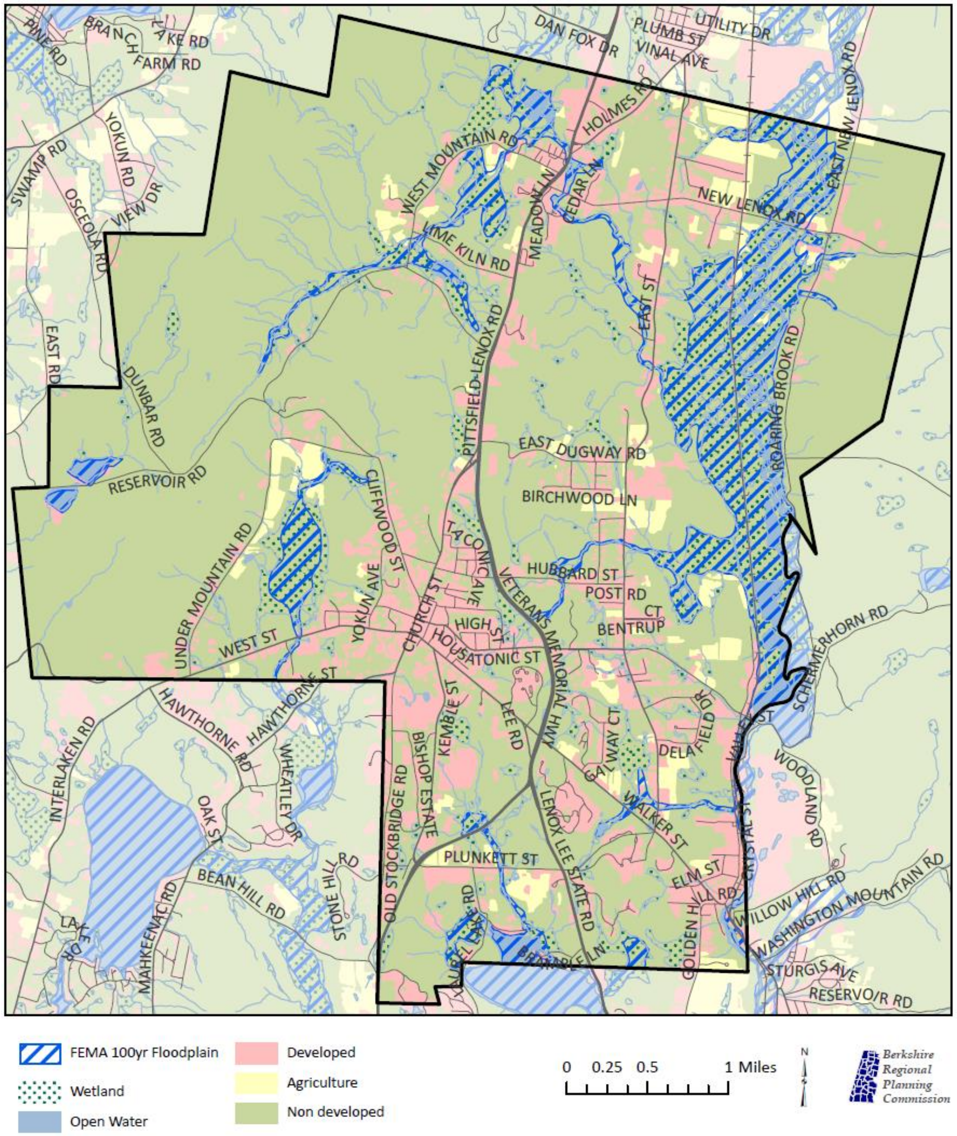
There are several areas that have caused flooding problems. Yokun Brook crosses Edgewood Drive and causes flooding. Debris tends to come downstream and block the culvert, causing flooding on the road. Edgewood Drive is a dead end and the flooding causes several residences to be cut off. Roaring Brook Road has flooding problems where it crosses Roaring Brook. This flooding is due to beavers. Sargent Brook causes flooding in two locations. The Route 7 crossing periodically floods due to beaver activity. Plunkett Road floods due to the inadequate size of the culvert.

There are 1777.8 acres in the 100-year floodplain in Lenox. Approximately 40 acres are developed in the floodplain. Figure 3.7 shows the areas developed along with the floodplain in Lenox. The FIRMs for Lenox have not been updated since the 1982 maps were adopted. The Town should assume that these nearly 40-year-old maps are outdated and in a likelihood the floodplain is more substantial than as shown. The Lenox has a floodplain bylaw, protecting zones A and A1-30 as shown on the FIRM.

Historic data

Between 1936 and 2019, four flood events equaling or exceeding the 1% annual chance flood have been documented the Berkshire County region: 1938, 1949, 1955 and 2011. Refer to Table 3.3. for a list of flood events impacting the region.

Figure 3.7: Town of Lenox Floodplain and Development (FEMA 100 year floodplain FIRM data)



This map was created by the Berkshire Regional Planning Commission and is intended for general planning purposes only. This map shall not be used for engineering, survey, legal, or regulatory purposes. MassGIS, MassDOT, BRPC or the municipality may have supplied portions of this data.

Table 3.3. Previous Flooding Occurrences in the Berkshire County Region

Year	Description of Event
1936	Widespread flooding occurs along the northern Atlantic in March 1936. Widespread loss of life and infrastructure. Many flood stages are discharges highest of record at many USGS stream gages, including Coltsville in Pittsfield.[3]
1938	Large rainstorm hit the area. This storm was considered a 1% annual chance flood event in several communities and a .2% annual chance flood event in Cheshire. The Hoosic River flooded downtown areas of densely-developed Adams and North Adams, with loss of life and extensive damage to buildings. Other communities were not as severely impacted by it.
December 31, 1948 - January 1, 1949	The New Year's Flood hit our region with many of our areas registering the flood as a 1% annual chance flood event.
1955	Hurricanes Connie and Diane combined to flood many of the communities in the region and registering in 1% -0.2% annual chance flood event (100-500-year flood event) (FEMA 1977-1991).
May 1984	A multi-day storm left up to 9" of rain throughout the region and 20" of rain in localized areas. This was reported as an 80-year flood for most of the area and higher where the rainfall was greater (USGS, 1989).
September 1999	The remnants from Hurricane Floyd brought over between 2.5-5" of rain throughout the region and produced significant flooding throughout the region. Due to the significant amount of rain and the accompanying wind, there were numerous reports of trees down.
December 2000	A complex storm system brought 2-4" of rain with some areas receiving an inch an hour. The region had numerous reports of flooding.
March 2003	An area of low pressure brought 1-2" of rain, however this and the unseasonable temperatures caused a rapid melting of the snow pack.
August 2003	Isolated thunderstorms developed that were slow moving and prolific rainmakers. These brought flooding to the area and caused the evacuation of the residents of the trailer park along Wahconah Falls Road in neighboring Dalton.
September 2004	The remnants from Hurricane Ivan brought 3-6" of rain. This, combined with saturated soils from previous storms, caused flooding throughout the region.
October 2005	A stationary cold front brought over 6" of rain and caused widespread flooding throughout the region.
November 2005	Widespread rainfall across the region of 1-1.5", which was preceded by 1-2 feet of snow, resulted in widespread minor flooding.
September 2007	Moderate to heavy rainfall occurred, which lead to localized flooding.
March 2008	Heavy rainfall ranging from 1-3" impact the area. Combined with frozen ground and snowmelt, this led to flooding across the region.

[3] Grover, Nathan C., 1937. *The Floods of March 1936, Part 1. New England Rivers*. USGS, Wash. DC.

August 2008	A storm brought very heavy rainfall and resulted in flash flooding across parts of the region.
December 2008	A storm brought 1-4” of rain to the region, with some areas reporting ¼ to 1/3 of an inch an hour of freezing rain., before changing to snow. Moderate flooding and ponding occurred throughout the region.
June 2009	Numerous slow-moving thunderstorms developed across the region, bringing very intense rainfalls and upwards of 6” of hail. This led to flash flooding in the region.
July 2009	Thunderstorms across the region caused heavy rainfall and flash flooding.
August 2009	An upper level disturbance moved across the region during the afternoon hours and triggered isolated thunderstorms which resulted in roads flooding.
October 2009	A low-pressure system moved across region bringing a widespread heavy rainfall to the area; 2-3” of rain was reported across the region.
March 2010	A storm brought heavy rainfall of 1.5-3” across the region, with roads closed due to flooding.
October 2010	The remnants from Tropical Storm Nicole brought 50-60 mph winds and 4-6” of rain resulting in urban flooding.
March 2011	Heavy rainfall, combined with runoff from snowmelt due to mild temperatures, resulted in flooding of rivers, streams, creeks, roads, and basements.
July 2011	Scattered strong to severe thunderstorms spread across the region resulting in small stream and urban flooding.
August 2011	Two distinct rounds of thunderstorms occurred producing heavy rainfall and localized flooding of roads.
August 2011	Tropical Storm Irene tracked over the region bringing widespread flooding and damaging winds. Riverine and flash flooding resulted from an average of 3-6 inches of rain and upwards of 9”, within a 12-hour period. Widespread road closures occurred throughout the region. In Williamstown this event was a 1% annual chance flood event.
September 2011	Remnants of Tropical Storm Lee brought 4-9” of heavy rainfall to the region. Due to the saturated soils from Tropical Storm Irene, this rainfall lead to widespread minor to moderate flooding on rivers as well as small streams and creeks.
August 2012	Remnants from Hurricane Sandy brought thunderstorms developed repeatedly bringing heavy rains over areas of the region. Upwards of 4-5” of rain occurred and flash flooding caused the closure of numerous roads.
May 2013	Thunderstorms brought wind and heavy rainfall caused flash flooding and road closures in areas.
August 2013	Heavy rainfall repeatedly moved across the region causing more then 3 inches of rain in just a few hours resulting in streams and creeks to overflow their banks and resulting in flash flooding. Roads were closed as a result of the flooding and water rushed into some basements.
September 2013	Showers and thunderstorms tracked over the same locations and resulted in persistent heavy rain, flash flooding and road closures.
June 2014	Slow moving showers and thunderstorms developed producing very heavy rain over a short period of time. This lead to some flash flooding and road closers, especially in urban and poor drainage areas.
June 2014	Showers and thunderstorms repeatedly passed over the same locations, leading to heavy rainfall and significant runoff, which caused flash flooding in some areas. Many roads were closed due to the flooding and some homes were affected by water as well.

July 2014	A cluster of strong to severe thunderstorms broke out causing heavy rainfall and flash flooding with 3-6" of rainfall occurring.
May 2016	Bands of slow-moving showers and thunderstorms broke out over the region. Due to the slow movement of these thunderstorms, heavy rainfall repeatedly fell over the area resulting in flash flooding and some roads were temporarily closed.
August 2017	Widespread rain moved through the area resulting in isolated flash flooding.
August 2017	Severe thunderstorms developed resulting in flash flooding.

Source: BRPC 2018 (unless otherwise noted)
***Bolded** events are in the top 15 events that caused the Housatonic River to flow above flood stage at the Coltsville USGS gage (5')*

Vulnerability Assessment

People

The impact of flooding on life, health, and safety is dependent upon several factors, including the severity of the event and whether or not adequate warning time is provided to residents. Populations living in or near floodplain areas may be impacted during a flood event. People may also be impacted when transportation infrastructure is compromised from flooding.

Of the population exposed, the most vulnerable include people with low socioeconomic status, people over the age of 65, young children, people with medical needs, and those with low English language fluency. For example, people with low socioeconomic status are more vulnerable because they are likely to consider the economic impacts of evacuation when deciding whether or not to evacuate. The population over the age of 65 is also more vulnerable because some of these individuals are more likely to seek or need medical attention because they may have more difficulty evacuating or the medical facility may be flooded. Those who have low English language fluency may not receive or understand the warnings to evacuate. Vulnerable populations may also be less likely to have adequate resources to recover from the loss of their homes and jobs.

The total number of injuries and casualties resulting from typical riverine flooding is generally limited due to advance weather forecasting, blockades, and warnings. Flooding can result in direct mortality to individuals in the flood zone. This hazard is particularly dangerous because even a relatively low-level flood can be more hazardous than many residents realize. For example, while 6 inches of moving water can cause adults to fall, 1 foot to 2 feet of water can sweep cars away. Downed powerlines, sharp objects in the water, or fast-moving debris that may be moving in or near the water all present an immediate danger to individuals in the flood zone. Events that cause loss of electricity and flooding in basements, which are where heating systems are typically located in Massachusetts homes, increase the risk of carbon monoxide poisoning.

Carbon monoxide results from improper location and operation of cooking and heating devices (grills, stoves), damaged chimneys, or generators.

According to the U.S. Environmental Protection Agency (EPA), floodwater often contains a wide range of infectious organisms from raw sewage. These organisms include intestinal bacteria, MRSA (methicillin-resistant staphylococcus aureus), strains of hepatitis, and agents of typhoid, paratyphoid, and tetanus (OSHA, 2005). Floodwaters may also contain agricultural or industrial chemicals and hazardous materials swept away from containment areas. Individuals who evacuate and move to crowded shelters to escape the storm may face the additional risk of contagious disease; however, seeking shelter from storm events when advised is considered far safer than remaining in threatened areas. Individuals with pre-existing health conditions are also at risk if flood events (or related evacuations) render them unable to access medical support. Flooded streets and roadblocks can also make it difficult for emergency vehicles to respond to calls for service, particularly in rural areas. Flood events can also have significant impacts after the initial event has passed. For example, flooded areas that do not drain properly can become breeding grounds for mosquitos, which can transmit vector-borne diseases. Exposure to mosquitos may also increase if individuals are outside of their homes for longer than usual as a result of power outages or other flood-related conditions.

Finally, the growth of mold inside buildings is often widespread after a flood. Investigations following Hurricane Katrina and Superstorm Sandy found mold in the walls of many water-damaged homes and buildings. Mold can result in allergic reactions and can exacerbate existing respiratory diseases, including asthma (CDC, 2004). Property damage and displacement of homes and businesses can lead to loss of livelihood and long-term mental stress for those facing relocation. Individuals may develop post-traumatic stress, anxiety, and depression following major flooding events (Neria et al., 2008 as cited in MEMA & EOEEA, 2018)

Built Environment

There are no critical municipal facilities located within the floodplain in Lenox. However, there are a few areas where main water lines are exposed to the force of flood waters by being suspended below bridges. These include the water main under the New Lenox Road bridge and the Mill Street bridge, both of which cross the Housatonic River. In addition, a main sewer line is exposed along lower Housatonic Street. The wastewater treatment plant is below the Lower Root Reservoir dam and would be inundated if the dam failed. Also, the Henry Avenue wastewater pumping station often has flooding during a storm event as there are storm drains which are connected to the wastewater system which cause the pump to exceed its capacity.

Electrical power outages can occur during flood storm events, particularly when storm events are accompanied by high winds, such as during hurricanes, tropical storms, thunderstorms and micro-bursts. Fortunately, most flooding in the Berkshire region is localized and have resulted in few widespread outages in recent years, and where it occurs service has typically been restored within a few hours.

Dam failures, which are defined as uncontrolled releases of impounded water due to structural deficiencies in the dam, can occur due to heavy rain events and/or unusually high runoff events (MEMA, 2013). Severe flooding can threaten the functionality or structural integrity of dams.

Lenox may experience damage to their wastewater treatment plant as a result of a 100-year or more likely, 500-year flood. Inundation of the treatment tanks or shutdown of the treatment system can pose health hazards that should be planned for. Septic systems can also flood, contaminating the surrounding areas, posing health risks, and damaging the environment. A common effect of septic overflows due to flooding is nutrient overloads in nearby bodies of water that can kill native wildlife and vegetation.

Flooding of homes and businesses can impact human safety health if the area of inundation is not properly dried and restored. Wood framing can rot if not properly dried, compromising building structure and strength. Undetected populations of mold can establish and proliferate in carpets, duct work, wall board and almost any surface that is not properly dried and cleaned. Repeated inundation brings increased risks of both structural damage and mold. Vulnerable populations, such as those whose immune systems are compromised by chronic illness or asthma, are at higher risk of illness due to mold.

The effective FIRMs for Lenox are from 1982 and out of date. Determining the number of buildings in the floodplain by overlaying the FIRM data and building footprints for Lenox with GIS applications will produce a conservative estimate. According the analysis performed, there are an approximate 13 residential buildings in floodplain in Lenox, 2 commercial buildings, and 13 industrial or non-commercial buildings including water treatment building, storage and the rod and gun club.

The Town of Lenox is a National Flood Insurance Program (NFIP) community. 44 CFR § 201.6(c)(2)(ii) requires all plans approved after October 1, 2008 must also address NFIP insured structures that have been repetitively damaged by floods. Community Information System (CIS) from 2020 show that there are two repetitive loss properties in Lenox. Both repetitive loss properties were single family residential homes.

Natural Environment

Flooding has the potential to affect the natural environment in several ways. Flooding can spread contamination potentially harmful to people, the environment, and wildlife. Flooding can remove trees, other vegetation, rocks and soil causing erosion, high turbidity and the loss of community assets. Additionally, flooding can spread invasive species that damages forest health so both native species and logging viability. Invasive Species will be discussed further in the Risk Assessment and Invasive Species Hazard Profile.

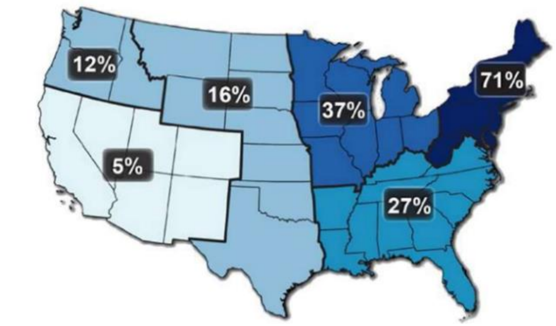
Economy

In addition to the value of buildings potentially lost during a flood event, there may be economic loss due to an inability to commute to work or communicate. There will potentially be a loss of farm crops and livestock or forest products that provide revenue for local businesses. The resilience of businesses potentially impacted by disaster and flood depends on insurance coverage, maintaining customer loyalty during recovery, level of loss, and many other factors.

Future Conditions

Based on data gathered from the Northeast Climate Science Center (NECSC), the yearly precipitation total for Berkshire County has been experiencing a gradual rise over the last 70 years, rising from 40.1 inches in the 1960's to 48.6 inches in the 2000's. According to projections from the NECSC, the county is projected to experience an additional 3.55 inches by the 2050's and 4.72 inches by the 2090's. (Northeast Climate Science Center, 2018)

Figure 3.8 Increase in Precipitation Falling in Top 1% Extreme Precipitation Events 1958-2012



Source: NOAA, adapted from Karl, et al, 2009

The scientific community agrees that climate change is altering the weather and precipitation patterns of the northeastern region of the U.S. The Intergovernmental Panel on Climate Change report of 2007 predicts temperature increases ranging from 2.5-5.0° C (36-41° F) over the next 100 years across the U.S., with the greatest increase in the northern states and during the winter months. More mid-winter cold/thaw weather patterns events could increase the risk of ice jams. Many studies agree that warmer late winter temperatures will result in more rain-on-snow storm events, leading to higher spring melt flows, which typically are already the highest flows of the year.

Studies have also reported increases in precipitation in both developed and undeveloped watersheds across the northeast, with the increases being observed over a range of precipitation intensities, particularly in categories characterized as heavy and extreme storm events. These events are expected to increase both in number and in magnitude. Some scientists predict that the recurrence interval for extreme storm and flood events will be significantly reduced. One study concluded that the 10-year storm may more realistically have a recurrence interval of 6 years, a 25-year storm may have a recurrence interval of 14 years and the 100-year storm may have a recurrence interval of 49-years. The same study predicts that if historic trends continue that flood magnitudes will increase, on average, by almost 17%. (Walter & Vogel, 2010)

Data from at USGS streamflow gages across the northeast show a clear increase in flow since 1940, with an indication that a sharp "stepped" increase occurred in the 1970s. This is despite the fact that much of the land within many New England watershed has been reforested, and this type of land cover change would tend to reduce, rather than increase, flood peaks (Collins, 2008).

Climate change will likely alter how the region receives its precipitation, with an increase of it falling in the form of severe or heavy events. The observed amount of precipitation falling in very heavy events, defined as the heaviest one percent of all daily events, has increased 71% in the Northeast between 1958-2012.[4]

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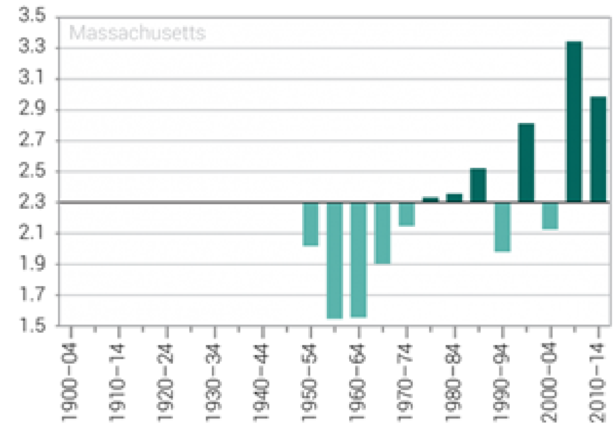
[4] *NOAA - https://toolkit.climate.gov/image/762, adapted from Karl et al.*

The NECSC also predicts that the Northeast will see an increase in the number of days with at least 1 inch of precipitation from 4.5 days in the 1960s, to 5.1 days in the 2000s to 6.6 days in 2050s and 7.1 days in 2090s. (Northeast Climate Science Center, 2018) Days with precipitation of more than 1 inch in the Hoosic River Watershed, as predicted in the Massachusetts Climate Change Projections report, is predicted to increase from the baseline of 5.9 days per year to 6.4 to 8.3 days by the 2050s, and to 6.5 to 9.4 days by the 2090s. The baseline reflects precipitation data 1971-2000. The upper scenario represents a 41% increase in these storms from the baseline by mid-century and a 60% increase by end of century. Summer is currently season when there is the greatest chance for extreme precipitation events to occur, and summer is projected to continue to be the season of greatest chance and the season with the greatest increases in the number of days with extreme precipitation.

Figure 3.9: Number of Extreme Precipitation Events of 2" or more in 1 Day



Source: https://statesummaries.ncics.org/ma

Already observed in Massachusetts, the number of extreme precipitation events, those defined as more than two inches in one day, has increased since the the 1980s, with the greastest increase in the past decade (see Fig. 3.9)[5].

This trend has direct implications on the design of municipal infrastructure that can withstand extreme storm and flood events, indicating that all future designs must be based on them most updated precipitation and stream gauge information available.

It may be prudent, therefore, to slightly overdesign the size of new stormwater management and flood control systems so that they have the capacity to accept the increase in flow or volume without failing. For many piped systems, such as culverts, drainage ditches and swales, the slight increase in size may provide a large increase in capacity, and for very little increase in cost. If space is available, an increase in the capacity of retention/detention ponds may also be cost effective. Bioretention cells can be engineered so that they can increase their holding capacity for extreme storm events with little incremental cost. The size of the engineered soil media, which is a costly component of the system, may remain the same size as current designs call for, but a surface ponding area surrounding the central soil media is increased to serve as a holding pond.

[5] *https://statesummaries.ncics.org/ma*

Severe Winter Storms

Hazard Profile

Severe winter storms in Lenox typically include heavy snow, blizzards, nor'easters, and ice storms. A blizzard is a winter snowstorm with sustained or frequent wind gusts to 35 mph or more, accompanied by falling or blowing snow reducing visibility to or below a quarter-mile. These conditions 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 this definition. However, the hazard created by the combination of snow, wind, and low visibility increases significantly with temperatures below 20ºF. A severe blizzard is categorized as having temperatures near or below 10 °F, winds exceeding 45 mph, and visibility reduced by snow to near zero (MEMA, 2013).

A Nor'easter is typically a large counter-clockwise wind circulation around a low-pressure center often resulting in heavy snow, high winds, and rain. Strong areas of low pressure often form off the southern east coast of the U.S, moving northward with heavy moisture and colliding with cooler winter inland temperatures. Sustained wind speeds of 20-40 mph are common during a nor'easter, with short-term wind speeds gusting up to 50-60 mph or even to hurricane force winds (MEMA, 2013).

Ice storm conditions are defined by liquid rain falling and freezing on contact with cold objects creating ice build-ups of ¼ inch or more that can cause severe damage. An ice storm warning, now included in the criteria for a winter storm warning, is for severe icing. This is issued when ½ - inch or more of accretion of freezing rain is expected. This may lead to dangerous walking or driving conditions and the pulling down of power lines and trees. (MEMA, 2013)

Likely Severity

Periodically, a storm will occur which is a true disaster, and necessitates intense, large-scale emergency response. The main impacts of severe winter storms in the Berkshires is deep snow depths, high winds and reduced visibility, potentially resulting in the closing of schools, businesses, some governmental operations and public gatherings. Loss of electric power and possible closure of roads can occur during the more severe storms events.

The magnitude or severity of a severe winter storm depends on several factors including a region's climatological susceptibility to snowstorms, snowfall amounts, snowfall rates, wind speeds, temperatures, visibility, storm duration, topography, time of occurrence during the day (e.g., weekday versus weekend), and time of season (MEMA, 2013)

NOAA's National Climatic Data Center (NCDC) is currently producing the Regional Snowfall Index (RSI) for significant snowstorms that impact the eastern two-thirds of the U.S. The RSI ranks snowstorm impacts on a scale from one to five. RSI is based on the spatial extent of the storm, the amount of snowfall, and the combination of the extent and snowfall totals with population. Data beginning in 1900 is used to give a historic perspective (MEMA 2013, NOAA 2018).

Table 3.5 Regional Snowfall Index Ranking Categories

Category	Description	RSI-Value	Approximate Percent of Storms
1	Notable	1-3	1%
2	Significant	3-6	2%
3	Major	6-10	5%
4	Crippling	10-18	25%
5	Extreme	18+	54%

Source: MEMA 2013.

Of the 12 recent winter storm disaster declarations that included Berkshire County, only two events were ranked as Extreme (EM-3103 in 1993 and DR-1090 in 1996), one was ranked Crippling (IM-3175 in 2003) and two were ranked as Major (EM-3191 in 2003 and DR-4110 in 2013). It should be noted that because population is used as a criteria, the storms that rank higher will be those that impact densely populated areas and regions such as Boston and other large cities and, as such, might not necessarily reflect the storms that impact lightly populated areas like the Berkshires. For example, one of the most famous storms in the Commonwealth in modern history was the Blizzard of '78, which dropped over two feet of snow in the Boston area during 65 mph winds that created enormous drifts and stranded hundreds of people on local highways. The storm hit the snow-weary city that was still digging out of a similar two-foot snowstorm 17 days earlier. Although the Berkshires received snow from this storm, the county was not listed in the declaration.

One of the most serious storms to impact communities in the Berkshires was the Ice Storm of December 11, 2008. The storm created widespread downed trees and power outages all across New York State, Massachusetts and New Hampshire. Over one million customers were without electricity, with 800,000 without power three days later and some without power weeks later. Living conditions were acerbated by extremely cold temperatures in the days following the event.

While severe winter weather declarations have become more prominent in the 1990s, we do not believe that this reflects more severe weather conditions than the Berkshires experienced in the years 40+ years prior to the 1990s. Respected elders across Berkshire County comment that snow depths prior to the 1990s were consistently deeper that what currently occurs in the 2010s.

Probability

The majority of blizzards and ice storms are viewed by people in the region as part of life in the Berkshires, an inconvenience and drain on municipal budgets. Residents and town staff expect to deal with several snow storms and a few Nor'easters each winter. According to the NOAA-NCDC storm database, over 200 winter storm events occurred in the Commonwealth between 2000 and 2012. Therefore, the subset of severe winter storms are likely to continue to occur annually (MEMA, 2013). Lenox's location in Western New England places it at a high-risk for winter storms. While the town may not get the heavy snowfall associated with coastal storms, the severe storms that the county gets are added to the higher annual snowfall the county normally gets due to its slightly higher elevation then its neighboring counties in the Pioneer and Hudson River Valleys.

Using history as a guide for future severe winter storms, it can be assumed that the town will be at risk for approximately six severe winter storms per winter. The highest risk of these storms occurs in January with significant risk also occurring in December through March. The region is getting less snowfall then previous years and can expect less snowfall in future years, however this does not mean the county will not experience years with high snowfall amounts (2010-11 had over 100 inches), but the trend indicates that the yearly snowfall total will continue to go down. It should be noted that although total snow depths may be reduced in the future, warmer winter temperatures will likely increase the number and severity of storms with heavy, wet snow, which can bring concerns for road travel, human injuries linked to shoveling and risk of roof failures.

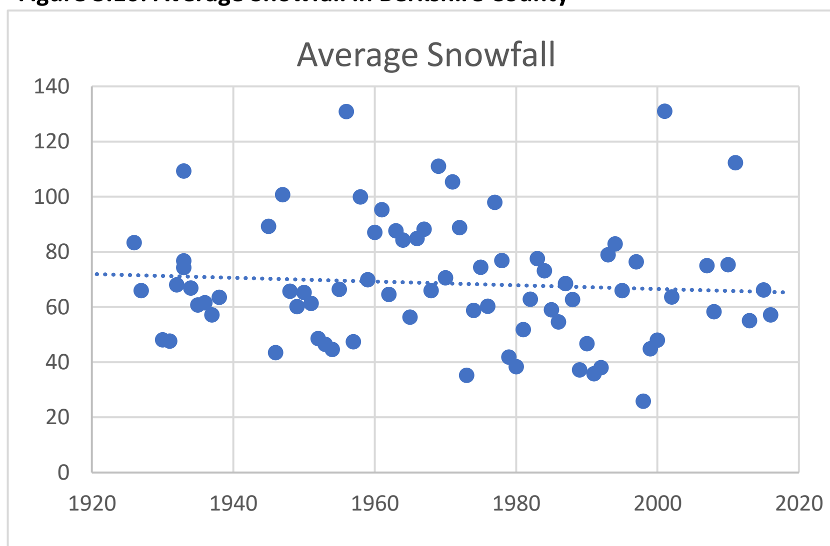
Geographic Areas Likely Impacted

Winter storms are the most common and most familiar of Massachusetts hazards which affect large geographical areas. Severe winter storm events generally occur across Lenox, although higher elevations have slightly higher snow depths.

Historic Data

Figure 3.10 illustrates historic snowfall totals the region has received. Although the entire community is at risk, the higher terrains tend to receive higher snowfall amounts, and these same areas may receive snow when the lower elevations received mixed snow/rain or just rain (National Climatic Data Center, 2017). The National Climatic Data Center, a division of NOAA, reports statistics on severe winter storms from 1993 through 2017. During this 24-year span, Berkshire County experienced 151 severe winter storms, an average of six per winter. This number

Figure 3.10: Average Snowfall in Berkshire County



varies each winter, ranging from one during 2006 to 18 during 2008. Snow and other winter precipitation occur very frequently across the entire region. Snowfall in the region can vary between 26 and 131 inches a year, however it averages around 65 inches a year, down from around 75 inches a year in 1920. Another tracking system is the one- and three-day record snowfall totals. According to data from the Northeast States Consortium, 99% of the one-day record snowfall events in the region typically yield snow depths in the range of 12"-24", while the majority of three-day record snowfall events yield snow depths of 24"-36" (Table 3.6).

Table 3.6: Record Snowfall Events and Snow Depths for Berkshire County

Record Snowfall Event	Snowfall 12" – 24"	Snowfall 24" – 36"
1-Day Record	99%	1%
3-Day Record	36%	64%

Source: (Northeast States Emergency Consortium, 2010).

Since 2000, two severe ice storm events have occurred in the region. The storms within that period occurred in December and January, but ice storms of lesser magnitudes may impact the region from October to April, and on at least an annual basis.

Based on all sources researched, known winter weather events that have affected Massachusetts and were declared a FEMA disaster are identified in the following sections. Of the 18 federally declared winter storm-related disaster declarations in Massachusetts between 1954 to 2018, Berkshire County has been included in 12 of those disasters. The number of disaster declarations for severe winter events in which Berkshire County was included is more than double that of declarations for non-winter, non-flood-related severe storm events.

Table 3.7: Severe Winter Weather – Declared Disasters that included Berkshire County 1992-2017

Incident Period	Description	Declaration Number
12/11/92-12/13/92	Nor'easter with snow 4'+ in higher elevations of Berkshires, with 48" reported in Becket, Peru and Becket; snow drifts of 12'+; 135,000 without power across the state	DR-975
03/13/93-03/17/93	High winds & heavy snow; generally 20-30" in Berkshires; blizzard conditions lasting 3-6 hrs afternoon of March 13.	EM-3103
01/07/96-01/08/96	Blizzard of 30+" in Berkshires, with strong to gale-force northeast winds; MEMA reported claims of approx. $32 million from 350 communities for snow removal	DR-1090
03/05/01-03/06/01	Heavy snow across eastern Berkshires to Worcester County; several roof collapses reported; $21 million from FEMA	EM-3165
02/17/03-02/18/03	Winter storm with snow of 12-24", with higher totals in eastern Berkshires to northern Worcester County; $28+ million from FEMA	EM-3175
12/06/03-12/07/03	Winter Storm with 1'-2' across state, with 36" in Peabody; $35 million from FEMA	EM-3191
01/22/05-01/23/05	Blizzard with heavy snow, winds and coastal flooding; highest snow falls in eastern Mass.; $49 million from FEMA	EM-3201
04/15/07-04/16/07	Severe Storm and Flooding; wet snow, sleet and rain added to snowmelt to cause flooding; higher elevations received heavy snow and ice; $8 million from FEMA	DR-1701

12/11/08-12/12/08	Major ice storm across eastern Berkshires & Worcester hills; at least ½" of ice accreted on exposed surfaces, downing trees, branches and power lines; 300,000+ customers without power in state, some for up to 3 wks.; $51+ million from FEMA	DR-1813
01/11/11-01/12/11	Nor'easter with up to 2' within 24 hrs.; $25+ million received from FEMA	DR-1959
10/29/11-10/30/11	Severe storm and Nor'easter with 1'-2' common; at peak 665,000 residents state-wide without power; 2,000 people in shelters statewide	DR-4051
02/08/13-02/09/13	Severe Winter Snowstorm and Flooding; $56+ million from FEMA	RE-4110

Source: FEMA 2017.

Vulnerability Assessment

People

According to the NOAA National Severe Storms Laboratory, every year, winter weather indirectly and deceptively kills hundreds of people in the U.S., primarily from automobile accidents, overexertion, and exposure. Winter storms are often accompanied by strong winds creating blizzard conditions with blinding wind-driven snow, drifting snow, and extreme cold temperatures with dangerous wind chill. They are considered deceptive killers because most deaths and other impacts or losses are indirectly related to the storm. Injuries and deaths may occur due to traffic accidents on icy roads, heart attacks while shoveling snow, or hypothermia from prolonged exposure to cold (MEMA & EOEEA, 2018).

Lenox is more densely developed, and residents are not as remote as many part of the Berkshires, though some residents are still isolated. In rural areas homes and farms may be isolated for days, and unprotected livestock may be lost. In the mountains, heavy snow can lead to avalanches. Residents may be displaced or require temporary to long-term sheltering. In addition, downed trees, damaged buildings, and debris carried by high winds can lead to injury or loss of life.

Vulnerable populations include the elderly living alone, who are susceptible to winter hazards due to their increased risk of injury and death from falls, overexertion, and/or hypothermia from attempts to clear snow and ice, or injury and death related to power failures. In addition, severe winter weather events can reduce the ability of these populations to access emergency services. People with low socioeconomic status are more vulnerable because they are likely to evaluate their risk and make decisions to evacuate based on the net economic impact on their families. Residents with low incomes may not have access to housing or their housing may be less able to withstand cold temperatures (e.g., homes with poor insulation and heating supply). The population over the age of 65, individuals with disabilities, and people with mobility limitations or who lack transportation are also more vulnerable because they are more likely to seek or need medical attention, which may not be available due to isolation during a flood event. These individuals are also more vulnerable because they may have more difficulty if evacuation becomes necessary. People with limited mobility risk becoming isolated or "snowbound" if they are unable to remove snow from their homes. Rural populations may become isolated by downed trees, blocked roadways, and power outages. The ability of emergency responders to respond to calls may be impaired by heavy snowfall, icy roads, and downed trees (MEMA & EOEEA, 2018).

Built Environment

Severe winter storms can damage the built environment by collapsing roofs under the weight of snow, making roads impassable due to snow or ice, damaging roads by freezing or unintended damage due to snowplows, freezing and bursting pipes, downing trees and power lines, and the flooding damages that result from melting snow.

Natural environment

Although winter storms are a natural part of the Massachusetts climate, and native ecosystems and species are well adapted to these events. However, changes in the frequency or severity of winter storms could increase their environmental impacts. Environmental impacts of severe winter storms can include direct mortality of individuals and felling of trees, which can damage the physical structure of the ecosystem. Similarly, if large numbers of plants or animals die as the result of a storm, their lack of availability can impact the food supply for animals in the same food web. If many trees fall within a small area, they can release large amounts of carbon as they decay. This unexpected release can cause further imbalance in the local ecosystem. The flooding that results when snow and ice melt can also cause extensive environmental impacts. Nor'easters can cause impacts that are similar to those of hurricanes and tropical storms, coastal flooding, and inland flooding. These impacts can include direct damage to species and ecosystems, habitat destruction, and the distribution of contaminants and hazardous materials throughout the environment (MEMA & EOEEA, 2018).

Economy

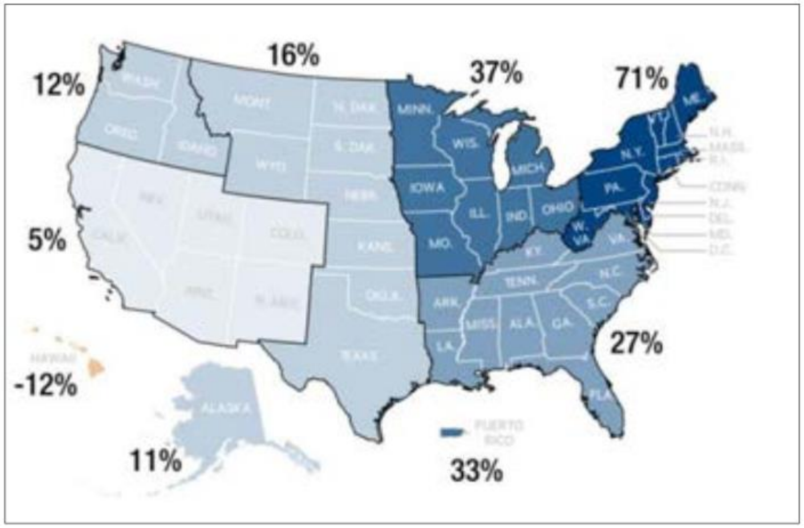
The cost of snow and ice removal and repair of roads from the freeze/thaw process can drain municipal and state financial resources due to the cost of staff overtime, snow removal and wear on equipment. Rescheduling of schools and other municipal programs and meetings can also be costly. The potential secondary impacts from winter storms also impact the local economy including loss of utilities, interruption of transportation corridors, and loss of business operations and functions, as well as loss of wages for employees.

Severe winter weather can lead to flooding in low-lying agricultural areas. Ice that accumulates on branches in orchards and forests can cause branches to break, while the combination of ice and wind can fell trees. Storms that occur in spring can delay planting schedules. Frost that occurs after warmer periods in spring can cause cold weather dieback and damage new growth (MEMA & EOEEA, 2018).

Future Conditions

Increased sea surface temperature in the Atlantic Ocean will cause air moving north over this ocean to hold more moisture. As a result, when these fronts meet cold air systems moving from the north, an even greater amount of snow than normal can be anticipated to fall on Massachusetts. Although no one storm can be linked directly to climate change, the severity of rain and snow events has increased dramatically in recent years. As shown in Figure 3.11, the amount of precipitation released by storms in the Northeast has increased by 71 percent from the baseline level (recorded from 1901 to 1960) and present-day levels (measured from 2001 to 2012) (USGCRP, 2014 as cited in MEMA & EOEEA, 2018).Winter precipitation is predicted to more often be in the form of rain rather than snow.

Figure 3.11: Observed Changes in Heavy Precipitation



Source: NCA, 2014 as cited in MEMA & EOEEA

Droughts

Hazard Profile

Lenox MVP Workshop participants expressed that drought was a top hazard of concern with increasing temperatures and changing precipitation patterns. Drought is a period characterized by long durations of below normal precipitation. Drought occurs 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. Direct impacts of drought include reduced water supply, crop yield, increased fire hazard, reduced water levels, and damage to wildlife and fish habitat.

The Massachusetts Executive Office of Energy and Environmental Affairs (EEA) and the Massachusetts Emergency Management Agency (MEMA) partnered to develop the *Massachusetts Drought Management Plan*, of which 2013 is the most updated version. The state's Drought Management Task Force, comprised of state and federal agencies, was created to assist in monitoring, coordinating and managing responses to droughts and recommends action to minimize impacts to public health, safety, the environment and agriculture (EEA, MEMA, 2013). The MA Department of Conservation Resources staff compile data from the agencies and develop monthly reports to track and summarize current water resource conditions.

In Massachusetts the determination of drought level is based on seven indices: Standardized Precipitation Index, Crop Moisture Index, Keetch-Byram Drought Index, Precipitation, Groundwater levels, Streamflow levels, and Index Reservoir levels. The Standardized Precipitation Index (SPI) reflects soil moisture and precipitation conditions, calculated monthly using Massachusetts Rainfall Database at the Department of Conservation and Recreation Office of Water Resources. SPI values are calculated for "look-back" periods of 1 month, 3 months, 6 months, and 12 months. (EEA, MEMA 2013)

The Crop Moisture Index (CMI) reflects short-term soil moisture conditions as used for agriculture to assess short-term crop water conditions and needs across major crop-producing regions. It is based on the concept of abnormal evapotranspiration deficit, calculated as the difference between computed actual evapotranspiration (ET) and computed potential evapotranspiration (i.e., expected or appropriate ET). Actual evapotranspiration is based on the temperature and precipitation that occurs during the week and computed soil moisture in both the topsoil and subsoil layers.

The Keetch-Byram Drought Index (KBDI)is designed specifically for fire potential assessment. It is a number representing the net effect of evapotranspiration and precipitation in producing cumulative moisture deficiency in deep duff and upper soil layers. It is a continuous index, relating to the flammability of organic material in the ground. The KBDI attempts to measure the amount of precipitation necessary to return the soil to full field capacity. The inputs for KBDI are weather station latitude, mean annual precipitation, maximum dry bulb temperature, and the last 24 hours of rainfall.

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 streamflow, water supply, reservoir levels, soil moisture and potential for forest fires. Precipitation is a key factor because it is the overall cause of improving conditions. Groundwater levels respond slowly to improving conditions, so they are good indicators of long-term recovery to normal conditions.

Likely severity

The severity of a drought depends on the degree of moisture deficiency, the duration, and the size and location of the affected area. The longer the duration of the drought and the larger the area impacted, the more severe the potential impacts. Droughts are not usually associated with immediate impacts on people or property, but they can have significant impacts on agriculture, which can impact the farming community of the region. As noted in the state Hazard Mitigation Plan, agriculture-related drought disasters are quite common, with 1/2 to 2/3 of the counties in the U.S. having been designated as disaster areas in each of the past several years. These designations make it possible for producers suffering losses to receive emergency loans. Such a disaster was declared in December 2010 for Berkshire County (USDA Designation # S3072).

When measuring the severity of droughts, analysts typically look at economic impacts on a planning area. Drought warnings, watches and advisories can be reduced based on: 1) normal levels of precipitation, and 2) groundwater levels within the "normal" range. In order to return to a normal status, groundwater levels must be in the normal range and/or one of two precipitation measures must be met. The precipitation measures are: 1) three months of precipitation that is cumulatively above normal, and 2) long-term cumulative precipitation above normal. The period for long-term cumulative precipitation ranges from 4 to 12 months, depending on the time of year. Precipitation falling during the fall and spring is ideal for groundwater recharge and, therefore, will result in the quickest return to normal conditions. Because the same levels of cumulative precipitation can differ in their abilities to reduce drought conditions, the decision to reduce a drought level will depend on the professional judgment of the Secretary of EEA with input from his agencies and the Drought Management Task Force (MEMA 2013)

MassDEP has the authority to declare water emergencies for communities facing public health or safety threats as a result of the status of their water supply systems, whether caused by drought conditions or for other reasons. The Department of Public Health (DPH) in conjunction with the DEP monitors drinking water quality in communities.

According to the data at hand, the most severe droughts in Massachusetts occurred 1930-31 and 1964-67. Many local water managers and officials remember the drought years of the 1960s, where mandatory water bans were issued. Outside of this time period, most water restrictions in the region have been voluntary.

Probability

As described below, Berkshire County is at lower risk of drought relative to the rest of the Commonwealth. However, that does not eliminate the hazard from potentially impacting the County and the Town of Lenox. Patterns show near misses of severe drought conditions, and increases in temperature lead to faster evaporation and drying of kindling.

Geographic Areas Likely Impacted

For the purposes of tracking drought conditions across the Commonwealth, the state has been divided into six regions, with the Western Region being made up of Berkshire County. For the purposes of this plan, the entire Town of Lenox is at risk of drought.

Historic Data

Massachusetts is relatively water-rich, with few documented drought occurrences. According to the state's Hazard Mitigation Plan of 2013, the state has experienced multi-year droughts periods 1879-83, 1908-12, 1929-32, 1939-44, 1961-69 and 1980-83. There have been 13 documented droughts in the state between 1945 and 2002 (see Table 3.8) (MEMA, 2013). The most severe drought occurred during the 1960s, due to both severity and extended duration.

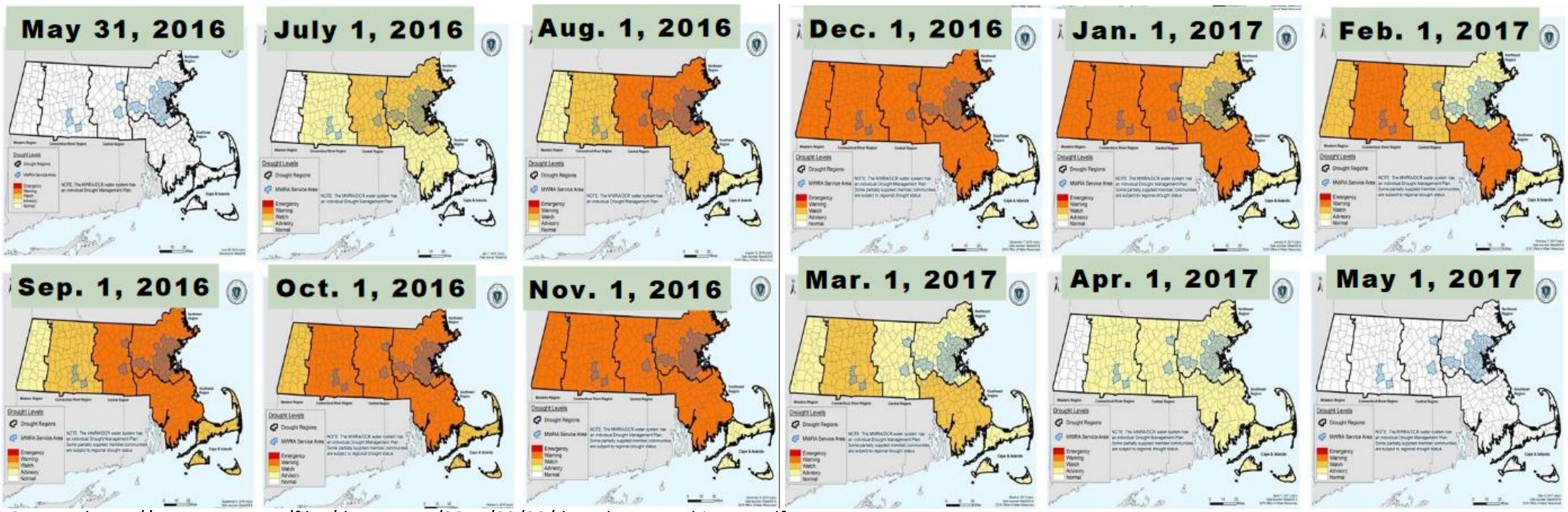
Table 3.8: Estimated Droughts Based on the Mass. Standardized Precipitation Index

Year(s)	Duration (Months)	Estimated Drought Level
1924-1925	13	Warning
1930-1931	12	Emergency
1934-1935	15	Warning
1944	11	Watch
1949-1950	15	Watch
1957-1958	12	Warning
1964-1967	36	Emergency
1971	8	Watch
1980-1981	13	Watch
1985	7	Watch
1988-1989	11	Watch
1990-1991	9	Watch
2001-2002	13	Watch

Source: MEMA, 2013

Additional information indicates that droughts occurred in the state 2007-08 and in 2010, although neither of these involved drought conditions in Berkshire County (Western Drought Region). The most recent drought in Massachusetts occurred during a 10-month span in 2016-17. In July 2016 Advisory and Watch drought levels began to be issued for the eastern and central portions of the state, worsening in severity until the entire state was under a Drought Warning status for the months of November-December 2016. Water levels began to recover in February 2017, with the entire state determined to be back to normal water levels in May 2017. The Massachusetts Water Resources Commission stated that the drought was the worst since the state's Drought Management Plan was first issued in 2001, and the most severe since the 1960s drought of record.[6]

Figure 3.12: Progression of the 2016-17 Drought



Source: https://www.mass.gov/files/documents/2017/09/08/drought-status-history.pdf

In general, the central portion of the state faired the worse and Berkshire County faired the best, with the county entering the drought later and emerging from the drought earlier than most of the rest of the state. Berkshire County was under a Watch status for two months and under a Warning status for three months during the height of the drought.

[6] *MA Water Resources Commission, 2017. Annual Report, Fiscal Year 2017. Boston, MA.*

Vulnerability Assessment

People

The entire population of Lenox is exposed and vulnerable to drought. Those with shallow wells may be hardest hit because shallow, quickly constructed wells are the most likely to go dry. Those with access and functional needs are at greatest risk in the case that they are unable to travel to or afford alternative water sources.

The Berkshire region has not suffered a severe, emergency level drought since the 1960s and it is unclear how well the systems and public water supply could serve the demands of Lenox during a prolonged drought given an increased population and changes in precipitation patterns. Lenox has experienced very low levels in their main reservoir. The Town has an agreement with the City of Pittsfield to tap into their water system if needed.

Due to the great expanses of state forest and wildlife lands in the region, which attract hikers and campers, and a tourist-based economy that brings additional people to the region in the summer, the risk of wildfire would increase during a severe drought. Drought would reduce the capacity of local firefighting efforts, hampering control of wildfire. A more detailed discussion of wildfire and the Town's vulnerability is found in that section of the report.

Built Environment with Infrastructure and Systems

Drought does not threaten the physical stability of critical facilities in the same manner as other hazards such as wind-based or flood-related events. However, if drought led to wildfire the entire Town, primarily private residential buildings, would be at risk. Additionally, as a result of wildfire, electrical and communication systems would be a significant risk. What water was remaining available would also be at risk of contamination.

Natural Environment

The natural environment is at greatest risk due to drought. Vegetation and wildlife would be challenged to find water to sustain life, and the vegetation and wildlife most sensitive to water availability would die off providing kindling for wildlife and leaving room for invasive species to dominant the landscape.

Drought has a wide-ranging impact on a variety of natural systems. Some of those impacts can include the following (Clark et al., 2016 as cited in MEMA & EOEEA, 2018):

- Reduced water availability, specifically, but not limited to, habitat for aquatic species
- Decreased plant growth and productivity
- Increased wildfires
- Greater insect outbreaks
- Increased local species extinctions
- Lower stream flows and freshwater delivery to downstream estuarine habitats
- Changes in the timing, magnitude, and strength of mixing (stratification) in coastal waters
- Increased potential for hypoxia (low oxygen) events
- Reduced forest productivity
- Direct and indirect effects on goods and services provided by habitats (such as timber, carbon sequestration, recreation, and water quality from forests)
- Limited fish migration or breeding due to dry streambeds or fish mortality caused by dry streambed/

In addition to these direct natural resource impacts, a wildfire exacerbated by drought conditions could cause significant damage to the Commonwealth's environment as well as economic damage related to the loss of valuable natural resources (MEMA & EOEEA, 2018).

Economy

The economic impacts of drought can be substantial, and would primarily affect the agriculture, recreation and tourism, forestry, and energy sectors. For example, drought can result in farmers not being able to plant crops or in the failure of planted crops (MEMA & EOEEA, 2018). Drier summers and intermittent droughts may strain irrigation water supplies, stress crops, and delay harvests (resilient MA, 2018). Droughts affect the ability of farmers to provide fresh produce to neighboring communities. Insufficient irrigation will impact the availability of produce, which may result in higher demand than supply. This can drive up the price of food, leading to economic stress on a broader portion of the economy.

In any season, a drought can also harm recreational companies that rely on water (e.g., ski areas, swimming pools, water parks, and river rafting companies) as well as landscape and nursery businesses because people will not invest in new plants if water is not available to sustain them. Social and environmental impacts are also significant, but data on the extent of damages is more challenging to collect. Although the impacts can be numerous and significant, dollar damage estimates are not tracked or available (MEMA & EOEEA, 2018).

Future Conditions

2020 was a real of significant drought conditions across the State, including Berkshire County. Climate change is causing greater extremes in weather patterns, swinging from higher than usual rainfall to very limited rainfall for weeks and months.

Changes in winter temperatures will lead to less snowpack and more rain-on-snow events, leading to more surface runoff and less groundwater recharge, leading to less stream and river base flows. Higher temperatures in warmer seasons can more severely impact the reduced base flows due to higher rates of evaporation of moisture from soil and lower groundwater and surface water inputs. According to the state's Climate Change Adaptation Report, a continued high greenhouse-gas-emission scenario could result in a 75% increase in the occurrence of drought conditions lasting 1-3 months.

During droughts soil moisture is limited or lacking, forest duff is dried out and standing vegetation is dry and possibly dead, providing the fuel needed for wildfire. Wildfire or small brush fires will cause further damage and use greater local resources to manage.

Change in Average Temperatures/ Extreme Temperatures

Hazard Profile

Changes in temperature, particularly extremes in temperate, was a top hazard identified by stakeholders through the MVP planning process. Temperature is a fundamental measurement to describe climate, which is the prevailing weather patterns in a given area. Climate determines the types of plant and animal species that are able to survive in a region, and changes in climate will have significant impacts on the landscape because most species will not have the time to evolve and adapt over multiple generations to the new climate[7]. Scientists are still uncovering ways climate change will impact our lives both directly and indirectly.

Likely severity

Relative to the rest of the Commonwealth, the Town of Lenox is protected from extreme heat by the higher elevation. At the same time however, the lack of many extreme heat events has left most unprepared. Homes have been built to keep in warmth, and few have air conditioners. The environment and people have adapted to cooler conditions; however, extremes in cold and hot still can and will occur, particularly in the changing climate.

NOAA utilizes data to determine average temperature using land-based weather station measurements and by satellite measurements that cover the lowest level of the Earth's atmosphere. In moderate climate like in the Berkshires, the most severe impacts of the change in average temperature will be on our environmental composition, as well as on our vulnerable populations, particularly in urbanized areas. Areas of Lenox such as along the northern portion of US-20/Pittsfield Road where the landscape is predominantly developed and paved may experience some level of the Urban Heat Island (UHI) effect.

The extent (severity or magnitude) of extreme cold temperatures is generally measured through the Wind Chill Temperature Index. Wind Chill Temperature is the temperature that people and animals feel when they are outside, and it is based on the rate of heat loss from exposed skin by the effects of wind and cold. As the wind increases, the body loses heat at a faster rate, causing the skin's temperature to drop. The NWS issues a Wind Chill Advisory if the Wind Chill Index is forecast to dip to –15°F to –24°F for at least 3 hours, based on sustained winds (not gusts). The NWS issues a Wind Chill Warning if the Wind Chill Index is forecast to fall to –25°F or colder for at least 3 hours. On November 1, 2001, the NWS implemented a Wind Chill Temperature Index designed to more accurately calculate how cold air feels on human skin.

[7] https://www.epa.gov/climate-indicators/climate-change-indicators-us-and-global-temperature

The NWS issues a Heat Advisory when the NWS Heat Index is forecast to reach 100 to 104°F for 2 or more hours. The NWS issues an Excessive Heat Warning if the Heat Index is forecast to reach 105°F or higher for 2 or more hours. The NWS Heat Index is based both on temperature and relative humidity and describes a temperature equivalent to what a person would feel at a baseline humidity level. It is scaled to the ability of a person to lose heat to their environment. It is important to know that the heat index values are devised for shady, light wind conditions. Exposure to full sunshine can increase heat index values by up to 15°F. Also, strong winds, particularly with very hot, dry air, can increase the risk of heat-related impacts.

Extreme heat temperatures are those that are 10°F or more above the average high temperature for the region and last for several hours. A heat wave is defined as 3 or more days of temperatures of 90°F or above. A basic definition of a heat wave implies that it is an extended period of unusually high atmosphere-related heat stress, which causes temporary modifications in lifestyle and which may have adverse health consequences for the affected population (MEMA & EOEEA, 2018).

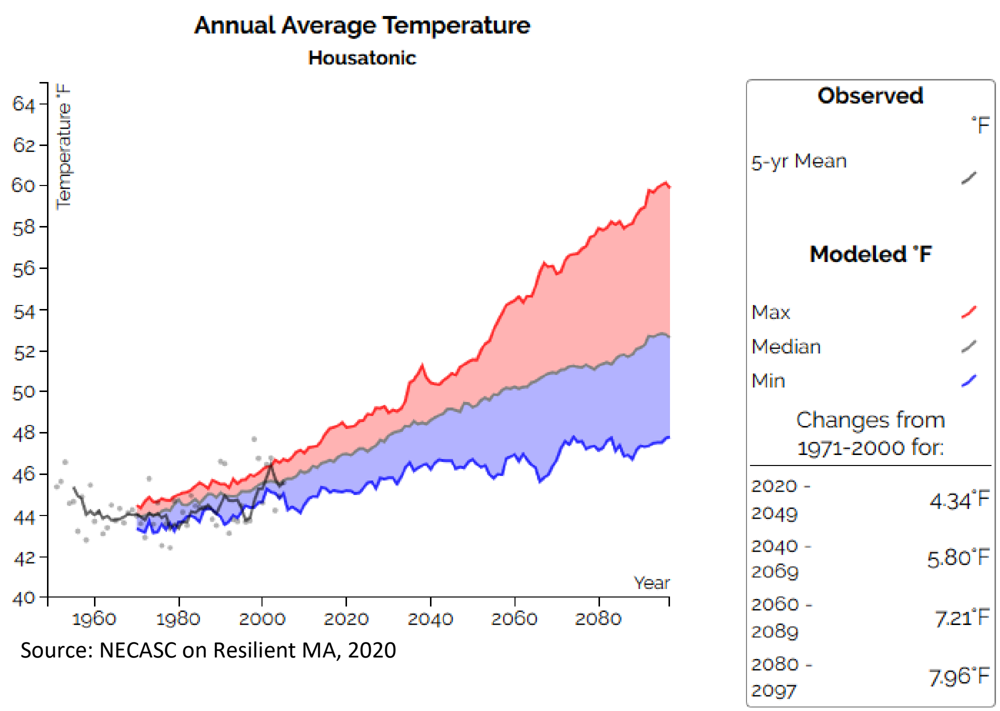
Probability

The change in average temperatures has already affected the Town of Lenox. Figure 3.13 shows the observed and projected annual average temperature, increasing through the next century. In the next 30 years, the Housatonic Watershed basin, will warm by an average of 4.34°F. The global changes in climate will lead to extreme temperatures as global weather patterns are altered. Figure 3.14 shows that this region has little experience with days over 90°F, but that will soon change as we see more days with dangerous levels of heat.

Geographic Areas Likely Impacted

Lenox in its entirety is exposed to the impacts of extreme temperatures and the change in average temperature. Extreme temperature events occur more frequently and vary more in the inland regions where temperatures are not moderated by the Atlantic Ocean. There may be some UHI effect in Lenox, though much less

Figure 3.13: Observed and Projected Annual Average Temperature by Watershed Basin



Source: NECASC on Resilient MA, 2020

severe than large urban areas. UHI occurs were there are dark surfaces including pavement and building roofs that absorb heat, anthropogenic heat production such as air conditioners and cars, and a dearth of natural vegetation to provide a cooling effect through evapotranspiration or by providing shade.

Historic Data

The world's five warmest years have all occurred since 2015 with nine of the 10 warmest years occurring since 2005, according to scientists from NOAA's National Centers for Environmental Information (NCEI)[8]. Figure 3.14 shows the increase in the number of observed and projected days over 90°F in the Housatonic watershed and Figure 3.15 shows the decline in observed and projected days below freezing for the Housatonic watershed, including Lenox.

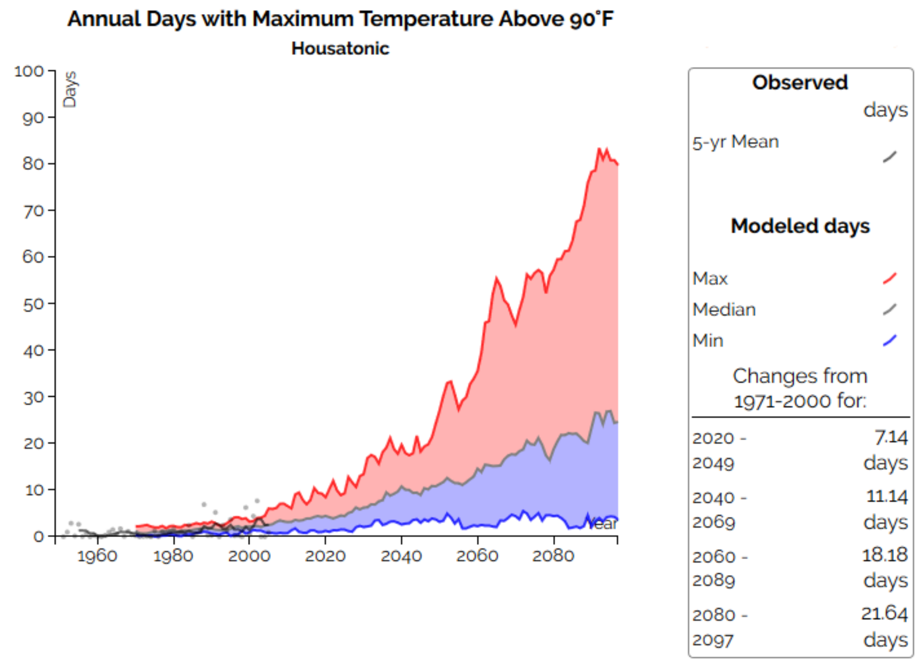


Figure 3.14: Observed and Projected Days Above 90°F by Watershed Basin

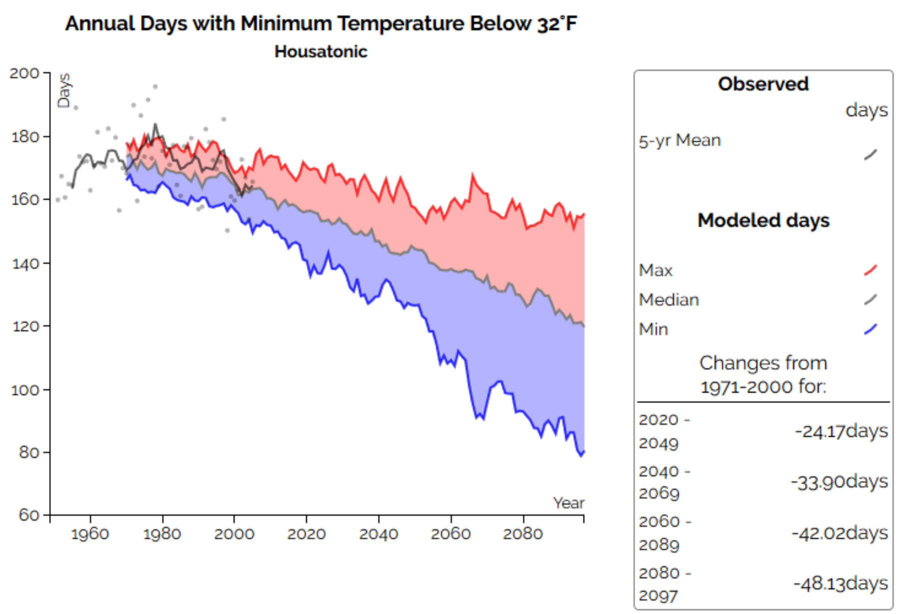


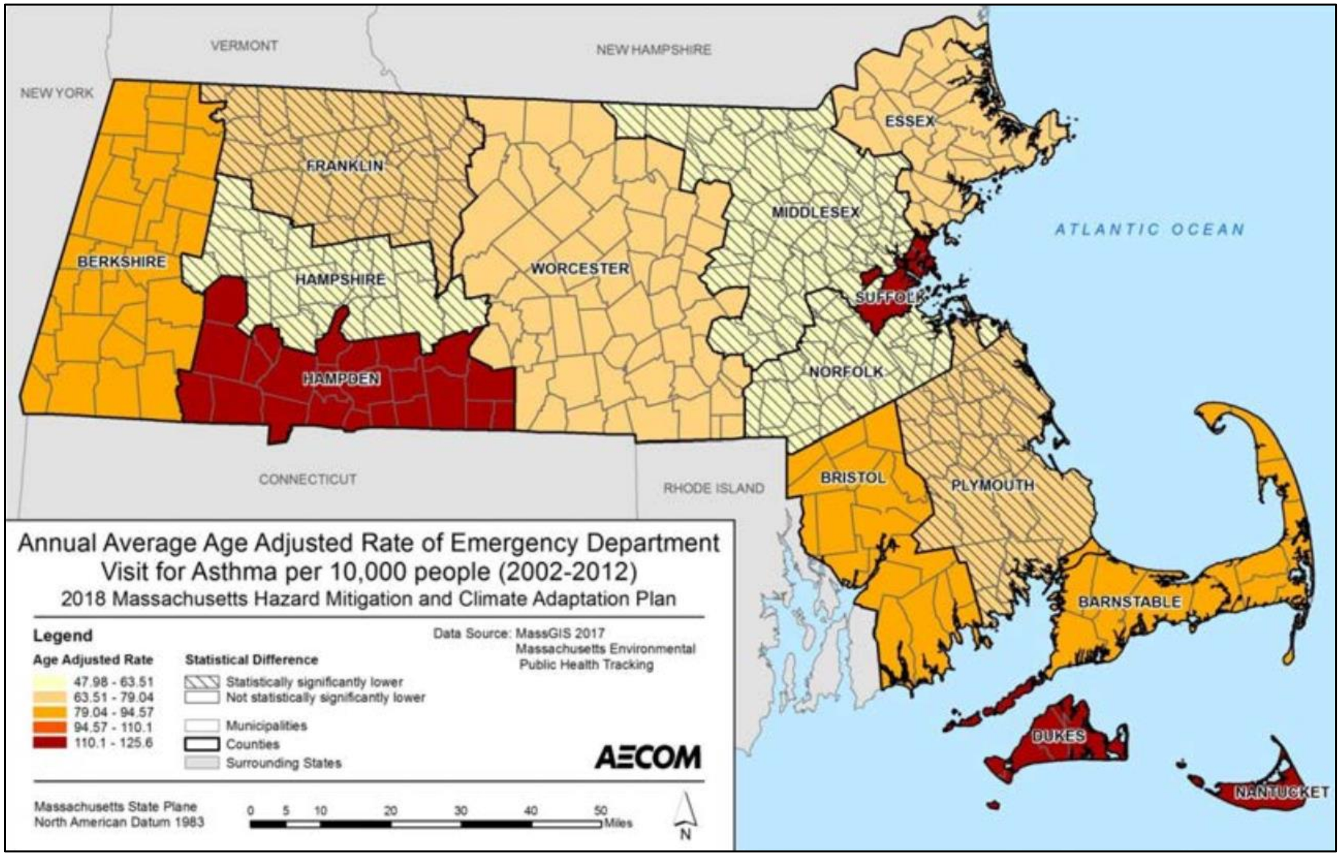
Figure 3.15: Observed and Projected Days Below 32°F by Watershed Basin

July is on average the hottest month of the year in Lenox with an average of high temperature of 82°F. The lowest average temperature in Lenox occurs in January. The average low in January is 11°F.

The changing temperatures will continue to have impacts on everything from natural cycles of snow melt and waterflow to the ability of insects such as ticks to survive and even reproduce at greater rates through the winter. Additional impacts will be discussed in the Vulnerability Assessment.

[8] https://www.noaa.gov/news/2019-was-2nd-hottest-year-on-record-for-earth-say-noaa-nasa

Figure 3.16: Rates of Emergency Department Visits Due to Asthma by County



People

Temperature alone does not define the stress that heat can have on the human body – humidity plays a powerful role in human health impacts, particularly for those with pre-existing pulmonary or cardio-vascular conditions. The NWS issues a Heat Advisory when the Heat Index is forecast to reach 100° to 104°F for two or more hours. The NWS issues an Excessive Heat Warning if the Heat Index is forecast to reach 105°F or more for two or more hours. According to the Centers for Disease Control and Prevention, populations most at risk to extreme cold and heat events include the following: (1) people over the age of 65, who are less able to withstand temperatures extremes due to their age, health conditions, and limited mobility to access shelters; (2) infants and children under 5 years of age; (3) individuals with pre-existing medical conditions that impair heat tolerance (e.g., heart disease or kidney disease); (4) low-income individuals who cannot afford proper heating and cooling; (5) people with respiratory conditions, such as asthma or chronic obstructive pulmonary disease; and (6) the general public who may overexert themselves when working or exercising during extreme heat events or who may experience hypothermia during extreme cold events. Additionally, people who live alone—particularly the elderly and individuals with disabilities—are at higher risk of heat-related illness due to their isolation and reluctance to relocate to cooler environments.

When people are exposed to extreme heat, they can suffer from potentially deadly illnesses, such as heat exhaustion and heat stroke. Heat is the leading weather-related killer in the U.S., even though most heat-related deaths are preventable through outreach and intervention (EPA, 2016). A study of heat-related deaths across Massachusetts estimated that when the temperature rises above the 85th percentile (hot: 85-86°F), 90th percentile (very hot: 87-89°F) and 95th percentile (extremely hot: 89-92°F) there are between five and seven excess deaths per day in Massachusetts.

These estimates were higher for communities with high percentages of African American residents and elderly residents on days exceeding the 85th percentile (Hattis et al., 2011). A 2013 study of heart disease patients in Worcester, MA, found that extreme heat (high temperature greater than the 95th percentile) in the 2 days before a heart attack resulted in an estimated 44 percent increase in mortality. Living in poverty appeared to increase this effect (Madrigano et al., 2013). In 2015, researchers analyzed Medicare records for adults over the age of 65 who were living in New England from 2000 to 2008. They found that a rise in summer mean temperatures of 1°C resulted in a 1 percent rise in the mortality rate due to an increase in the number and intensity of heat events (Shi et al., 2015). Hot temperatures can also contribute to deaths from respiratory conditions (including asthma), heart attacks, strokes, other forms of cardiovascular disease, renal disease, and respiratory diseases such as asthma and chronic obstructive pulmonary disorder. Human bodies cool themselves primarily through sweating and through increasing blood flow to body surfaces. Heat events thus increase stress on cardiovascular, renal, and respiratory systems, and may lead to hospitalization or death in the elderly and those with pre-existing diseases. Massachusetts has a very high prevalence of asthma: approximately 1 out of every 11 people in the state currently has asthma (Mass.gov, n.d.). In Massachusetts, poor air quality often accompanies heat events, as increased heat increases the conversion of ozone precursors in fossil fuel combustion emissions to ozone. Particulate pollution may also accompany hot weather, as the weather patterns that bring heat waves to the region may carry pollution from other areas of the continent. Poor air quality can negatively affect respiratory and cardiovascular systems and can exacerbate asthma and trigger heart attacks.

Built Environment

All elements of the built environment are exposed to the extreme temperature hazard, including state-owned critical facilities. The impacts of extreme heat on buildings include: increased thermal stresses on building materials, which leads to greater wear and tear and reduces a building’s useful lifespan; increased air-conditioning demand to maintain a comfortable temperature; overheated heating, ventilation, and air-conditioning systems; and disruptions in service associated with power outages (ResilientMA, 2018). Extreme cold can cause materials such as plastic to become less pliable, increasing the potential for these materials to break down during extreme cold events (resilient MA, 2018). In addition to the facility-specific impacts, extreme temperatures can impact critical infrastructure sectors of the built environment in a number of ways, which are summarized in the subsections that follow.

Extreme cold temperature events can damage buildings through freezing or bursting pipes and freeze and thaw cycles. Additionally, manufactured buildings (trailers and mobile homes) and antiquated or poorly constructed facilities may not be able to withstand extreme temperatures. The heavy snowfall and ice storms associated with extreme cold temperature events can also cause power interruptions. Backup power is recommended for critical facilities and infrastructure.

Extreme heat has potential impacts on the design and operation of the transportation system. Impacts on the design include the instability of materials, particularly pavement, exposed to high temperatures over longer periods of time, which can cause buckling and lead to increased failures (MassDOT, 2017). High heat can cause pavement to soften and expand, creating ruts, potholes, and jarring, and placing additional stress on bridge joints. Extreme heat may cause heat stress in materials such as asphalt and increase the frequency of repairs and replacements (resilient MA, 2018). Similar effects can occur as the result of freezing and thawing cycles that cause what is known as a frost heave in the pavement. Frost heaves are significant hazards to drivers and railways, as they can make roads and tracks uneven.

Railroad tracks can expand in extreme heat, causing the track to “kink” and derail trains. Higher temperatures inside the enclosure-encased equipment, such as traffic control devices and signal control systems for rail service, may result in equipment failure (MEMA & EOEEA, 2018).

Natural Environment

There are numerous ways in which changing temperatures will impact the natural environment. Because the species that exist in a given area have adapted to survive within a specific temperature range, extreme temperature events can place significant stress both on individual species and the ecosystems in which they function. High-elevation spruce-fir forests, forested boreal swamp, and higher-elevation northern hardwoods are likely to be highly vulnerable to climate change (MCCS and DFW, 2010). Higher summer temperatures will disrupt wetland hydrology. Paired with a higher incidence and severity of droughts, high temperatures and evapotranspiration rates could lead to habitat loss and wetlands drying out (MCCS and DFW, 2010). Individual extreme weather events usually have a limited long-term impact on natural systems, although unusual frost events occurring after plants begin to bloom in the spring can cause significant damage. However, the impact on natural resources of changing average temperatures and the changing frequency of extreme climate events is likely to be massive and widespread. Climate change is anticipated to be the second-greatest contributor to this biodiversity crisis, which is predicted to change global land use. One significant impact of increasing temperatures may be the northern migration of plants and animals. Over time, shifting habitat may result in a geographic mismatch between the location of conservation land and the location of critical habitats and species the conserved land was designed to protect. Between 1999 and 2018 (fiscal years), the Commonwealth spent more than $395 million on the acquisition of more than 143,033 acres of land and has managed this land under the assumption of a stable climate. As species respond to climate change, they will likely continue to shift their ranges or change their phenologies to track optimal conditions (MCCS and DFW, 2010). As a result, climate change will have significant impacts on traditional methods of wildlife and habitat management, including land conservation and mitigation of non-climate stressors (MCCS and DFW, 2010). Changing temperatures, particularly increasing temperatures, will also have a major impact on the sustainability of our waterways and the connectivity of aquatic habitats (i.e., entire portions of major rivers will dry up, limiting fish passage down the rivers). Additional impacts of warming temperatures include the increased survival and grazing damage of white-tailed deer, increased invasion rates of invasive plants, and increased survival and productivity of insect pests, which cause damage to forests (MCCS and DFW, 2010). As temperature increases, the length of the growing season will also increase. Since the 1960s, the growing season in Massachusetts increased by approximately 10 days (CAT, n.d. as cited in MEMA & EOEEA, 2018).

Climate change is also likely to result in a shift in the timing and durations of various seasons. This change will likely have repercussions on the life cycles of both flora and fauna within the Commonwealth. While there could be economic benefits from a lengthened growing season, a lengthened season also carries a number of risks. The probability of frost damage will increase, as the earlier arrival of warm temperatures may cause many trees and flowers to blossom prematurely only to experience a subsequent frost. Additionally, pests and diseases may also have a greater impact in a drier world, as they will begin feeding and breeding earlier in the year (Land Trust Alliance, n.d. as cited in MEMA & EOEEA, 2018).

Economy 44 CFR § 201.6(c)(2)(i)(B)

The agricultural industry is most directly at risk in terms of economic impact and damage due to extreme temperature and drought events. Extreme heat can result in drought and dry conditions, which directly impact livestock and crop production. Increasing average temperatures may make crops more susceptible to invasive species (see Section 4.3.3 for additional information). Higher temperatures that result in greater concentrations of ozone negatively impact plants that are sensitive to ozone (USGCRP, 2009). Additionally, as previously described, changing temperatures can impact the phenology.

Above average, below average, and extreme temperatures are likely to impact crops—such as apples, cranberries, and maple syrup—that rely on specific temperature regimes (resilient MA, 2018). Unseasonably warm temperatures in early spring that are followed by freezing temperatures can result in crop loss of fruit-bearing trees. Farmers may have the opportunity to introduce new crops that are viable under warmer conditions and longer growing seasons; however, a transition such as this may be costly (resilient MA, 2018 as cited in MEMA & EOEEA, 2018). Livestock are also impacted, as heat stress can make animals more vulnerable to disease, reduce their fertility, and decrease the rate of milk production. Additionally, scientists believe the use of parasiticides and other animal treatments may increase as the threat of invasive species grows. Increased use of these treatments increases the risk of pesticides entering the food chain and could result in pesticide resistance, which could result in additional economic impacts on the agricultural industry (MEMA & EOEEA, 2018).

Future Conditions

Temperature changes will be gradual over the years. However, for the extremes, meteorologists can accurately forecast event development and the severity of the associated conditions with several days lead time. High, low, and average temperatures in Massachusetts are all likely to increase significantly over the next century as a result of climate change. This gradual change will put long-term stress on a variety of social and natural systems and will exacerbate the influence of discrete events (MEMA & EOEEA, 2018).

Tornadoes/High Wind

Hazard Profile

MVP Workshop stakeholders identified wind as a top hazard in the planning process, particularly concerns over trees taking out powerlines.

Likely Severity

Tornadoes are potentially the most dangerous of local storms. If a major tornado were to strike damage could be significant, particularly if there is a home or other facility in its path. Many people could be displaced for an extended period of time; buildings could be damaged or destroyed; businesses could be forced to close for an extended period of time or even permanently; and routine services, such as telephone or power, could be disrupted.

The NWS rates tornadoes using the Enhanced Fujita scale (EF scale), which does not directly measure wind speed but rather the amount of damage created. This scale derives 3-second gusts estimated at the point of damage based on the assignment of 1 out of 8 degrees of damage to a range of different structure types. These estimates vary with height and exposure. This method is considerably more sophisticated than the original Fujita scale, and it allows surveyors to create more precise assessments of tornado severity.

Probability

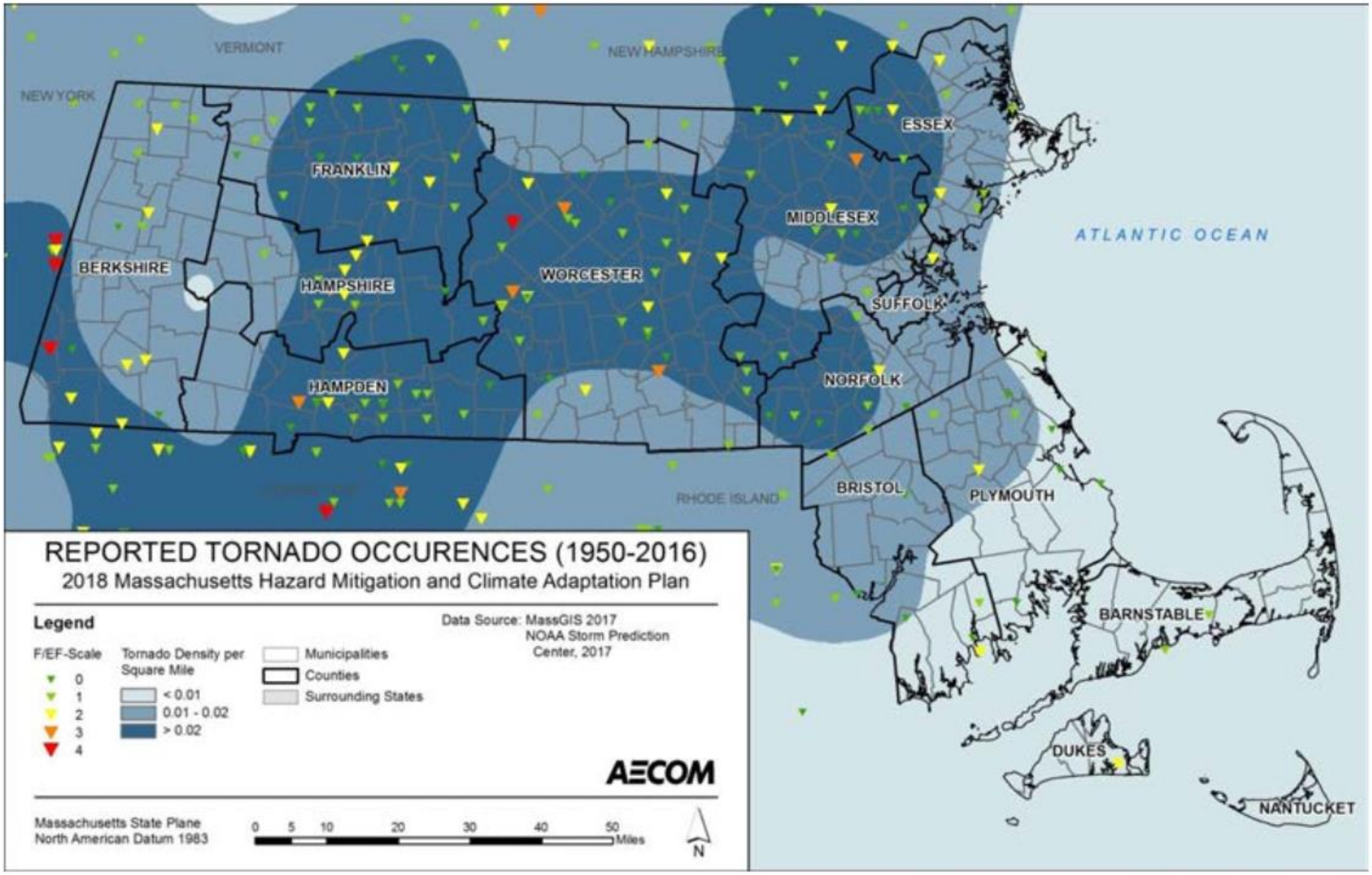
The location of tornado impact is totally unpredictable. Tornadoes are fierce phenomena which generate wind funnels of up to 200 MPH or more, and occur in Massachusetts usually during June, July, and August. Worcester County, and areas just to its west have been dubbed the "tornado alley" of the state, as the majority of significant tornadoes in Massachusetts weather history have occurred in that region (BRPC, 2012).

From 1950 to 2017, the Commonwealth experienced 171 tornadoes, or an average annual occurrence of 2.6 tornado events per year. In the last 20 years, the average frequency of these events has been 1.7 events per year (NOAA, 2018). Massachusetts experienced an average of 1.4 tornadoes per 10,000 square feet annually between 1991 and 2010, less than half of the national average of 3.5 tornadoes per 10,000 square feet per year (NOAA, n.d. as cited in MEMA & EOEEA, 2018).

Geographic Areas Likely Impacted

While the area impacted by a tornado will be limited at the time of the event, anywhere in Lenox is susceptible. Figure 3.15 is show tornadoes reported in Massachusetts.

Figure 3.17: Density of Reported Tornadoes per Square Mile



Historic Data

The National Climatic Data Center reports data on tornado events and does so as far back as 1950. 18 tornados have occurred in Berkshire County between 1950 and 2020. Four tornados occurred during a single storm on July 3, 1997. These have resulted in over $29 million in damage, seven deaths, and 60+ injuries (NOAA, 2017). The most memorable tornados in recent history occurred in West Stockbridge in August of 1973 (category F4) and in Great Barrington, Egremont, and Monterey in May of 1995 (category F4). In the West Stockbridge tornado four people died and 36 were injured, and in Great Barrington three people died and 24 were injured. The signs of the tornado's destruction are still visible today in Great Barrington from Rt. 7. The hill to the east is scarred where the tornado uprooted and toppled trees (MEMA & EOEEA, 2018).

Vulnerability Assessment

People

In general, vulnerable populations include people over the age of 65, people with low socioeconomic status, people with low English language fluency, people with compromised immune systems, and residents living in areas that are isolated from major roads. Power outages can be life-threatening to those who are dependent on electricity for life support and can result in increased risk of carbon monoxide poisoning. Individuals with limited communication capacity, such as those with limited internet or phone access, may not be aware of impending tornado warnings. The isolation of these populations is also a significant concern, as is the potential insufficiency of older or less stable housing to offer adequate shelter from tornadoes (MEMA & EOEEA, 2018).

Built Environment

All critical facilities and infrastructure are exposed to tornado events. High winds could down power lines and poles adjacent to roads (resilient MA, 2018). Damage to aboveground transmission infrastructure can result in extended power outages. Incapacity and loss of roads and bridges are the primary transportation failures resulting from tornadoes, and these failures are primarily associated with secondary hazards, such as landslide events. Tornadoes can cause significant damage to trees and power lines, blocking roads with debris, incapacitating transportation, isolating populations, and disrupting ingress and egress. Of particular concern are bridges and roads providing access to isolated areas and to the elderly. The hail, wind, debris, and flash flooding associated with tornadoes can cause damage to infrastructure, such as storage tanks, hydrants, residential pumping fixtures, and distribution systems. This can result in loss of service or reduced pressure throughout the system. Water and wastewater utilities are also vulnerable to potential contamination due to chemical leaks from ruptured containers. Ruptured service lines in damaged buildings and broken hydrants can lead to loss of water and pressure (EPA, 2015 as cited in MEMA & EOEEA, 2018).

Natural environment

Direct impacts may occur to flora and fauna small enough to be uprooted and transported by the tornado. Even if the winds are not sufficient to transport trees and other large plants, they may still uproot them, causing significant damage to the surrounding habitat. As felled trees decompose, the increased dry matter may increase the threat of wildfire in vegetated areas. Additionally, the loss of root systems increases the potential for soil erosion. Disturbances created by blowdown events may also impact the biodiversity and composition of the forest ecosystem. Invasive plant species are often able to quickly capitalize on the resources (such as sunlight) available in disturbed and damaged ecosystems. This enables them to gain a foothold and establish quickly with less competition from native species. In addition to damaging existing ecosystems, material transported by tornadoes can also cause environmental havoc in surrounding areas. Particular challenges are presented by the possibility of asbestos-contaminated building materials or other hazardous waste being transported to natural areas or bodies of water, which could then become contaminated. Public drinking water reservoirs may also be damaged by widespread winds uprooting watershed forests and creating serious water quality disturbances.

Economy

Forestry species and agricultural crops, equipment, and infrastructure may be directly impacted by tornadoes. Tornado events are typically localized; however, in those areas, economic impacts can be significant. Types of impacts may include loss of business functions, water supply system damage, damage to inventories, relocation costs, wage losses, and rental losses due to the repair or replacement of buildings. Recovery and clean-up costs can also be costly. The damage inflicted by historical tornadoes in Massachusetts varies widely, but the average damage per event is approximately $3.9 million.

Future Conditions

As highlighted in the National Climate Assessment, tornado activity in the U.S. has become more variable, and increasingly so in the last 2 decades. While the number of days per year that tornadoes occur has decreased, the number of tornadoes on these days has increased. Climate models show projections that the frequency and intensity of severe thunderstorms (which include tornadoes, hail, and winds) will increase (USGCRP, 2017 as cited in MEMA & EOEEA, 2018).

Landslides

Hazard Profile

The term landslide includes a wide range of ground movements, such as rock falls, deep failure of slopes, and shallow debris flows. The most common types of landslides in Massachusetts include translational debris slides, rotational slides, and debris flows. Most of these events are caused by a combination of unfavorable geologic conditions (silty clay or clay layers contained in glaciomarine, glaciolacustrine, or thick till deposits), steep slopes, and/or excessive wetness leading to excess pore pressures in the subsurface (MEMA & EOEEA, 2018).

Likely Severity

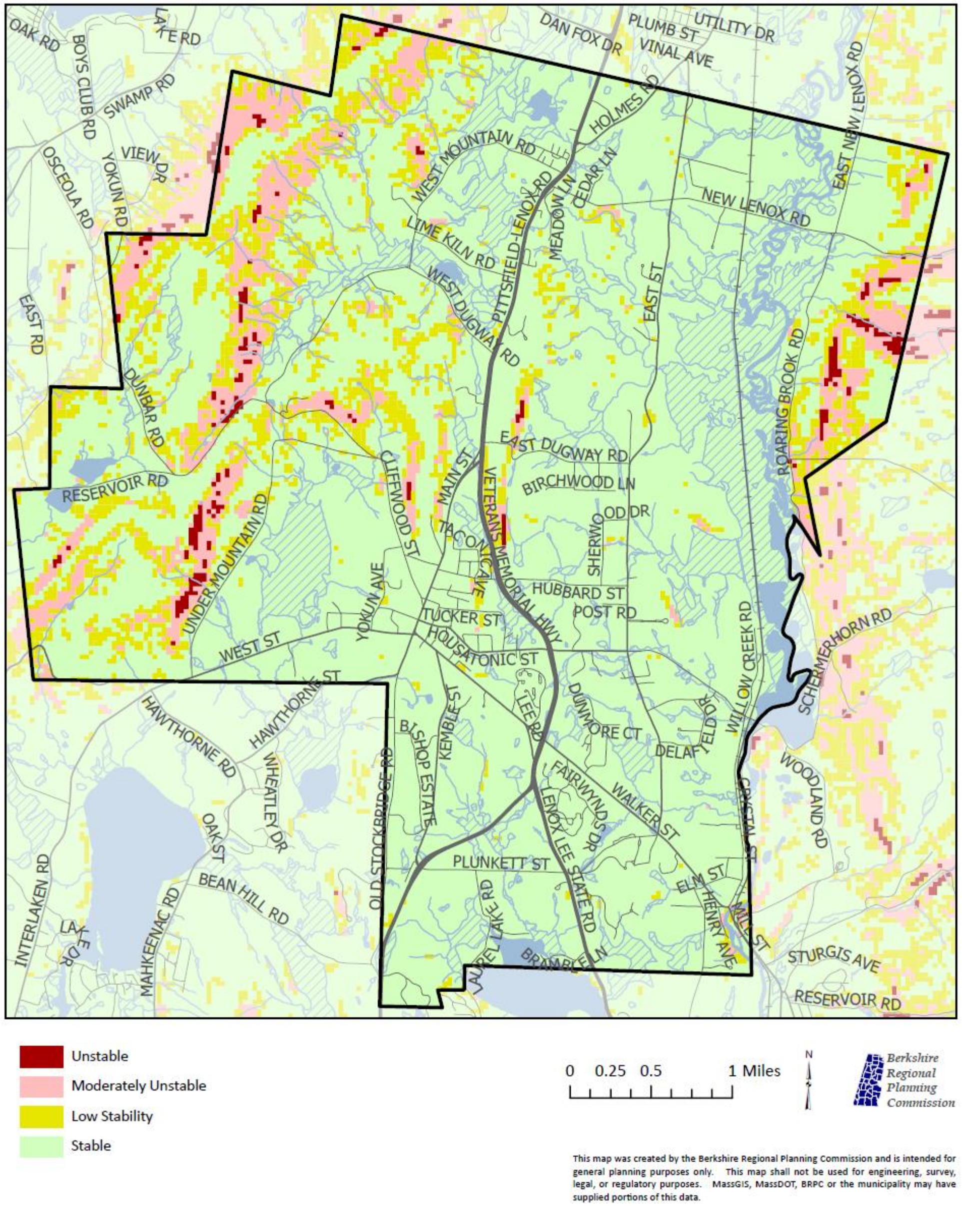
Natural variables that contribute to the overall extent of potential landslide activity in any particular area include soil properties, topographic position and slope, and historical incidence. Predicting a landslide is difficult, even under ideal conditions (MEMA & EOEEA, 2018). The Town of Lenox did not rank damages of landslides as severe relative to other hazards because it is likely to impact a very small area that may or more likely will not have structures. estimations of the potential severity of landslides are informed by previous occurrences as well as an examination of landslide susceptibility. Information about previous landslides provide insight as to both where landslides may occur and what types of damage may result. It is important to note, however, that landslide susceptibility only identifies areas potentially affected and does not imply a time frame when a landslide might occur (MEMA & EOEEA, 2018).

Probability

The probability of instability metric indicates how likely each area is to be unstable. In 2013, the Massachusetts Geological Survey prepared an updated map of potential landslide hazards for the Commonwealth (funded by FEMA's Hazard Mitigation Grant Program) to provide the public, local governments, and emergency management agencies with the location of areas where slope movements have occurred or may possibly occur in the future under conditions of prolonged moisture and high-intensity rainfall (MEMA & EOEEA, 2018). Using the data prepared for Massachusetts, a color-coded map of slope stability was prepared for Lenox, which can be used to roughly predict areas prone to landslide. This study is discussed further later in the landslide section of this plan.

For the purposes of this HMP, the probability of future occurrences is defined by the number of events over a specified period of time. Looking at the recent record, from 1996 to 2012, there were eight noteworthy events that triggered one or more slides in the Commonwealth. However, because many landslides are minor and occur unobserved in remote areas, the true number of landslide events is probably higher. Based on conversations with the Massachusetts Department of Transportation (MassDOT), it is estimated that about 30 or more landslide events occurred in the period between 1986 and 2006 (Hourani, 2006). This roughly equates to one to three landslide events each year.

Figure 3.19: Lenox Slope Stability - Landslide Map



Generally accepted warning signs for landslide activity include the following:

- Springs, seeps, or saturated ground in previously dry areas
- New cracks or unusual bulges in the ground
- Soil moving away from foundations
- Ancillary structures, such as decks and patios, tilting and/or moving relative to the main house
- Tilting or cracking of concrete floors and foundations
- Broken waterlines and other underground utilities
- Leaning telephone poles, trees, retaining walls, or fences
- Offset fence lines
- Sunken or down-dropped road beds
- Rapid increase in creek water levels, possibly accompanied by increased turbidity (soil content)
- Sudden decrease in creek water levels even though rain is still falling or has just recently stopped
- Sticking doors and windows, and visible open spaces indicating jambs and frames out of plumb
- A faint rumbling that increases in volume as the landslide nears
- Unusual sounds, such as trees cracking or boulders knocking together (MEMA & EOEEA, 2018

Geographic Areas Likely Impacted

Although specific landslide events cannot be predicted, a slope stability map shows where slope movements are most likely to occur after periods of high-intensity rainfall. Unstable areas are located throughout the Commonwealth. The highest prevalence of unstable slopes is generally found in the western portion of the Commonwealth, including the area around Mount Greylock and the nearby portion of the Deerfield River, the U.S. Highway 20 corridor near Chester, as well as the main branches of the Westfield River (MEMA & EOEEA, 2018). Figure 3.19 shows slope stability in Lenoc. The color-coded map delineates relative hazard rankings (high, moderate, low and very low) for the initiation of naturally occurring, shallow, translational slope movements (debris flows, debris avalanches, mudslides). These rankings are based on the severity of the slope, various soil parameters and the response of that landscape to rainfall that leads to saturated conditions (relative wetness index). The four relative hazard rankings are generalized from six stability zones[9]. The red areas on the map indicating unstable to the upper threshold of instability for the Predicated Stability Zone. Pink shows the lower threshold of instability. Mustard yellow is nomically stable or moderately stable, which would require minor to moderate destabilizing factors for instability. Green represents the stable areas, which would require significant destabilizing factors to cause instability. Areas with high to moderate hazard rankings are areas where further slope stability analysis and assessment, including field verification, is recommended before any ground disturbance[10].

Landslides associated with slope saturation occur predominantly in areas with steep slopes underlain by glacial till or bedrock. Bedrock is relatively impermeable relative to the unconsolidated material that overlies it. Similarly, glacial till is less permeable than the soil that forms

[9,10] http://www.geo.umass.edu/stategeologist/Products/Landslide_Map/Slope_Stability_Map_MA_Report.pdf?_ga=2.218289625.1917141679.1562177934-548417844.1562177934

above it. Thus, there is a permeability contrast between the overlying soil and the underlying, and less permeable, unweathered till and/or bedrock. Water accumulates on this less permeable layer, increasing the pore pressure at the interface. This interface becomes a plane of weakness. If conditions are favorable, failure will occur (Mabee, 2010 as cited in MEMA & EOEEA, 2018). Occasionally, landslides occur as a result of geologic conditions and/or slope saturation. Adverse geologic conditions exist wherever there are lacustrine or marine clays, as clays have relatively low strength. These clays often formed in the deepest parts of the glacial lakes that existed in Massachusetts following the last glaciation. Landslides can also be caused by external forces, including both undercutting (due to flooding) and construction. Construction-related failures occur predominantly in road cuts excavated into glacial till where topsoil has been placed on top of the till. Examples can be found along the Massachusetts Turnpike. Other construction-related failures occur in utility trenches excavated in materials that have very low cohesive strength and an associated high-water table (usually within a few feet of the surface). This situation occurs in sandy deposits with very few fine sediments and can occur in any part of the Commonwealth (MEMA & EOEEA, 2018).

Historic Data

Historical landslide data for the Commonwealth suggests that most landslides are preceded by 2 or more months of higher than normal precipitation, followed by a single, high-intensity rainfall of several inches or more (Mabee and Duncan, 2013). This precipitation can cause slopes to become saturated. In Massachusetts, landslides tend to be more isolated in size and pose threats to high traffic roads and structures that support tourism, and general transportation. Landslides commonly occur shortly after other major natural disasters, such as earthquakes and floods, which can exacerbate relief and reconstruction efforts. Many landslide events may have occurred in remote areas, causing their existence or impact to go unnoticed. Expanded development and other land uses may contribute to the increased number of landslide incidences and/or the increased number of reported events in the recent record (MEMA & EOEEA, 2018).

The most severe landslide to occur in the Berkshire region occurred along Route 2 in Savoy during T.S. Irene in 2011. The slide was 900 feet long, approximately 1.5 acres, with an average slope angle is 28 to 33°. The elevation difference from the top of the slide to the bottom was 460 feet, with an estimated volume of material moved being 5,000 cubic yards. Only the top 2 to 4 feet of soil material was displaced (BRPC, 2012).

Vulnerability Assessment

People

Populations who rely on potentially impacted roads for vital transportation needs are considered to be particularly vulnerable to this hazard. The number of lives endangered by the landslide hazard is increasing due to the state's growing population and the fact that many homes are built on property atop or below bluffs or on steep slopes subject to mass movement. People in landslide hazard zones are exposed to the risk of dying during a large-scale landslide; however, damage to infrastructure that impedes emergency access and access to health care is the largest health impact associated with this hazard. Mass movement events in the vicinity of major roads could deposit many tons of sediment and debris on top of the road. Restoring vehicular access is often a lengthy and expensive process. Additionally, landslides can result in injury and loss of life. Landslides can impact access to power and clean water and increase exposure to vector-borne diseases.

Built Environment

According to the building maps available, Lenox does not have any buildings within areas designated as unstable, shown as red on the map. There are 7 buildings within areas designated at moderately unstable, the pink areas on the map. Through the hazard mitigation planning process, the Town decided to utilize slope stability data for future development decisions.

Landslides can result in direct losses as well as indirect socioeconomic losses related to damaged infrastructure. Infrastructure located within areas shown as unstable on the Slope Stability Map should be considered to be exposed to the landslide hazard. Highly vulnerable areas include mountain roads and transportation infrastructure, both because of their exposure to this hazard and the fact that there may be limited transportation alternatives if this infrastructure becomes unusable. Mass movements can knock out bridge abutments or significantly weaken the soil supporting them, making them hazardous for use. Access to major roads is crucial to life safety after a disaster event and to response and recovery operations. The ability of emergency responders to reach people and property impacted by landslides can be impaired by roads that have been buried or washed out by landslides. The instability of areas where landslides have occurred can also limit the ability of emergency responders to reach survivors.

The energy sector is vulnerable to damaged infrastructure associated with landslides. Transmission lines are generally elevated above steep slopes, but the towers supporting them can be subject to landslides. A landslide may cause a tower to collapse, bringing down the lines and causing a transmission fault. Transmission faults can cause extended and broad area outages (MEMA & EOEEA, 2018).

Surface water bodies may become directly or indirectly contaminated by landslides. Landslides can reduce the flow of streams and rivers, which can result in upstream flooding and reduced downstream flow. This may impact the availability of drinking water (MEMA & EOEEA, 2018).

Natural Environment

Landslides can affect a number of different facets of the environment, including the landscape itself, water quality, and habitat health. Following a landslide, soil and organic materials may enter streams, reducing the potability of the water and the quality of the aquatic habitat. Additionally, mass movements of sediment may result in the stripping of forests, which in turn impacts the habitat quality of the animals that live in those forests (Geertsema and Vaugeouis, 2008 as cited in MEMA & EOEEA, 2018). Flora in the area may struggle to re-establish following a significant landslide because of a lack of topsoil.

Economy

Direct costs of landslide include the actual damage sustained by buildings, property, and infrastructure. Indirect costs, such as clean-up costs, business interruption, loss of tax revenues, reduced property values, and loss of productivity are difficult to measure. Additionally, ground failure threatens transportation corridors, fuel and energy conduits, and communication lines (USGS, 2003 as cited in MEMA & EOEEA, 2018). Landslides that affect farmland can result in significant loss of livelihood and long-term loss of productivity. Forests can also be significantly impacted by landslides.

Future Conditions

Increased precipitation, severe weather events and other effects of climate change affecting Lenox and the great region may lead to a higher likelihood for landslides as soil and vegetative cover are impacted. Overall Lenox is at low risk of damages due to landslide, however further development of unstable slopes could prove to be detrimental.

Hazard Profile

A wildfire can be defined as any non-structure fire that occurs in vegetative wildland that contains grass, shrub, leaf litter, and forested tree fuels. Wildfires in Massachusetts are caused by natural events, human activity, or prescribed fire. Wildfires often begin unnoticed but spread quickly, igniting brush, trees, and potentially homes (MEMA & EOEEA, 2018).

Likely severity

Relative to the likely severity on a national scale for wildfire impacts, Lenox is at a relatively low risk. The “wildfire behavior triangle” reflects how three primary factors influence wildfire behavior: fuel, topography, and weather. Each point of the triangle represents one of the three factors, and arrows along the sides represent the interplay between the factors. For example, drier and warmer weather with low relative humidity combined with dense fuel loads and steeper slopes can result in dangerous to extreme fire behavior. How a fire behaves primarily depends on the characteristics of available fuel, weather conditions, and terrain.

Fuel:

−Lighter fuels such as grasses, leaves, and needles quickly expel moisture and burn rapidly, while heavier fuels such as tree branches, logs, and trunks take longer to warm and ignite.

−Snags and hazard trees, especially those that are diseased or dying, become receptive to ignition when influenced by environmental factors such as drought, low humidity, and warm temperatures.

Weather:

−Strong winds, especially wind events that persist for long periods or ones with significant sustained wind speeds, can exacerbate extreme fire conditions or accelerate the spread of wildfire.

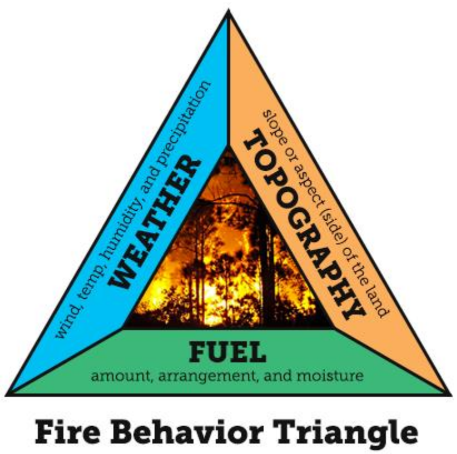
−Dry spring and summer conditions, or drought at any point of the year, increases fire risk. Similarly, the passage of a dry, cold front through the region can result in sudden wind speed increases and changes in wind direction.

−Thunderstorms in Massachusetts are usually accompanied by rainfall; however, during periods of drought, lightning from thunderstorm cells can result in fire ignition. Thunderstorms with little or no rainfall are rare in New England but have occurred.

Terrain

−Topography of a region or a local area influences the amount and moisture of fuel.

−Barriers such as highways and lakes can affect the spread of fire.



Source: WeatherSTEM.com

−Elevation and slope of landforms can influence fire behavior because fire spreads more easily uphill compared to downhill.

Probability

It is difficult to predict the likelihood of wildfires in a probabilistic manner because a number of factors affect fire potential and because some conditions (e.g., ongoing land use development patterns, location, and fuel sources) exert changing pressure on the wildland-urban interface zone. However, based on the frequency of past occurrences, there will likely be at least one notable wildfire in the Commonwealth each year, narrowing down the probably of Lenox being affected even lower. Brush fires that are routinely handled by the local fire department are much more common.

Geographic Areas Likely Impacted

Lenox is potentially vulnerable to wildfire across the municipality. Fire risk and associated damages increases where there is a mix of development and forested land. While the risk of fire is relatively low for Lenox compared to the Commonwealth, there is some hazard still posed by wildfire. Given increasing temperature and evaporation, drought and forest fire concerns are growing because of the potential for more fuel in forested land.

The ecosystems that are most susceptible to the wildfire hazard are pitch pine, scrub oak, and oak forests, as these areas contain the most flammable vegetative fuels. Other portions of the Commonwealth are also susceptible to wildfire, particularly at the urban-wildland interface. The SILVIS Lab at the University of Wisconsin-Madison Department of Forest Ecology and Management classifies exposure to wildlife hazard as "interface" or "intermix." Intermix communities are those where housing and vegetation intermingle and where the area includes more than 50 percent vegetation and has a housing density greater than one house per 16 hectares (approximately 6.5 acres). Interface communities are defined as those in the vicinity of contiguous vegetation, with more than one house per 40 acres and less than 50 percent vegetation, and within 1.5 miles of an area of more than 500 hectares (approximately 202 acres) that is more than 75 percent vegetated. Inventoried assets (population, building stock, and critical facilities) were overlaid with interface data to determine potential exposure and impacts related to this hazard, and can be seen in Figure 3.20 (MEMA & EOEEA, 2018). Figure 3.21 shows the results of a geospatial analysis of fire risk by the Northeast Wildfire Risk Assessment Geospatial Work Group.

Figure 3.20: Wildland-Urban Interface and Intermix for the Commonwealth of Massachusetts

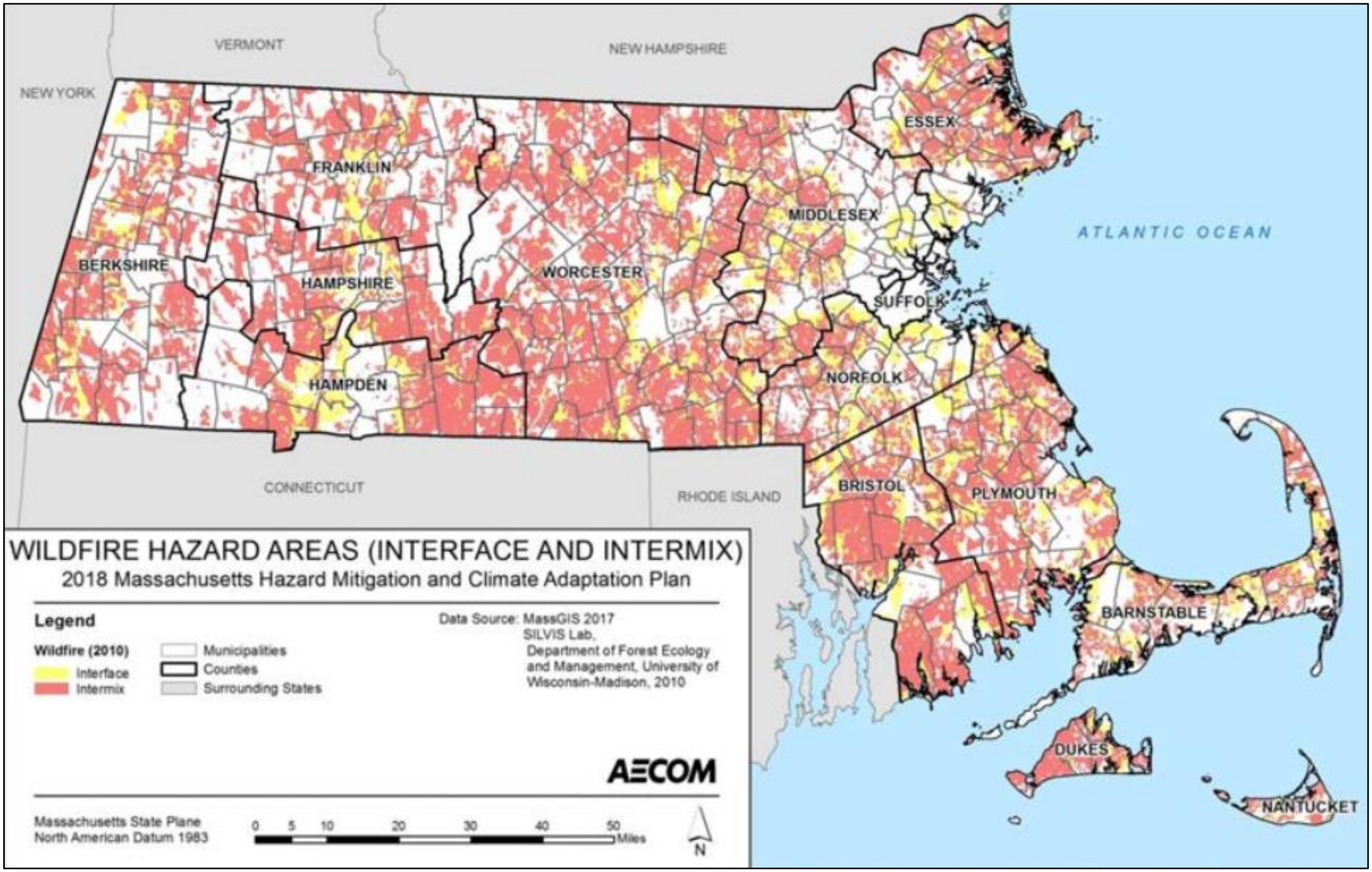
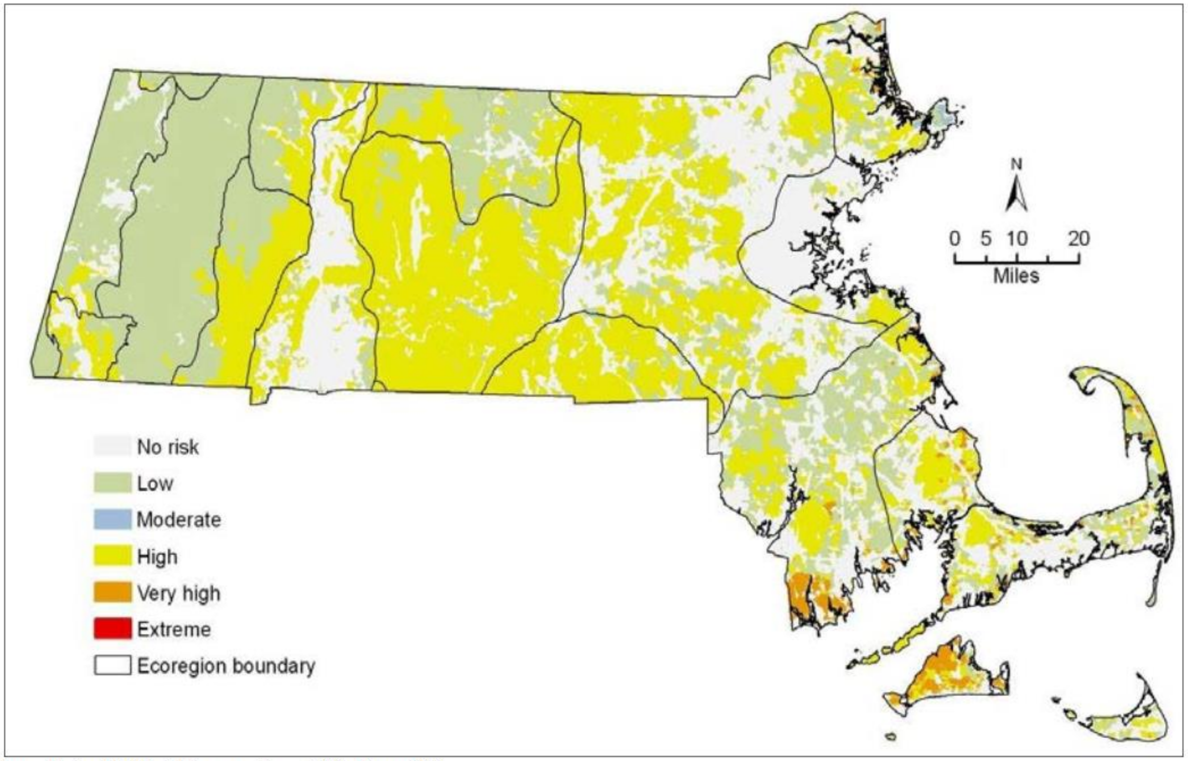


Figure 3.21: Wildfire Risk Areas for the Commonwealth of Massachusetts



Source: Northeast Wildfire Risk Assessment Geospatial Work Group, 2009

Historic Data

The wildfire season in Massachusetts usually begins in late March and typically culminates in early June, corresponding with the driest live fuel moisture periods of the year. April is historically the month in which wildfire danger is the highest. Drought, snowpack level, and local weather conditions can impact the length of the fire season (MEMA & EOEEA, 2018).

Based on the DCR Bureau of Forest Fire Control and Forestry records, in 1911, more than 34 acres were burned on average during each wildfire statewide. Since then, that figure has been reduced to 1.17 acres burned annually statewide (MEMA, 2013). According to the Massachusetts Fire Incident Reporting System, wildfires reported to DCR in the past five years are generally trending downward. According to this system there were 901 fire incidents, combined urban and wildland, in Berkshire County during the years 2007-2016, and of these 411 (46% of total) occurred in the City of Pittsfield, the urban center of the region. This same data reports that a total of 832 acres were burned in the county during those 10 years, 631 (76%) of which are reported as acres of wildland burned. This indicates that over this 10-year span an average of 63 acres of wildland burned annually in Berkshire County. Of the 901 incidents, only 12 burned more than 10 acres and two of these burned more than 100 acres. It should be noted that during this same time period there were two large wildland fires in the county: 168 acres in Lanesborough in 2008 and 272 acres in Clarksburg near the Williamstown border in 2015. If these incidents were considered statistic outliers and removed from the data, the average totaled burned acres during 2007-2016 would be 39 and the average wildland acres burned would be 19. Berkshire County fire officials respond rapidly through mutual aid and through a coordinated effort with the DCR.

Vulnerability Assessment

People

As demonstrated by historical wildfire events, potential losses from wildfire include human health and the lives of residents and responders. The most vulnerable populations include emergency responders and those within a short distance of the interface between the built environment and the wildland environment. In 2018 MEMA and EOEEA estimated the population vulnerable to the wildfire hazard by overlaying the interface and intermix hazard areas with the 2010 U.S. Census population data. The Census blocks identified as interface or intermix were used to calculate the estimated population exposed to the wildfire hazard. Interface or intermix areas are those where buildings intermingle with forest. In Berkshire County 131,219 persons were in Wildlife Hazard Areas. 55,486 in Interface areas, and 39,171 in Intermix areas.

All individuals whose homes or workplaces are located in wildfire hazard zones are exposed to this hazard, as wildfire behavior can be unpredictable and dynamic. However, the most vulnerable members of this population are those who would be unable to evacuate quickly, including those over the age of 65, households with young children under the age of 5, people with mobility limitations, and people with low socioeconomic status. Landowners with pets or livestock may face additional challenges in evacuating if they cannot easily transport their animals. Outside of the area of immediate impact, sensitive populations, such as those with compromised immune systems or cardiovascular or respiratory diseases, can suffer health impacts from smoke inhalation. Individuals with asthma are more vulnerable to the poor air quality associated with wildfire. Finally, firefighters and first responders are vulnerable to this hazard if they are deployed to fight a fire in an area they would not otherwise be in.

Smoke and air pollution from wildfires can be a severe health hazard. Smoke generated by wildfire consists of visible and invisible emissions containing particulate matter (soot, tar, and minerals), gases (water vapor, carbon monoxide, carbon dioxide (CO_2), and nitrogen oxides), and toxics (formaldehyde and benzene). Emissions from wildfires depend on the type of fuel, the moisture content of the fuel, the efficiency (or temperature) of combustion, and the weather. Other public health impacts associated with wildfire include difficulty in breathing, reactions to odor, and reduction in visibility. Due to the high prevalence of asthma in Massachusetts, there is a high incidence of emergency department visits when respiratory irritants like smoke envelop an area. Wildfires may also threaten the health and safety of those fighting the fires. First responders are exposed to dangers from the initial incident and the aftereffects of smoke inhalation and heat-related illness.

Built Environment

All buildings, municipal, residential, ancillary and utility are vulnerable to wildfire. Communications and electrical systems would be cut off by wildfire if affected at portion of the system. Drinking water for the Town would also be at risk of contamination. Most roads and railroads would be without damage except in the worst scenarios. However, fires can create conditions that block or prevent access, and they can isolate residents and emergency service providers. The wildfire hazard typically does not have a major direct impact on bridges, but wildfires can create conditions in which bridges are obstructed (MEMA & EOEEA, 2018).

Natural environment

Fire is a natural part of many ecosystems and serves important ecological purposes, including facilitating the nutrient cycling from dead and decaying matter, removing diseased plants and pests, and regenerating seeds or stimulating germination of certain plants. However, many wildfires, particularly man-made wildfires, can also have significant negative impacts on the environment. In addition to direct mortality, wildfires and the ash they generate can distort the flow of nutrients through an ecosystem, reducing the biodiversity that can be supported. Frequent wildfires can eradicate native plant species and encourage the growth of fire-resistant invasive species. Some of these invasive species are highly flammable; therefore, their establishment in an area increases the risk of future wildfires. There are other possible feedback loops associated with this hazard. For example, every wildfire contributes to atmospheric CO_2 accumulation, thereby contributing to global warming and increasing the probability of future wildfires (as well as other hazards). There are also risks related to hazardous material releases during a wildfire. During wildfires, containers storing hazardous materials could rupture due to excessive heat and act as fuel for the fire, causing rapid spreading of the wildfire and escalating it to unmanageable levels. In addition, these materials could leak into surrounding areas, saturating soils and seeping into surface waters to cause severe and lasting environmental damage (MEMA & EOEEA, 2018).

Economy

Wildfire events can have major economic impacts on a community, both from the initial loss of structures and the subsequent loss of revenue from destroyed businesses and a decrease in tourism. Individuals and families also face economic risk if their home is impacted by wildfire. The exposure of homes to this hazard is widespread. Additionally, wildfires can require thousands of taxpayer dollars in fire response efforts and can involve hundreds of operating hours on fire apparatus and thousands of man-hours from volunteer firefighters. There are also many direct and indirect costs to local businesses that excuse volunteers from work to fight these fires (MEMA & EOEEA, 2018).

Future Conditions

Climate change alter the weather and fuel factors of wildfires. Climate scenarios project summer temperature increases between 3°F and 9°F and precipitation increases of up 5 inches (Northeast Climate Science Center, 2018). Hot dry spells create the highest fire risk, due to decreased soil moisture and increased evaporation and evapotranspiration. While in general annual precipitation has slightly increased Massachusetts in the past decades, the timing of snow and rainfall is changing. Less snowfall can lead to drier soils earlier in the spring and possible drought conditions in summer. More of our rain is falling in downpours, with higher rates of runoff and less soil infiltration. Such conditions would exacerbate summer drought and further promote high elevation wildfires where soil depths are generally thin. Climate change also may increase winds that spread fires. Faster fires are harder to contain, and thus are more likely to expand into residential neighborhoods (MEMA, 2013).

- Without an increase in summer precipitation (greater than any predicted by climate models), future areas burned is very likely to increase.
- Infestation from insects is also a concern as it may affect forest health. Potential insect populations may increase with warmer temperatures and infested trees may increase fuel amount.
- Tree species composition will change as species respond uniquely to a changing climate.
- Wildfires cause both short-term and long-term losses. Short-term losses can include destruction of timber, wildlife habitat, scenic vistas, and watersheds. Long-term effects include smaller timber harvests, reduced access to affected recreational areas, and the destruction of cultural and economic resources and community infrastructure (MEMA, 2013).

Hazard Profile

Likely Severity

Tropical cyclones (tropical depressions, tropical storms, and hurricanes) form over the warm, moist waters of the Atlantic Ocean, Caribbean Sea, and Gulf of Mexico:

- A tropical depression is declared when there is a low-pressure center in the tropics with sustained winds of 25 to 33 mph.
- A tropical storm is a named event defined as having sustained winds from 34 to 73 mph.
- If sustained winds reach 74 mph or greater, the storm becomes a hurricane. The Saffir-Simpson scale ranks hurricanes based on sustained wind speeds—from Category 1 (74 to 95 mph) to Category 5 (156 mph or more). Category 3, 4, and 5 hurricanes are considered "major" hurricanes. Hurricanes are categorized based on sustained winds; wind gusts associated with hurricanes may exceed the sustained winds and cause more severe localized damage (NOAA, n.d.[b]).

When water temperatures are at least 80°F, hurricanes can grow and thrive, generating enormous amounts of energy, which is released in the form of numerous thunderstorms, flooding, rainfall, and very damaging winds. The damaging winds help create a dangerous storm surge in which the water rises above the normal astronomical tide. In the lower latitudes, hurricanes tend to move from east to west. However, when a storm drifts further north, the westerly flow at the mid-latitudes tends to cause the storm to curve toward the north and east. When this occurs, the storm may accelerate its forward speed. This is one of the reasons why some of the strongest hurricanes of record have reached New England (MEMA & EOEEA, 2018).

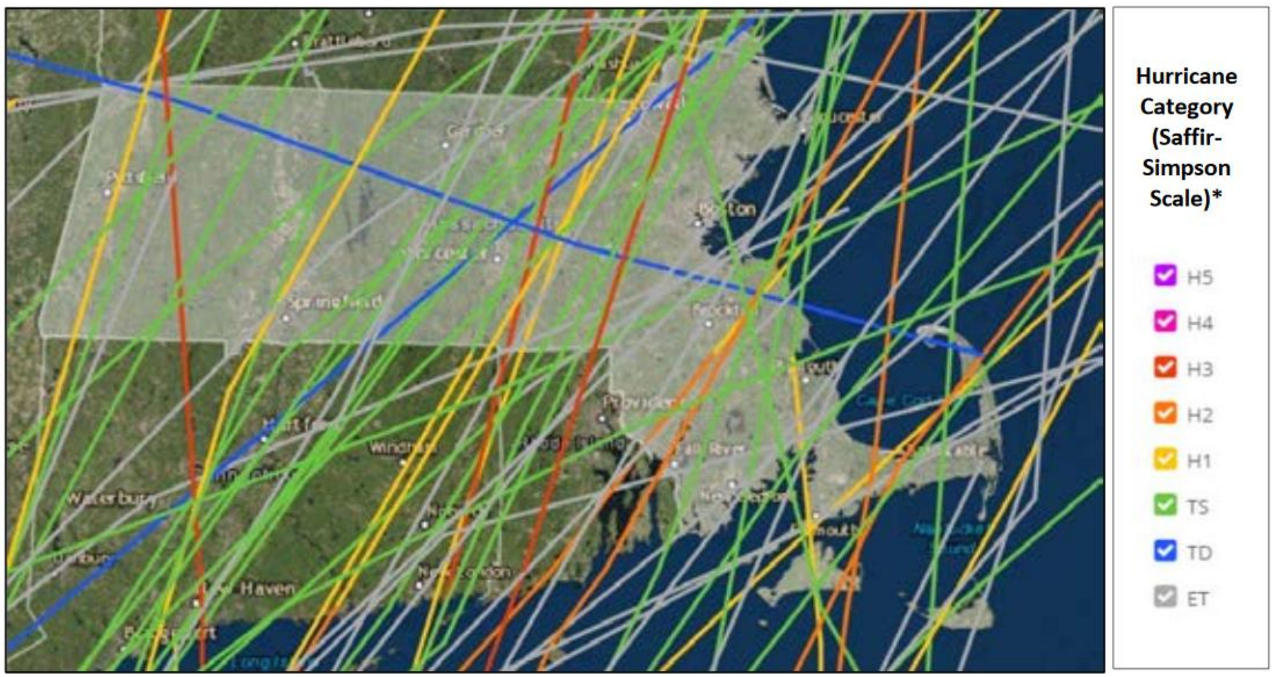
The severity of a hurricane is categorized by the Saffir-Simpson Hurricane Scale. This scale categorizes or rates hurricanes from 1 (Minimal) to 5 (Catastrophic) based on their intensity. This is used to give an estimate of the potential property damage and flooding expected along the coast from a hurricane landfall. Wind speed is the determining factor in the scale. In Berkshire County flooding tends to be the impact of greatest concern because hurricane-force winds here occur less often. Historical data show that most tropical storms and hurricanes that hit landfall in New England are seldom of hurricane force, and of those most are a category 1 hurricane. The category hurricanes that stand out are those from 1938 and 1954 (BRPC, 2012).

Probability

Based on past reported hurricane and tropical storm data, the region can expect a tropical depression, storm or hurricane to cross the region every 14.5 years.   However, the community may also be impacted by a tropical event whose path is outside of the region every 0.75 years. Based on past storm events and given that the center of the county is approximately 85 miles to the Long Island Sound and 115 miles to Boston Harbor, the Berkshires will continue to be impacted by hurricanes and tropical storms.

The NOAA Hurricane Research Division published a map showing the chance that a tropical storm or hurricane (of any intensity) will affect a given area during the hurricane season (June to November). This analysis was based on historical data from 1944 to 1999. Based on this analysis, the community has a 20-40% chance of a tropical storm or hurricane affecting the area each year (MEMA, 2013).

Figure 3.22: Historical Hurricane Paths within 65 miles of Massachusetts



Source: NOAA, n.d. as cited in MEMA & EOEEA, 2018 (*TS= Tropical Storm, TD = Tropical Depression)

The official hurricane season runs from June 1 to November 30. In New England, these storms are most likely to occur in August, September, and the first half of October. This is due in large part to the fact that it takes a considerable amount of time for the waters south of Long Island to warm to the temperature necessary to sustain the storms this far north. Also, as the region progresses into the fall months, the upper-level jet stream has more dips, meaning that the steering winds might flow from the Great Lakes southward to the Gulf States and then back northward up the eastern seaboard. This pattern would be conducive for capturing a tropical system over the Bahamas and accelerating it northward.

Geographic Areas Likely Impacted

The entire Commonwealth is vulnerable to hurricanes and tropical storms, depending on each storm's track. The coastal areas are more susceptible to damage due to the combination of both high winds and tidal surge. Inland areas, especially those in floodplains, are also at risk for flooding from heavy rain and wind damage. The majority of the damage following hurricanes and tropical storms often results from residual wind damage and inland flooding, as was demonstrated during recent tropical storms. Historic storm tracks can be seen in the NOAA graphic, figure 3.22. The graphic shows tracks that have cut through Lenox.

Historic Data

The National Oceanic and Atmospheric Administration (NOAA) has been keeping records of hurricanes since 1842 (Table 3.9). From 1842 to 2018, there have been five (5) Tropical Depressions, five (5) Tropical Storms, one (1) Category 1 Hurricane and one (1) Category 2 Hurricane pass directly through Berkshire County.

Table 3.9: Tropical Depressions, Storms, and Hurricanes Traveling Across Berkshire County

Name	Category	Date
Not Named	Tropical Depression	8/17/1867
Unnamed	Tropical Storm	9/19/1876
Unnamed	Tropical Depression	10/24/1878
Unnamed	Category 1 Hurricane	8/24/1893
Unnamed	Tropical Storm	8/29/1893
Unnamed	Tropical Depression	11/1/1899
Unnamed	Tropical Depression	9/30/1924
Unnamed	Category 2 Hurricane	9/21/1938
Able	Tropical Storm	9/1/1952
Gracie	Tropical Depression	10/1/1959
Doria	Tropical Storm	8/28/1971
Irene	Tropical Storm	8/28/2011

The Hurricane Floods of 1938 remains one of the most memorable historic storms. In 1940 the USGS wrote "The floods of September 1938 coming so shortly after the wide-spread floods of March 1936 and only 11 years after the New England flood of November 1927 have not only impressed upon the inhabitants of the affected regions the magnitude of the problem of controlling and confining the flood waters but have also indicated a prevailing frequency of occurrence that may have an important bearing on the economics of flood control. Each local, State, or Federal organization engaged in formulating plans for protective measures requires sound and adequate basic information relating to the stages, discharges, and other characteristics of all out-standing floods that have affected their particular areas." The hurricane came after 4 days of rainfall where streams were already at bankfull levels, pushing flood waters over the edge and into communities that had developed in the floodplain.

Hurricane Gloria caused extensive damage along the east coast of the U.S. and heavy rains and flooding in western Massachusetts in 1985. This event resulted in a federal disaster declaration (FEMA DR-751). In October 2005 the remnants of Tropical Storm Tammy followed by a subtropical depression produced significant rain and flooding across western Massachusetts. It was reported that between nine and 11 inches of rain fell. The heavy rainfall washed out many roads in Hampshire and Franklin Counties. The Green River flooded a mobile home park in Greenfield, with at least 70 people left homeless. Following these events, the mobile home park was demolished, and the site was turned into a town park. Localized flooding in Berkshire County was widespread, with several road washouts. This series of storms resulted in a federal disaster declaration (FEMA DR-1614) and Massachusetts received over $13 million in individual and public assistance. (MEMA, 2013)

Tropical Storm Irene (August 27-29, 2011) produced significant amounts of rain, storm surge, inland and coastal flooding, and wind damage across southern New England and much of the east coast of the U.S. In Massachusetts, rainfall totals ranged between 0.03 inches (Nantucket Memorial Airport) to 9.92 inches (Conway, MA). Wind speeds in Massachusetts ranged between 46 and 67 mph. These heavy rains caused flooding throughout the Commonwealth and a presidential disaster was declared (FEMA DR-4028). The Commonwealth received over $31 million in individual and public assistance from FEMA (MEMA, 2013)

Vulnerability Assessment

People

High winds from tropical storms and hurricanes can knock down trees, limbs and electric lines, can damage buildings, and send debris flying, leading to injury or loss of life. Economically distressed, elderly and other vulnerable populations are most susceptible, based on several factors including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. Populations that live or work in proximity to facilities that use or store toxic substances are at greater risk of exposure to these substances during a flood event such as near the railroad tracks, town garage, or transfer station.

The most vulnerable include people with low socioeconomic status, people over the age of 65, people with medical needs, and those with low English language fluency. For example, people with low socioeconomic status are likely to consider the economic impacts of evacuation when deciding whether to evacuate. Individuals with medical needs may have trouble evacuating and accessing needed medical care while displaced. Those who have low English language fluency may not receive or understand the warnings to evacuate. Findings reveal that human behavior contributes to flood fatality occurrences. For example, people between the ages of 10 and 29 and over 60 years of age are found to be more vulnerable to floods. During and after an event, rescue workers and utility workers are vulnerable to impacts from high water, swift currents, rescues, and submerged debris. Vulnerable populations may also be less likely to have adequate resources to recover from the loss of their homes and jobs or to relocate from a damaged neighborhood (MEMA & EOEEA, 2018).

Built Environment

Hurricanes and tropical storms can destroy homes with wind, flooding, or even fire that results from the destructive forces of the storm. Critical facilities are mostly impacted during a hurricane by flooding, and these impacts are discussed in the flooding section of this plan. Wind-related damages from downed trees, limbs, electricity lines and communications systems would be at risk during high winds. Local and state-owned police and fire stations, other public safety buildings, and facilities that serve as emergency operation centers may experience direct loss (damage) during a hurricane or tropical storm. Emergency responders may also be exposed to hazardous situations when responding to calls. Road blockages caused by downed trees may impair travel.

Heavy rains can lead to contamination of well water and can release contaminants from septic systems (DPH, 2014 as cited in MEMA & EOEEA, 2018). Additionally, hurricanes and tropical storms often result in power outages and contact with damaged power lines during and after a storm, which may result in electrocution.

Natural Environment

The environmental impacts of hurricanes and tropical storms are similar to those described for other hazards, including inland flooding, severe winter storms and other severe weather events. As the storm is occurring, flooding may disrupt normal ecosystem function and wind may fell trees and other vegetation. Additionally, wind-borne or waterborne detritus can cause mortality to animals if they are struck or transported to a non-suitable habitat. In the longer term, impacts to natural resources and the environment as a result of hurricanes and tropical storms are generally related to changes in the physical structure of ecosystems. For example, flooding may cause scour in riverbeds, modifying the river ecosystem and depositing the scoured sediment in another location. Similarly, trees that fall during the storm may represent lost habitat for local species, or they may decompose and provide nutrients for the growth of new vegetation. If the storm spreads pollutants into natural ecosystems, contamination can disrupt food and water supplies, causing widespread and long-term population impacts on species in the area.

Economy

Hurricane/tropical storm events can greatly impact the economy, including loss of business function, damage to inventory, relocation costs, wage loss, and rental loss due to the repair/replacement of buildings. Due to the wind and water damage, and transportation issues that result, the impact to the economy can potentially be very high.

Future conditions

The Northeast has been experiencing more frequent days with temperatures above 90°F, increasing sea surface temperatures and sea levels, changes in precipitation patterns and amounts, and alterations in hydrological patterns. According to the Massachusetts Climate Change Adaptation Report, large storm events are becoming more frequent. Although there is still some level of uncertainty, research indicates the warming climate may double the frequency of Category 4 and 5 hurricanes by the end of the century and decrease the frequency of less severe hurricane events. More frequent and intense storm events will cause an increase in damage to the built environment and could have devastating effects on the economy and environment. As stated earlier, cooler water temperatures along the Northeast Atlantic Ocean help to temper the strength of tropical storms, but if the ocean continues to warm, this tempering force could be lessened, leading to greater intensity of storms that make landfall in New England.

Hazard Profile

Other severe weather captures the natural hazardous events that occur outside of notable storm events, but still can cause significant damages. These events include high winds and thunderstorms. The Town of Lenox and the entire region has experienced numerous thunderstorms and high wind events including microbursts. Wind is air in motion relative to the surface of the earth. A thunderstorm is a storm originating in a cumulonimbus cloud. Cumulonimbus clouds produce lightning, which locally heats the air to 50,000 degrees Celsius, which in turn produces an audible shock wave, known as thunder. Frequently during thunderstorm events, heavy rain and gusty winds are present. Less frequently, hail is present, which can become very large in size. Tornadoes can also be generated during these events (MEMA & EOEEA, 2018).

Likely Severity

High Winds

Effects from high winds can include downed trees and/or power lines and damage to roofs, windows, and other structural components. High winds can cause scattered power outages. Massachusetts is susceptible to high winds from several types of weather events: before and after frontal systems, hurricanes and tropical storms, severe thunderstorms and tornadoes, and nor'easters. Sometimes, wind gusts of only 40 to 45 mph can cause scattered power outages from downed trees and wires. This is especially true after periods of prolonged drought or excessive rainfall, since both are situations that can weaken the root systems and make them more susceptible to the winds' effects. Winds measuring less than 30 mph are not considered to be hazardous under most circumstances. Wind speeds are measured using the Beaufort wind scale shown in table 3.10.

Thunderstorms

A thunderstorm is classified as "severe" when it produces damaging wind gusts in excess of 58 mph (50 knots), hail that is 1 inch in diameter or larger (quarter size), or a tornado (NWS, 2013). The severity of thunderstorms can vary widely, from commonplace and short-term events to large-scale storms that result in direct damage and flooding. Widespread flooding is the most common characteristic that leads to a storm being declared a disaster. The severity of flooding varies widely based both on characteristics of the storm itself and the region in which it occurs. Lightning can occasionally also present a severe hazard (MEMA & EOEEA, 2018).

Table 3.10: Beaufort Wind Scale – Effects on Land

Force	Wind (Knots)	WMO Classification	Appearance of Wind Effects On Land
0	Less than 1	Calm	Calm, smoke rises vertically
1	1-3	Light Air	Smoke drift indicates wind direction, still wind vanes
2	4-6	Light Breeze	Wind felt on face, leaves rustle, vanes begin to move
3	7-10	Gentle Breeze	Leaves and small twigs constantly moving, light flags extended
4	11-16	Moderate Breeze	Dust, leaves, and loose paper lifted, small tree branches move
5	17-21	Fresh Breeze	Small trees in leaf begin to sway
6	22-27	Strong Breeze	Larger tree branches moving, whistling in wires
7	28-33	Near Gale	Whole trees moving, resistance felt walking against wind
8	34-40	Gale	Twigs breaking off trees, generally impedes progress
9	41-47	Strong Gale	Slight structural damage occurs, slate blows off roofs
10	48-55	Storm	Seldom experienced on land, trees broken or uprooted, "considerable structural damage"
11	56-63	Violent Storm	
12	64+	Hurricane	

Source: NOAA Storm Prediction Center. Developed in 1805 by Sir Francis Beaufort
ft = feet; WMO = World Meteorological Organization

Probability

High Winds

Over the last 10 years (between January 1, 2008, and December 31, 2017), a total of 435 high wind events occurred in Massachusetts on 124 days, and an annual average of 43.5 events occurred per year. High winds are defined by NWS 10-1605 as sustained non-convective winds of 35 knots (40 mph) or greater lasting for 1 hour or longer, or gusts of 50 knots (58 mph) or greater for any duration (NCDC, 2018). However, many of these events may have occurred as a result of the same weather system, so this count may overestimate the frequency of this hazard. The probability of future high wind events is expected to increase as a result of climate projections for the state that suggest a greater occurrence of severe weather events in the future.

Thunderstorms

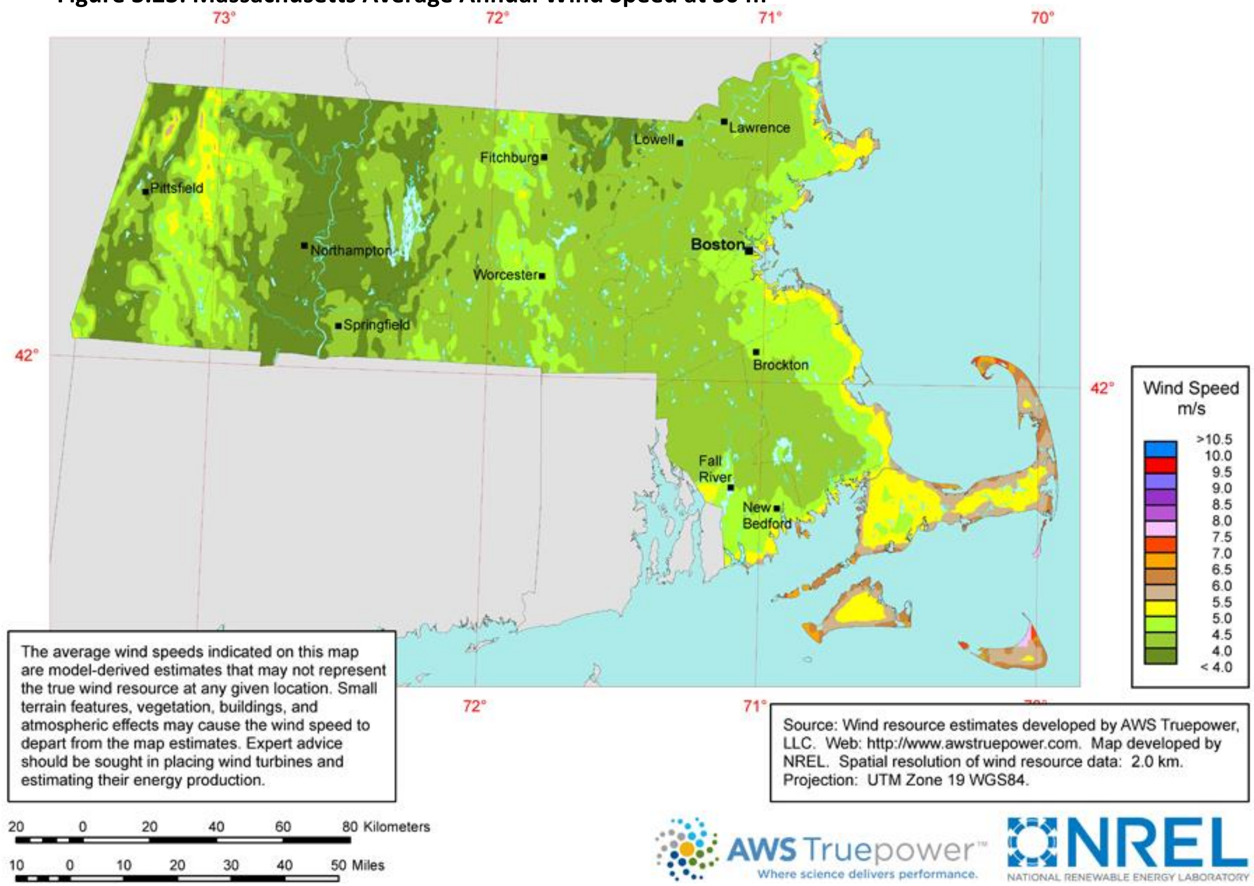
Three basic components are required for a thunderstorm to form: moisture, rising unstable air, and a lifting mechanism. The sun heats the surface of the earth, which warms the air above it. If this warm surface air is forced to rise—by hills or mountains, or areas where warm/cold or wet/dry air bump together causing a rising motion—it will continue to rise as long as it weighs less and stays warmer than the air around it. As the warm surface air rises, it transfers heat from the surface of the earth to the upper levels of the atmosphere (the process of convection). The water vapor it contains begins to cool, releasing the heat, and the vapor condenses into a cloud. The cloud eventually grows upward into areas where the temperature is below freezing. Some of the water vapor turns to ice, and some of it turns into water droplets. Both have electrical charges. When a sufficient charge builds up, the energy is discharged in a bolt of lightning, which causes the sound waves we hear as thunder. An average thunderstorm is 15 miles across and lasts 30 minutes; severe thunderstorms can be much larger and longer. Southern New England typically experiences 10 to 15 days per year with severe thunderstorms (MEMA & EOEEA, 2018).

Geographic Areas Likely Impacted

High Winds

The entire Town is vulnerable to high winds that can cause extensive damage. Relative to the rest of the Commonwealth and surrounding areas of Berkshire county, wind speeds on average are typically higher in parts of Lenox as shown in figure 3.23. Some areas are more susceptible to wind than others. The Housatonic Valley having lower wind speeds, and the Berkshire Plateau having higher wind speeds.

Figure 3.23: Massachusetts Average Annual Wind Speed at 30 m



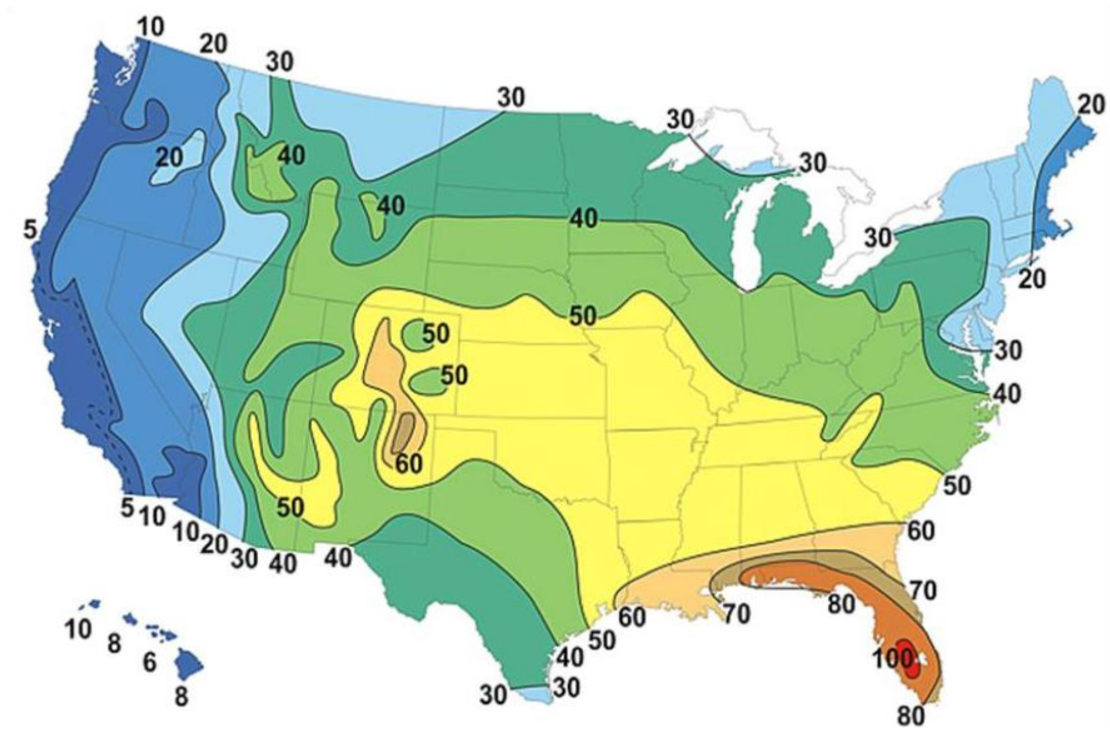
THUNDERSTORMS

Even more so than high wind, thunderstorms have the potential of impacting Lenox. Microbursts can also occur anywhere associated with thunderstorms.

Historic Data

It is difficult to define the number of other severe weather events experienced by Lenox each year. Figure 3.24 shows number of annual thunderstorm days across the United States. Massachusetts experiences 20 to 30 thunderstorm days each year.

Figure 3.24: Annual Average Number of Thunderstorm Days in the U.S.



Source: NOAA NWS, n.d.

Vulnerability Assessment

People

The entire population of the Commonwealth is considered exposed to high-wind and thunderstorm events. Downed trees, damaged buildings, and debris carried by high winds can lead to injury or loss of life.

Socially vulnerable populations are most susceptible to severe weather based on a number of factors, including their physical and financial ability to react or respond during a hazard, and the location and construction quality of their housing. In general, vulnerable populations include people over the age of 65, the elderly living alone, people with low socioeconomic status, people with low English language fluency, people with limited mobility or a life- threatening illness, and people who lack transportation or are living in areas that are isolated from major roads. The isolation of these populations is a significant concern. Power outages can be life-threatening to those dependent on electricity for life support. Power outages may also result in inappropriate use of combustion heaters, cooking appliances and generators in indoor or poorly ventilated areas, leading to increased risks of carbon monoxide poisoning. People who work or engage in recreation outdoors are also vulnerable to severe weather.

Both high winds and thunderstorms present potential safety impacts for individuals without access to shelter during these events. Extreme rainfall events can also affect raw water quality by increasing turbidity and bacteriological contaminants leading to gastrointestinal illness. Additionally, research has found that thunderstorms may cause the rate of emergency room visits for asthma to increase to 5 to 10 times the normal rate (Andrews, 2012). Much of this phenomenon is attributed to the stress and anxiety that many individuals, particularly children, experience during severe thunderstorms. The combination of wind, rain, and lightning from thunderstorms with pollen and mold spores can exacerbate asthma (UG, 2017). The rapidly falling air temperatures characteristic of a thunderstorm as well as the production of nitrogen oxide gas during lightning strikes have also both been correlated with asthma (SKMCAP, 2018).

Built Environment

All elements of the built environment are exposed to severe weather events such as high winds and thunder storms. Damage to buildings is dependent upon several factors, including wind speed, storm duration, path of the storm track, and building construction. According to the Hazus wind model, direct wind-induced damage (wind pressures and windborne debris) to buildings is dependent upon the performance of components and cladding, including the roof covering (shingles, tiles, membrane), roof sheathing (typically wood-frame construction only), windows, and doors, and is modeled as such. Structural wall failures can occur for masonry and wood-frame walls, and uplift of whole roof systems can occur due to failures at the roof/wall connections. Foundation failures (i.e., sliding, overturning, and uplift) can potentially take place in manufactured homes (MEMA & EOEEA, 2018).

The most common problem associated with severe weather is loss of utilities. Severe windstorms causing downed trees can create serious impacts on power and aboveground communication lines. High winds caused one of the 24 NERC-reported electric transmission outages between 1992 and 2009, resulting in disruption of service to 225,000 electric customers in the Commonwealth (DOE, n.d.). During this period, lightning caused nearly 25,000 disruptions (DOE, n.d.). Downed power lines can cause blackouts, leaving large areas isolated. Loss of electricity and phone connections would leave certain populations isolated because residents would be unable to call for assistance. Additionally, the loss of power can impact heating or cooling provision to citizens (including the young and elderly, who are particularly vulnerable to temperature-related health impacts). Utility infrastructure (power lines, gas lines, electrical systems) could suffer damage, and impacts can result in the loss of power, which can impact business operations. After an event, there is a risk of fire, electrocution, or an explosion.

Public safety facilities and equipment may experience a direct loss (damage) from high winds. Roads may become impassable due to flash or urban flooding, or due to landslides caused by heavy, prolonged rains. Impacts to transportation lifelines affect both short-term (e.g., evacuation activities) and long-term (e.g., day-to-day commuting) transportation needs. The hail, wind, and flash flooding associated with thunderstorms and high winds can cause damage to water infrastructure. Flooding can overburden stormwater, drinking water, and wastewater systems. Water and sewer systems may not function if power is lost (MEMA & EOEEA, 2018).

Natural Environment

As described under other hazards, such as hurricanes and nor'easters, high winds can defoliate forest canopies and cause structural changes within an ecosystem that can destabilize food webs and cause widespread repercussions. Direct damage to plant species can include uprooting or total destruction of trees and an increased threat of wildfire in areas of tree debris. High winds can also erode soils, which can damage both the ecosystem from which soil is removed as well as the system on which the sediment is ultimately deposited. Environmental impacts of extreme precipitation events often include soil erosion, the growth of excess fungus or bacteria, and direct impacts to wildlife. For example, research by the Butterfly Conservation Foundation shows that above-average rainfall events have prevented butterflies from successfully completing their mating rituals, causing population numbers to decline. Harmful algal blooms and associated neurotoxins can also be a secondary hazard of extreme precipitation events as well as heat. Public drinking water reservoirs may also be damaged by widespread winds uprooting watershed forests and creating serious water quality disturbances (MEMA & EOEEA, 2018).

Economy

According to the NOAA's Technical Paper on Lightning Fatalities, Injuries, and Damage Reports in the U.S. from 1959 to 1994, monetary losses for lightning events range from less than $50 to greater than $5 million (the larger losses are associated with forest fires, with homes destroyed, and with crop loss) (NOAA, 1997). Lightning can be responsible for damage to buildings; can cause electrical, forest and/or wildfires; and can damage infrastructure, such as power transmission lines and communication towers (MEMA & EOEEA, 2018).

Agricultural losses due to lightning and the resulting fires can be extensive. Forestry species and agricultural crops, equipment, and infrastructure may be directly impacted by high winds. Trees are also vulnerable to lightning strikes.

Future Conditions

Increased frequency of severe weather events in general is an effect of climate change, and thus we can expect to see more severe wind event and thunderstorms in Lenox in the future. Research into the impact of climate change on severe storms such as thunderstorms has looked at the impact of the increased convective available potential energy (CAPE) on frequency and intensity of storms, and a decrease in wind shear as the Artic warms. Some studies show no change in the number of storms, but an increase in intensity due to more energy and evaporated moisture available to fuel storms. Other studies have shown an increase in the number and intensity of storms because the increase in CAPE compensated for a decrease in wind shear[11]. We can expect greater impacts of severe storms in the region while the exact changes are still being determined.

[11] https://earthobservatory.nasa.gov/features/ClimateStorms

Hazard Profile

The threat of invasive species, both plant and animal, was in the top hazards identified by stakeholders through the MVP planning process. Invasive species are defined as non-native species that cause or are likely to cause harm to ecosystems, economies, and/or public health (NISC 2006).

Likely Severity

The damage rendered by invasive species is significant. The Massachusetts Invasive Plant Advisory Group (MIPAG), a collaborative representing organizations and professionals concerned with the conservation of the Massachusetts landscape, is charged by EOEEA to provide recommendations to the Commonwealth to manage invasive species of plants. MIPAG defines invasive plants as "non-native species that have spread into native or minimally managed plant systems in Massachusetts, causing economic or environmental harm by developing self-sustaining populations and becoming dominant and/or disruptive to those systems" (MIPAG, n.d.). These species have biological traits that provide them with competitive advantages over native species, particularly because in a new habitat they are not restricted by the biological controls of their native habitat. As a result, these invasive species can monopolize natural communities, displacing many native species and causing widespread economic and environmental damage (MEMA & EOEEA, 2018).

Invasive species are a widespread problem in Massachusetts and throughout the country. The geographic extent of invasive species varies greatly depending on the species in question and other factors, including habitat and the range of the species (MEMA & EOEEA, 2018).

Probability

Increased rates of global trade and travel have created many new pathways for the dispersion of exotic species. As a result, the frequency with which these threats have been introduced has increased significantly. Increased international trade in ornamental plants is particularly concerning because many of the invasive plants species in the U.S. were originally imported as ornamentals.

Geographic Areas Likely Impacted

Areas most likely impacted by invasive species are those that have experienced some form of disturbance or human activity that allows the species of plant or animal to establish itself in an area. It is common to find invasive species in residential areas where people have mowed lawns, plowed fields, or even planted invasive species believing them to be aesthetically beneficial in their yards. Waterways are also likely areas where invasive plants can be found because of the ability of the plants to travel along the water, particularly during a highwater event.

Experts estimate that about 3 million acres within the U.S. (an area twice the size of Delaware) are lost each year to invasive plants (Pulling Together, 1997, from Mass.gov “Invasive Plant Facts”). The massive scope of this hazard means that the entire Commonwealth experiences impacts from these species. Furthermore, the ability of invasive species to travel far distances (either via natural mechanisms or accidental human interference) allows these species to propagate rapidly over a large geographic area. Similarly, in open freshwater and marine ecosystems, invasive species can quickly spread once introduced, as there are generally no physical barriers to prevent establishment, outside of physiological tolerances, and multiple opportunities for transport to new locations (by boats, for example).

Historic Data

Invasive species are a human-caused hazard, often spread when shipping goods between continents, forest products are transported, or people plant nonnative species on their properties for their aesthetic value. Because the presence of invasive species is ongoing rather than a series of discrete events, it is difficult to quantify the frequency of these occurrences.

The terrestrial and freshwater species listed on the MIPAG website as “Invasive” (last updated April 2016) are listed in Table 3.11. The table also includes details on the nature of the ecological and economic challenges presented by each species as well as information on when and where the species was first detected in Massachusetts (MEMA & EOEEA, 2018). Invasive insects are a significant threat, particularly to trees and everything that depends on those trees from wildlife to people. In Lenox, invasive species including Japanese knotweed, Garlic mustard, and the Hardy kiwi have been major threats to the health of natural landscapes.


Japanese Knotweed

Table 3.11: Invasive Plants in Massachusetts

Species	Common name	Notes
Terrestrial/Freshwater		
Acer platanoides	Norway maple	A tree occurring in all regions of the state in upland and wetland habitats, and especially common in woodlands with colluvial soils. It grows in full sun to full shade. Escapes from cultivation; can form dense stands; outcompetes native vegetation, including sugar maples; dispersed by wind, water, and vehicles.
Acer pseudoplatanus	Sycamore maple	A tree occurring mostly in southeastern counties of Massachusetts, primarily in woodlands and especially near the coast. It grows in full sun to partial shade. Escapes from cultivation inland as well as along the coast; salt-spray tolerant; dispersed by wind, water, and vehicles.
Aegopodium podagraria	Bishop's goutweed, bishop's weed; goutweed	A perennial herb occurring in all regions of the state in uplands and wetlands. Grows in full sun to full shade. Escapes from cultivation; spreads aggressively by roots; forms dense colonies in floodplains.
Ailanthus altissima	Tree of Heaven	This tree occurs in all regions of the state in upland, wetland, and coastal habitats. Grows in full sun to full shade. Spreads aggressively from root suckers, especially in disturbed areas.
Alliaria petiolata	Garlic mustard	A biennial herb occurring in all regions of the state in uplands. Grows in full sun to full shade. Spreads aggressively by seed, especially in wooded areas.
Berberis thunbergii	Japanese barberry	A shrub occurring in all regions of the state in open and wooded uplands and wetlands. Grows in full sun to full shade. Escapes from cultivation; spread by birds; forms dense stands.
Cabomba caroliniana	Carolina fanwort; fanwort	A perennial herb occurring in all regions of the state in aquatic habitats. Common in the aquarium trade; chokes waterways.
Celastrus orbiculatus	Oriental bittersweet; Asian or Asiatic bittersweet	A perennial vine occurring in all regions of the state in uplands. Grows in full sun to partial shade. Escapes from cultivation; berries spread by birds and humans; overwhelms and kills vegetation.
Cynanchum louiseae	Black swallow-wort; Louise's swallow-wort	A perennial vine occurring in all regions of the state in upland, wetland, and coastal habitats. Grows in full sun to partial shade. Forms dense stands, outcompeting native species: deadly to Monarch butterflies.
Elaeagnus umbellata	Autumn olive	A shrub occurring in uplands in all regions of the state. Grows in full sun. Escapes from cultivation; berries spread by birds; aggressive in open areas; has the ability to change soil.
Euonymus alatus	Winged euonymus, burning bush	A shrub occurring in all regions of the state and capable of germinating prolifically in many different habitats. It grows in full sun to full shade. Escapes from cultivation and can form dense thickets and dominate the understory; seeds are dispersed by birds.
Euphorbia esula	Leafy spurge; wolf's milk	A perennial herb occurring in all regions of the state in grasslands and coastal habitats. Grows in full sun. An aggressive herbaceous perennial and a notable problem in the western U.S..

Species	Common name	Notes
Frangula alnus	European buckthorn, glossy buckthorn	Shrub or tree occurring in all regions of the state in upland, wetland, and coastal habitats. Grows in full sun to full shade. Produces fruit throughout the growing season; grows in multiple habitats; forms thickets.
Glaucium flavum	Sea or horned poppy, yellow hornpoppy	A biennial and perennial herb occurring in southeastern MA in coastal habitats. Grows in full sun. Seeds float; spreads along rocky beaches; primarily Cape Cod and Islands.
Hesperis matronalis	Dame's rocket	A biennial and perennial herb occurring in all regions of the state in upland and wetland habitats. Grows in full sun to full shade. Spreads by seed; can form dense stands, particularly in floodplains.
Iris pseudacorus	Yellow iris	A perennial herb occurring in all regions of the state in wetland habitats, primarily in floodplains. Grows in full sun to partial shade. Outcompetes native plant communities.
Lepidium latifolium	Broad-leaved pepperweed, tall pepperweed	A perennial herb occurring in eastern and southeastern regions of the state in coastal habitats. Grows in full sun. Primarily coastal at upper edge of wetlands; also found in disturbed areas; salt tolerant.
Lonicera japonica	Japanese honeysuckle	A perennial vine occurring in all regions of the state in upland, wetland, and coastal habitats. Grows in full sun to full shade. Rapidly growing, dense stands climb and overwhelm native vegetation; produces many seeds that are dispersed by birds; more common in southeastern Massachusetts.
Lonicera morrowii	Morrow's honeysuckle	A shrub occurring in all regions of the state in upland, wetland, and coastal habitats. Grows in full sun to full shade. Part of a confusing hybrid complex of non-native honeysuckles commonly planted and escaping from cultivation via bird dispersal.
Lonicera x bella [morrowii x tatarica]	Bell's honeysuckle	This shrub occurs in all regions of the state in upland, wetland, and coastal habitats. Grows in full sun to full shade. Part of a confusing hybrid complex of non-native honeysuckles commonly planted and escaping from cultivation via bird dispersal.
Lysimachia nummularia	Creeping jenny, moneywort	A perennial herb occurring in all regions of the state in upland and wetland habitats. Grows in full sun to full shade. Escaping from cultivation; problematic in floodplains, forests and wetlands; forms dense mats.
Lythrum salicaria	Purple loosestrife	A perennial herb or subshrub occurring in all regions of the state in upland and wetland habitats. Grows in full sun to partial shade. Escaping from cultivation; overtakes wetlands; high seed production and longevity.
Myriophyllum heterophyllum	Variable water-milfoil; two-leaved water-milfoil	A perennial herb occurring in all regions of the state in aquatic habitats. Chokes waterways, spread by humans and possibly birds.
Myriophyllum spicatum	Eurasian or European water-milfoil; spike water- milfoil	A perennial herb found in all regions of the state in aquatic habitats. Chokes waterways, spread by humans and possibly birds.
Phalaris arundinacea	Reed canary-grass	This perennial grass occurs in all regions of the state in wetlands and open uplands. Grows in full sun to partial shade. Can form huge colonies and overwhelm wetlands; flourishes in disturbed areas; native and introduced strains; common in agricultural settings and in forage crops.

Species	Common name	Notes
Phragmites australis	Common reed	A perennial grass (USDA lists as subshrub, shrub) found in all regions of the state. Grows in upland and wetland habitats in full sun to full shade. Overwhelms wetlands forming huge, dense stands; flourishes in disturbed areas; native and introduced strains.
Polygonum cuspidatum / Fallopia japonica	Japanese knotweed; Japanese or Mexican bamboo	A perennial herbaceous subshrub or shrub occurring in all regions of the state in upland, wetland, and coastal habitats. Grows in full sun to full shade, but hardier in full sun. Spreads vegetatively and by seed; forms dense thickets.
Polygonum perfoliatum	Mile-a-minute vine or weed; Asiatic tearthumb	This annual herbaceous vine is currently known to exist in several counties in MA, and has also has been found in RI and CT. Habitats include streamsides, fields, and road edges in full sun to partial shade. Highly aggressive; bird and human dispersed.
Potamogeton crispus	Crisped pondweed, curly pondweed	A perennial herb occurring in all regions of the state in aquatic habitats. Forms dense mats in the spring and persists vegetatively.
Ranunculus ficaria	Lesser celandine; fig buttercup	A perennial herb occurring on stream banks, and in lowland and uplands woods in all regions of the state. Grows in full sun to full shade. Propagates vegetatively and by seed; forms dense stands, especially in riparian woodlands; an ephemeral that outcompetes native spring wildflowers.
Rhamnus cathartica	Common buckthorn	A shrub or tree occurring in all regions of the state in upland and wetland habitats. Grows in full sun to full shade. Produces fruit in fall; grows in multiple habitats; forms dense thickets.
Robinia pseudoacacia	Black locust	A tree that occurs in all regions of the state in upland habitats. Grows in full sun to full shade. While the species is native to central portions of Eastern North America, it is not indigenous to MA. It has been planted throughout the state since the 1700s and is now widely naturalized. It behaves as an invasive species in areas with sandy soils.
Rosa multiflora	Multiflora rose	A perennial vine or shrub occurring in all regions of the state in upland, wetland, and coastal habitats. Grows in full sun to full shade. Forms impenetrable thorny thickets that can overwhelm other vegetation; bird dispersed.
Salix atrocinerea/Salix cinerea	Rusty Willow/Large Gray Willow complex	A large shrub or small tree most commonly found in the eastern and southeastern areas of the state, with new occurrences being reported further west. Primarily found on pond shores but is also known from other wetland types and rarely uplands. Forms dense stands and can outcompete native species along the shores of coastal plain ponds.
Trapa natans	Water chestnut	An annual herb occurring in the western, central, and eastern regions of the state in aquatic habitats. Forms dense floating mats on water.

Invasive and nuisance (native) insects and their host trees are described in table 3.12.

Table 3.12: Invasive and Nuisance Insects with Potential Threat to Berkshire County Forest Health

Insect	Origin	Host Trees	DCR-Management Approach
Gypsy Moth	Introduced	Oaks, other deciduous species	Discovered in 1869, the current management approach relies on natural population controls- naturally abundant virus and fungus populations regulate gypsy moth population cycles.
Hemlock Woolly Adelgid	Introduced	Eastern hemlock	Discovered in 1989, two biocontrol species, Psedudoscymnus tsugae and Laricobius nigrinus, have been released in MA to limited establishment success.
Southern Pine Beetle	Native	Pitch pine	Population densities are being monitored through annual trapping. The impacts of climate change could significantly alter southern pine beetle generation periods and devastate pitch pine stands.
Emerald Ash Borer	Introduced	All ash species	Discovered in 2012, three biocontrol species, Tetrastichus planipennisi, Spathius galinae, and Oobius agrili, have successfully been released in MA. Continued releases are planned.
White Pine Needlecast	Native	Eastern white pines	White pine defoliation is being monitored across the state. Needlecast has been identified to be caused by multiple fungal pathogens; the most prevalent agent in Massachusetts is Lecanosticta acicola.

Source: https://www.mass.gov/service-details/current-forest-health-threats


Emerald Ash Borer


Forest Impact of Emerald Ash Borer

Vulnerability Assessment

People

Invasive species rarely result in direct impacts on humans, but sensitive people may be vulnerable to specific species that may be present in the state in the future. These include people with compromised immune systems, children under the age of 5, people over the age of 65, and pregnant women. Those who rely on natural systems for their livelihood or mental and emotional well-being are more likely to experience negative repercussions from the expansion of invasive species.

An increase in species not typically found in Massachusetts could expose populations to vector-borne disease. A major outbreak could exceed the capacity of hospitals and medical providers to care for patients.

Built Environment

Because invasive species are present throughout the Commonwealth, all elements are considered exposed to this hazard; however, the built environment is not expected to be impacted by invasive species to the degree that the natural environment is. Buildings are not likely to be directly impacted by invasive species. Amenities such as outdoor recreational areas that depend on biodiversity and ecosystem health may be impacted by invasive species. Facilities that rely on biodiversity or the health of surrounding ecosystems, such as outdoor recreation areas or agricultural/forestry operations, could be more vulnerable to impacts from invasive species.

Invasive species may lead to reduced water quality, which has implications for the drinking water supplies and the cost of treatment.

Natural Environment

An analysis of threats to endangered and threatened species in the U.S. indicates that invasives are implicated in the decline of 42 percent of the endangered and threatened species. In 18 percent of the cases, invasive species were listed as the primary cause of the species being threatened, whereas in 24 percent of the cases they were identified as a contributing factor (Somers, 2016). A 1998 study found that competition or predation by alien species is the second most significant threat to biodiversity, only surpassed by direct habitat destruction or degradation (Wilcove et al., 1998). This indicates that invasive species present a significant threat to the environment and natural resources in the Commonwealth. Aquatic invasive species pose a particular threat to water bodies. In addition to threatening native species, they can degrade water quality and wildlife habitat. Impacts of aquatic invasive species include:

- Reduced diversity of native plants and animals
- Impairment of recreational uses, such as swimming, boating, and fishing
- Degradation of water quality
- Degradation of wildlife habitat
- Increased threats to public health and safety

- Diminished property values
- Declines in fin and shellfish populations
- Loss of coastal infrastructure due to the habits of fouling and boring organisms
- Local and complete extinction of rare and endangered species (EOEEA, 2002 as cited by MEMA & EOEEA, 2018)

Economy

The agricultural sector is vulnerable to increased invasive species associated with increased temperatures. More pest pressure from insects, diseases, and weeds may harm crops and cause farms to increase pesticide use. In addition, floodwaters may spread invasive plants that are detrimental to crop yield and health. Agricultural and forestry operations that rely on the health of the ecosystem and specific species are likely to be vulnerable to invasive species.

Invasive species are widely considered to be one of the costliest natural hazards in the U.S. A widely cited paper (Pimental et al., 2005) found that invasive species cost the U.S. more than $120 billion in damages every year. One study found that in 1 year alone, Massachusetts agencies spent more than $500,000 on the control of invasive aquatic species through direct efforts and cost-share assistance. This figure does not include the extensive control efforts undertaken by municipalities and private landowners, lost revenue due to decreased recreational opportunities, or decreases in property value due to infestations (Hsu,2000). Individuals who are particularly vulnerable to the economic impacts of this hazard would include all groups who depend on existing ecosystems in the Commonwealth for their economic success. This includes all individuals working in agriculture-related fields, as well as those whose livelihoods depend on outdoor recreation activities such as hunting, hiking, or aquatic sports. Additionally, homeowners whose properties are adjacent to vegetated areas could experience property damage in a number of ways. For example, the roots of the Tree of Heaven (Ailanthus altissima) plant are aggressive enough that they can damage both sewer systems and house foundations up to 50 to 90 feet from the parent tree (MEMA & EOEEA, 2018).

Future Conditions

Temperature, concentration of CO2 in the atmosphere, frequency and intensity of hazardous events, atmospheric concentration of CO2, and available nutrients are key factors in determining species survival. It is likely that climate change will alter all of these variables. As a result, climate change is likely to stress native ecosystems and increase the chances of a successful invasion. Additionally, some research suggests that elevated atmospheric CO2concentrations could reduce the ability of ecosystems to recover after a major disturbance, such as a flood or fire event. As a result, invasive species—which are often able to establish more rapidly following a disturbance—could have an increased probability of successful establishment or expansion. Other climate change impacts that could increase the severity of the invasive species hazard include the following (Bryan and Bradley, 2016; Mineur et al., 2012; Schwartz, 2014; Sorte,2014; Stachowicz et al., 2002 as cited in MEMA & EOEEA, 2018):

- Elevated atmospheric CO_2 levels could increase some organisms' photosynthetic rates, improving the competitive advantage of those species.
- Changes in atmospheric conditions could decrease the transpiration rates of some plans, increasing the amount of moisture in the underlying soil. Species that could most effectively capitalize on this increase in available water would become more competitive.
- Fossil fuel combustion can result in widespread nitrogen deposition, which tends to favor fast-growing plant species. In some regions, these species are primarily invasive, so continued use of fossil fuels could make conditions more favorable for these species.
- As the growing season shifts to earlier in the year, several invasive species (including garlic mustard, barberry, buckthorn, and honeysuckle) have proven more able to capitalize by beginning to flower earlier, which allows them to outcompete later-blooming plants for available resources. Species whose flowering times do not respond to elevated temperatures have decreased in abundance.
- Some research has found that forests pests (which tend to be ectotherms, drawing their body heat from environmental sources) will flourish under warming temperatures. As a result, the population sizes of defoliating insects and bark beetles are likely to increase.
- Warmer winter temperatures also mean that fewer pests will be killed off over the winter season, allowing populations to grow beyond previous limits.
- There are many environmental changes possible in the aquatic environment that can impact the introduction, spread, and establishment of aquatic species, including increased water temperature, decreased oxygen concentration, and change in pH. For example, increases in winter water temperatures could facilitate year-round establishment of species that currently cannot overwinter in New England (Sorte, 2014 as cited in MEMA & EOEEA, 2018).

Invasive species can trigger a wide-ranging cascade of lost ecosystem services. Additionally, they can reduce the resilience of ecosystems to future hazards by placing a constant stress on the system (MEMA & EOEEA, 2018).

Hazard Profile

Vector-borne diseases, particularly those transmitted by ticks, was identified as s top hazard of concern for Lenox MVP Workshop participants.

Likely severity

The Town of Lenox chose to examine the hazard of vector-borne diseases in their community. Vector-borne disease are defined by the CDC as illnesses in humans derived from a vector, including mosquitoes, ticks, and fleas that spread pathogens. Examples of mosquito-borne diseases include Chikungunya, Eastern Equine Encephalitis (EEE), Zika, and the West Nile Virus. Examples of tick-borne diseases include Lyme Disease, Anaplasmosis/Ehrlichiosis, Babesiosis, and Powassan. The damage rendered by vector-borne diseases can be significant in a community, and can drastically affect quality of life, ability to work, loss of specific bodily functions, increase life-long morbidity and increase mortality.

Probability

According to the CDC, the geographic and seasonal distribution of vector populations, and the diseases they can carry depends not only on the climate, but also on land use, socioeconomic and cultural factors, pest control, access to health care, and human responses to disease risk. Climate variability can result in vector/pathogen adaptation and shifts or expansions in their geographic ranges. Infectious disease transmission is sensitive to local, small-scale differences in weather, human modification of the landscape, the diversity of animal hosts, and human behavior that affects vector/human contact.

The Berkshires provide outdoor recreation opportunities for both residents and visitors, including hiking, swimming, mountain biking, and camping. Increased exposure to the outdoors, particularly to areas with heavy tree and forest cover, and areas with tall grass or standing water, significantly increase a person's exposure to vector-borne illnesses. Increases in average year-round temperature during the past few decades has also led to the over-wintering of ticks in Berkshire County, and a lengthening warm season, among other characteristics of the Berkshire environment, has increased tick and mosquito populations significantly. Cases of Lyme in Berkshire County have increased. Additionally, Massachusetts has seen cases of once non-existent or very rare tick borne illnesses rise, including Anaplasmosis/Ehrlichiosis (848 cases in 2016, can be fatal), Babesiosis (518 cases in 2016, significantly higher than any other state, can be fatal), Lyme (198 cases in 2016), Powassan (5 cases in 2016, fatality rate is 10%), Spotted fever rickettsiosis (8 cases in 2016, 20% untreated cases are fatal), and Tularemia (5 cases in 2016).

Geographic Areas Likely Impacted

Residents, pets, and other animals across Lenox are already impacted by vector-borne disease and is likely to be increasingly impacted. Exposure to any outdoor area with tall grasses, standing water, and trees increases risk. Residents and visitors can be exposed at home and in more commercial areas, although exposure in commercial areas is generally less likely.

Historic Data

In the United States in 2016, a total of 96,075 cases were reported, 1,827 of which were reported in the state of Massachusetts. In Berkshire County, [drop in local data and data source]. The CDC indicates that cases of vector-borne diseases are substantially underreported. Tickborne illnesses more than doubled between 2004 and 2016 and accounted for 77% of all vector-borne disease reports in the United States. Lyme disease accounted for 82% of all tickborne cases, but spotted fever rickettsioses, babesiosis, and anaplasmosis/ehrlichiosis cases also increased. During the years of 2004 to 2016, nine vector-borne human diseases were reported for the first time from the United States and US territories. According to the CDC, vector-borne diseases have been difficult to prevent and control, and a Food and Drug Administration (FDA) approved vaccine is only available for yellow fever virus. Insecticide resistance is widespread and is increasing.

Vulnerability Assessment

People

Vector-borne illness have a significant impact on humans and on a community, and significantly affect health, long-term morbidity and mortality, quality of life, and can significantly reduce a persons' ability to work or contribute to the community in other ways. In addition to the direct effect of vector-borne illnesses on a person, pesticides and herbicides used to control populations of vectors can also negatively impact human health.

Built Environment

Vector-borne illnesses pose little threat to the built environment in a community. Overtime we may see changes in development as people respond to the increase in disease carrying insects.

Natural Environment

Increases in vector-borne illnesses can increase the likelihood that a community needs to use chemical pesticides and herbicides to control vector populations. The increased use of these products and chemicals can significantly affect the natural environment, including vegetation and other animal populations. Reducing populations of ticks and mosquitos can reduce the food source for other dependent animal populations. Additionally, diseases carried by insects can affect wildlife as they do humans. There is also the risk of people reacting to the threat of disease by altering the environment to not support habitat, severely damaging long-term ecosystem health.

Economy

The economy is susceptible to the indirect impacts of vector-borne illnesses. If a community decides to engage in a pest-control program or another program to reduce vector populations, this can significantly affect their operating budget. Incorporation of any program to reduce vector populations in a community will likely cause tax increases within the municipality. Long-term, the more individuals in a population affected by vector-borne disease that can cause life-long morbidity or mortality will reduce the overall economic participation and output of the population in a municipality. There will also be the impacts on outdoor recreation, which is a major revenue driver for Berkshire County. People today choose to or are advised by officials to avoid outdoor activities in fear of tick and mosquito bites.

Future Conditions

Continued changes to the climate, extreme precipitation events, issues with control of stormwater, changes to animal and vector populations, and continued increases in insecticide resistance will lead to a continued and growing threat to individuals, governments, and businesses. Local governments will need to invest in methods to reduce or prevent exposure to vector-borne diseases and should strongly consider methods that do not include the increased use of insecticides and herbicides. This may include methods such as promoting populations of bats, opossums and other animals that consume vectors of concern, increase opportunities for residents to get ticks from tick bites tested, reduce the cost and burden of testing ticks for individuals, and increase the level of education and awareness of current and new vector-borne illnesses with the public and practitioners so treatment can be expedited. Municipalities should implement educational programs for residents and visitors for bite-prevention and detection.

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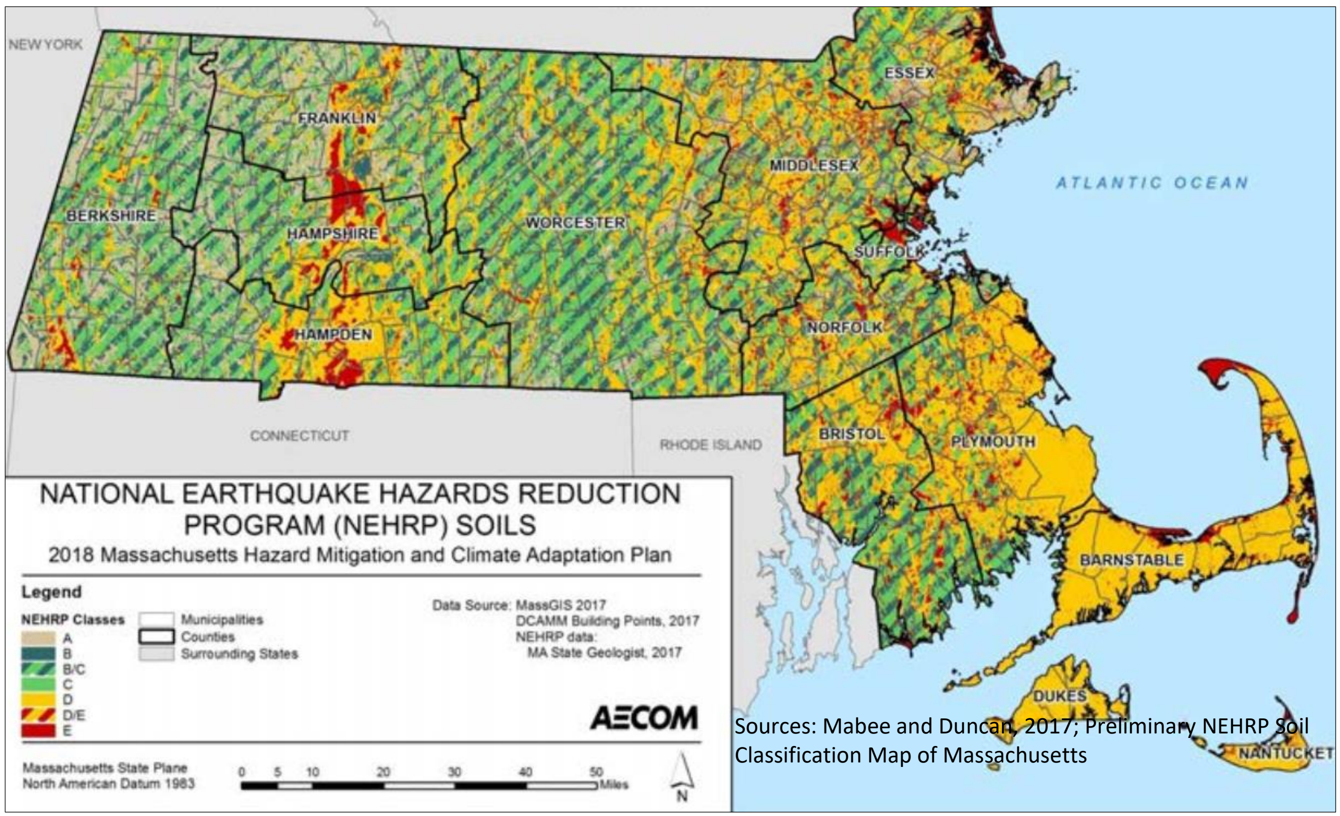
Hazard Profile

An earthquake is the vibration of the Earth's surface that follows a release of energy in the Earth's crust. These earthquakes often occur along fault boundaries. As a result, areas that lie along fault boundaries—such as California, Alaska, and Japan—experience earthquakes more often than areas located within the interior portions of these plates, including Lenox (MEMA & EOEEA, 2018).

Likely severity

Figure 3.25: NEHRP Soil Types in Massachusetts



Sources: Mabee and Duncan, 2017; Preliminary NEHRP Soil Classification Map of Massachusetts

Ground shaking is the primary cause of earthquake damage to man-made structures. This damage can be increased due to the fact that soft soils amplify ground shaking. A contributor to site amplification is the velocity at which the rock or soil transmits shear waves (S waves). The National Earthquake Hazards Reduction Program (NEHRP) developed five soil classifications, which are defined by their S-wave velocity, that impact the severity of an earthquake. The soil classification system ranges from A to E, where A represents hard rock that reduces ground motions from an earthquake and E represents soft soils that amplify and magnify ground shaking and increase building damage and losses. These soil types are shown in Figure 3.22. Soil types A, B, C, and D are reflected in the Hazus analysis that generated the exposure and vulnerability results later in the section (MEMA & EOEEA, 2018).

The location of an earthquake is commonly described by the geographic position of its epicenter and by its focal depth. The focal depth of an earthquake is the depth from the surface to the region where the earthquake's energy originates (the focus). Earthquakes with focal depths up to about 43.5 miles are classified as shallow. Earthquakes with focal depths of 43.5 to 186 miles are classified as intermediate. The focus of deep earthquakes may reach depths of more than 435 miles. The focus of most earthquakes is concentrated in the upper 20 miles of the Earth's crust. The depth to the Earth's core is about 3,960 miles, so even the deepest earthquakes originate in relatively shallow parts of the Earth's interior. The epicenter of an earthquake is the point on the Earth's surface directly above the focus. Seismic waves are the vibrations from earthquakes that travel through the Earth and are recorded on instruments called seismographs. The magnitude or extent of an earthquake is a seismograph-measured value of the amplitude of the seismic waves. The Richter magnitude scale (Richter scale) was developed in 1932 as a mathematical device to compare the sizes of earthquakes. The Richter scale is the most widely known scale for measuring earthquake magnitude. It has no upper limit and is not used to express damage. An earthquake in a densely populated area, which results in many deaths and considerable damage, can have the same magnitude as an earthquake in a remote area that causes no damage. The perceived severity of an earthquake is based on the observed effects of ground shaking on people, buildings, and natural features, and severity varies with location. Intensity is expressed by the Modified Mercalli Scale, which describes how strongly an earthquake was felt at a particular location. The Modified Mercalli Scale expresses the intensity of an earthquake's effects in a given locality in values ranging from I to XII. Seismic hazards are also expressed in terms of PGA, which is defined by USGS as "what is experienced by a particle on the ground" in terms of percent of acceleration force of gravity. More precisely, seismic hazards are described in terms of Spectral Acceleration, which is defined by USGS as "approximately what is experienced by a building, as modeled by a particle on a massless vertical rod having the same natural period of vibration as the building" in terms of percent of acceleration force of gravity (percent g).

Because of the low frequency of earthquake occurrence and the relatively low levels of ground shaking that are usually experienced, the entirety of the Commonwealth can be expected to have a low to moderate risk to earthquake damage as compared to other areas of the country. However, impacts at the local level can vary based on types of construction, building density, and soil type, among other factors (MEMA & EOEEA, 2018).

Probability

New England experiences intraplate earthquakes because it is located deep within the interior of the North American plate. Scientists are still exploring the cause of intraplate earthquakes, and many believe these events occur along geological features that were created during ancient times and are now weaker than the surrounding areas (MEMA & EOEEA, 2018).

A 1994 report by the USGS, based on a meeting of experts at the Massachusetts Institute of Technology, provides an overall probability of occurrence. Earthquakes above about magnitude 5.0 have the potential for causing damage near their epicenters, and larger magnitude earthquakes have the potential for causing damage over larger areas. This report found that the probability of a magnitude 5.0 or greater earthquake centered somewhere in New England in a 10-year period is about 10 percent to 15 percent. This probability rises to about 41 percent to 56 percent for a 50-year period. The last earthquake with a magnitude above 5.0 that was centered in New England took place in the Ossipee Mountains of New Hampshire in 1940 (MEMA & EOEEA, 2018).

Geographic Areas Likely Impacted

New England is located in the middle of the North American Plate. One edge of the North American Plate is along the West Coast where the plate is pushing against the Pacific Ocean Plate. The eastern edge of the North American Plate is located at the middle of the Atlantic Ocean, where the plate is spreading away from the European and African Plates. New England's earthquakes appear to be the result of the cracking of the crustal rocks due to compression as the North American Plate is being very slowly squeezed by the global plate movements. As a result, New England epicenters do not follow the major mapped faults of the region, nor are they confined to particular geologic structures or terrains. Because earthquakes have been detected all over New England, seismologists suspect that a strong earthquake could be centered anywhere in the region. Furthermore, the mapped geologic faults of New England currently do not provide any indications detailing specific locations where strong earthquakes are most likely to be centered. Instead, a probabilistic assessment conducted through a Level 2 analysis in Hazus (using a moment magnitude value of 5) provides information about where in Massachusetts impacts would be felt from earthquakes of various severities. For this plan, an assessment was conducted for the 100-, 500-, 1,000-, and 2,500-year mean return periods. The results of that analysis are discussed later in this section (MEMA & EOEEA, 2018).

Historic Data

In some places in New England, including locations in Massachusetts, small earthquakes seem to occur with some regularity. For example, since 1985 there has been a small earthquake approximately every 2.5 years within a few miles of Littleton, Massachusetts. It is not clear why some localities experience such clustering of earthquakes, but a possibility suggested by John Ebel of Boston College's Weston Observatory is that these clusters occur where strong earthquakes were centered in the prehistoric past. The clusters may indicate locations where there is an increased likelihood of future earthquake activity (MEMA & EOEEA, 2018).

Although it is well documented that the zone of greatest seismic activity in the U.S. is along the Pacific Coast in Alaska and California, in the New England area, an average of six earthquakes are felt each year. Damaging earthquakes have taken place historically in New England. According to the Weston Observatory Earthquake Catalog, 6,470 earthquakes have occurred in New England and adjacent areas. However, only 35 of these events were considered significant (MEMA & EOEEA, 2018).

Vulnerability Assessment

People

The entire population of Massachusetts is potentially exposed to direct and indirect impacts from earthquakes. The degree of exposure depends on many factors, including the age and construction type of the structures where people live, work, and go to school; the soil type these buildings are constructed on; and the proximity of these building to the fault location. In addition, the time of day also exposes different sectors of the community to the hazard. There are many ways in which earthquakes could impact the lives of individuals across the Commonwealth. Business interruptions could keep people from working, road closures could isolate populations, and loss of utilities could impact populations that suffered no direct damage from an event itself. People who reside or work in unreinforced masonry buildings are vulnerable to liquefaction.

The populations most vulnerable to an earthquake event include people over the age of 65 and those living below the poverty level. These socially vulnerable populations are most susceptible, based on a number of factors, including their physical and financial ability to react or respond during a hazard, the location and construction quality of their housing, and the inability to be self-sustaining after an incident due to a limited ability to stockpile supplies.

Hazus performed for the State Hazard Mitigation and Climate Adaptation Plan estimates the number of people that may be injured or killed by an earthquake depending on the time of day the event occurs. Estimates are provided for three times of day representing periods when different sectors of the community are at their peak: peak residential occupancy at 2:00 a.m.; peak educational, commercial, and industrial occupancy at 2:00 p.m.; and peak commuter traffic at 5:00 p.m. Table 3.13 shows the number of injuries and casualties expected for events of varying severity, occurring at various times of the day.

Table 3.13: Estimated Number of Injuries, Causalities and Sheltering Needs in Berkshire County

Severity	***100-Year MRP***			***500-Year MRP***			***1,000-Year MRP***			***2,500-Year MRP***		
Time	**2am**	**2pm**	**5pm**	**2am**	**2pm**	**5pm**	**2am**	**2pm**	**5pm**	**2am**	**2pm**	**5pm**
Injuries	0	0	0	4	6	4	9	13	10	22	35	25
Hospitalization	0	0	0	0	1	1	1	2	1	3	6	5
Casualties	0	0	0	0	0	0	0	0	0	1	1	1
Displaced Households	0			21			51			143		
Short-Term Sheltering Needs	0			12			29			82		

Source: SCMCAP, 2018 HAZUS

MRP= Mean Return Period

Built Environment

All elements of the built environment in the planning area are exposed to the earthquake hazard. In addition to direct impacts, there is increased risk associated with hazardous materials releases, which have the potential to occur during an earthquake from fixed facilities, transportation-related incidents (vehicle transportation), and pipeline distribution. These failures can lead to the release of materials to the surrounding environment, including potentially catastrophic discharges into the atmosphere or nearby waterways, and can disrupt services well beyond the primary area of impact (MEMA & EOEEA, 2018).

Earthquakes can damage power plants, gas lines, liquid fuel storage infrastructure, transmission lines, utilities poles, solar and wind infrastructure, and other elements of the energy sector. Damage to any components of the grid can result in widespread power outages (MEMA & EOEEA, 2018). Damage to road networks and bridges can cause widespread disruption of services and impede disaster recovery and response (MEMA & EOEEA, 2018).

Earthquakes can also cause large and sometimes disastrous landslides and wildfires. Soil liquefaction is a secondary hazard unique to earthquakes that occurs when water-saturated sands, silts, or gravelly soils are shaken so violently that the individual grains lose contact with one another and float freely in the water, turning the ground into a pudding-like liquid. Building and road foundations lose load-bearing strength and may sink into what was previously solid ground. Unless properly secured, hazardous materials can be released, causing significant damage to the environment and people. Liquefaction may occur along the shorelines of rivers and lakes, and can also happen in low-lying areas away from water bodies but where the underlying groundwater is near the Earth's surface. Earthen dams and levees are highly susceptible to seismic events, and the impacts of their eventual failures can be considered secondary risks for earthquakes (MEMA & EOEEA, 2018).

Natural Environment

Earthquakes can impact natural resources and the environment in a number of ways, both directly and through secondary impacts. For example, damage to gas pipes may cause explosions or leaks, which can discharge hazardous materials into the local environment or the watershed if rivers are contaminated. Fires that break out as a result of earthquakes can cause extensive damage to ecosystems, as described in Section 4.3.2. Primary impacts of an earthquake vary widely based on strength and location. For example, if strong shaking occurs in a forest, trees may fall, resulting not only in environmental impacts but also potential economic impacts to any industries relying on that forest. If shaking occurs in a mountainous environment, cliffs may crumble and caves may collapse. Disrupting the physical foundation of the ecosystem can modify the species balance in that ecosystem and leave the area more vulnerable to the spread of invasive species (MEMA & EOEEA, 2018).

Economy

Earthquakes also have impacts on the economy, including loss of business functions, damage to inventories, relocation costs, wage losses, and rental losses due to the repair or replacement of buildings. The business interruption losses are the losses associated with the inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses of those people displaced from their homes because of the earthquake.

Additionally, earthquakes can result in loss of crop yields, loss of livestock, and damage to barns, processing facilities, greenhouses, equipment, and other agricultural infrastructure. Earthquakes can be especially damaging to farms and forestry if they trigger a landslide (MEMA & EOEEA, 2018).

Future Conditions

Earthquakes cannot be predicted and may occur at any time. Peak Ground Acceleration (PGA) maps are used as tools to determine the likelihood that an earthquake of a given Modified Mercalli Intensity may be exceeded over a period of time, but they are not useful for predicting the occurrence of individual events. Therefore, geospatial information about the expected frequency of earthquakes throughout Massachusetts is not available. Unlike previous hazards analyzed, there is little evidence to show that earthquakes are connected to climate change (MEMA & EOEEA, 2018). However, there are some theories that earthquakes may be associated with a thawing Earth as the temperature increases.

Hazard Profile

Likely severity

A dam is an artificial barrier that has the ability to impound water, wastewater, or any liquid-borne material for the purpose of storage or control of water. The height of the dam is determined by the height of the dam at the maximum water storage elevation. The storage capacity of the dam is the volume of water contained in the impoundment at maximum water storage elevation. Size class may be determined by either storage or height, whichever gives the larger size classification. See table 3.14.

Table 3.14: Dam Size Classification

Category	Storage (acre-feet)	Height (feet)
Small	>= 15 and <50	>= 6 and <15
Intermediate	>= 50 and <1000	>= 15 and <40
Large	>= 1000	>= 40

Table 3.15: Dam Hazard Potential Classification

Hazard Classification	Hazard Potential
High Hazard (Class I):	Dams located where failure or mis-operation will likely cause loss of life and serious damage to home(s), industrial or commercial facilities, important public utilities, main highway(s) or railroad(s).
Significant Hazard (Class II):	Dams located where failure or mis-operation may cause loss of life and damage home(s), industrial or commercial facilities, secondary highway(s) or railroad(s) or cause interruption of use or service of relatively important facilities.
Low Hazard (Class III):	Dams located where failure or mis-operation may cause minimal property damage to others. Loss of life is not expected.

The classification for potential hazard shall be in accordance with table 3.15. The Hazard Potential Classification rating pertains to potential loss of human life or property damage in the event of failure or improper operation of the dam or appurtenant works. The hazard potential classification for a dam has no relationship to the current structural integrity, operational status, flood routing capability, or safety condition of the dam or its appurtenances[12]. Poor condition indicates a dam that presents a significant risk to public safety due to deficiencies such as significant seepage, erosion or sink holes, cracking of structural elements, or vegetation undermining the structural stability of the dam.

Probable future development of the area downstream from the dam that would be affected by its failure shall be considered in determining the classification. Even dams which, theoretically, would pose little threat under normal circumstances can overspill or fail under the stress of a cataclysmic event such as an earthquake or sabotage.

Dam owners are legally responsible for having their dams inspected on a regular basis. High hazard dams must be inspected every two years, Significant Hazard dams must be inspected every five years, and Low Hazard dams must be inspected every 10 years. In addition, owners of High Hazard dams must develop Emergency Action Plans (EAPs) that outline the activities that would occur if the dam failed or appeared to be failing. Owners of Significant Hazard dams are strongly encouraged to also develop EAPs. The Plan would include a notification flow chart, list of response personnel and their responsibilities, a map of the inundation area that would be impacted, and a procedure for warning and evacuating local residents in the inundation area. The EAP must be filed with local and state emergency agencies (BRPC, 2012).

Probability

Factors that contribute to dam failure include design flaw, age, over-capacity stress and lack of maintenance (BRPC, 2012). Maintenance, or the lack thereof, is a serious concern for many Berkshire communities. By law dam owners are responsible for the proper maintenance of their dams. If a dam were to fail and cause flooding downstream, the dam owner would be liable for damages and loss of life that were a result of the failure. As a result of difficulty in getting information on private dams, local officials are largely unaware of the age and condition of the dams within their communities (BRPC, 2012).

There are two primary types of dam failure: catastrophic failure, characterized by the sudden, rapid, and uncontrolled release of impounded water, or design failure, which occurs as a result of minor overflow events. Dam overtopping is caused by floods that exceed the capacity of the dam, and it can occur as a result of inadequate spillway design, settlement of the dam crest, blockage of spillways, and other factors. Overtopping accounts for 34 percent of all dam failures in the U.S.

There are a number of ways in which climate change could alter the flow behavior of a river, causing conditions to deviate from what the dam was designed to handle. For example, more extreme precipitation events could increase the frequency of intentional discharges. Many other climate impacts—including shifts in seasonal and geographic rainfall patterns—could also cause the flow behavior of rivers to deviate from previous hydrographs. When flows are greater than expected, spillway overflow events (often referred to as “design failures”) can occur. These

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[12] https://www.mass.gov/files/documents/2017/10/30/302cmr10.pdf

overflows result in increased discharges downstream and increased flooding potential. Therefore, although climate change will not increase the probability of catastrophic dam failure, it may increase the probability of design failures (MEMA & EOEEA, 2018).

Geographic Areas Likely Impacted

Table 3.16: provides a summary of information on the dams located in Lenox. The DCR Office of Dam Safety lists 5 dams in Lenox. Information was last acquired from the Massachusetts Office of Dam Safety in 2004. Figure 3.26 provides a map of dam locations in Lenox. The Town is also concerned by the dams associated with the Pittsfield water supply, as the inundation areas for these dams would cover a portion of town.

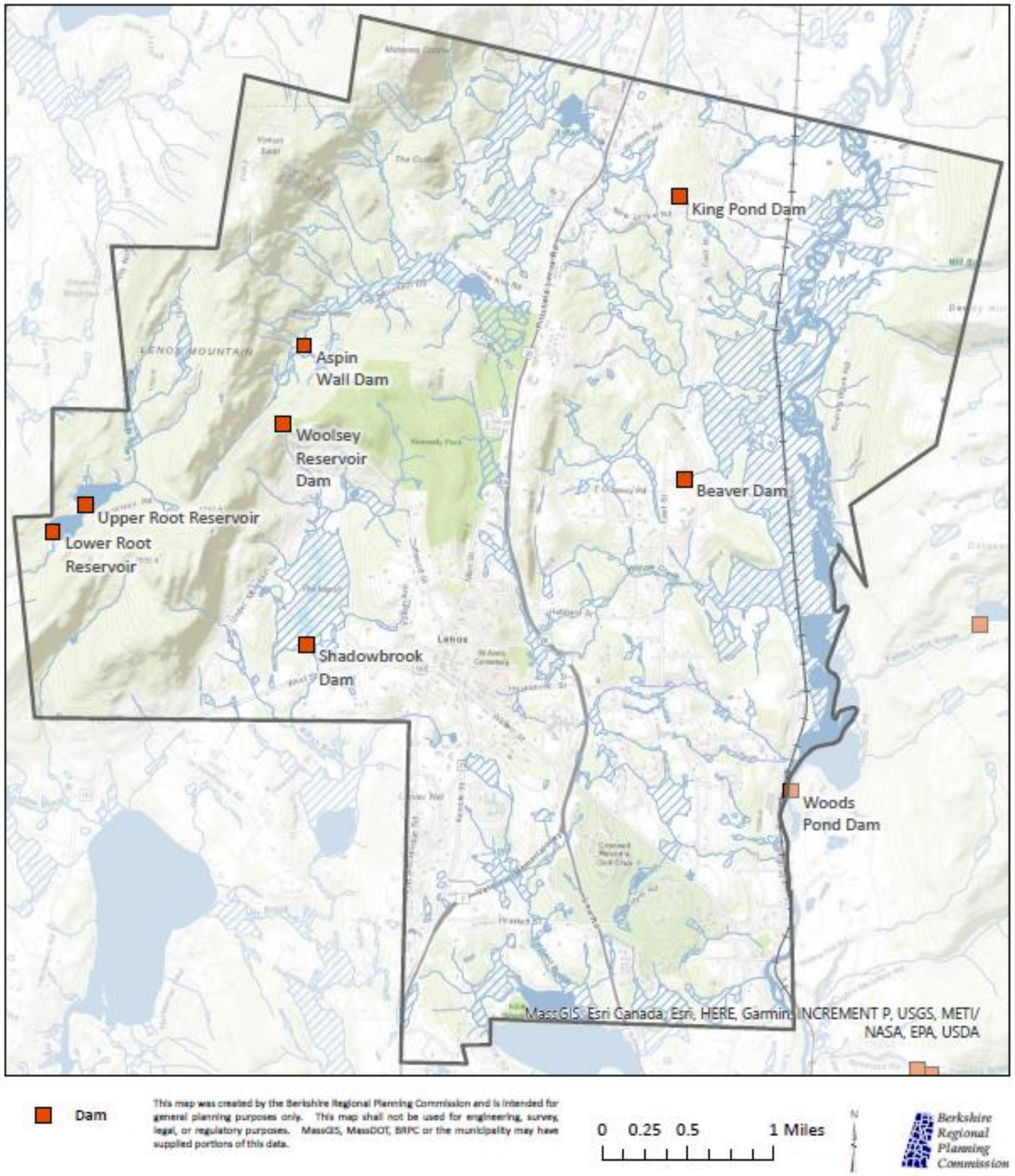
Table 3.16: Dam Hazard Status for Lenox

Name	Hazard Code	Size Class	Inspection Condition	Owner	Water Source	Impounded Waterbody
Aspin Wall Dam	Low	N/A	Poor	Mass Audubon	Yokun Brook	Pike's Pond
Beaver Dam	Low	N/A	Poor	HG October Mountain Estate LLC	Unknown	Unnamed Wetland
Lower Root Reservoir	High	Intermediate	Good	Town of Lenox	Lenox Mountain Brook	Lower Root Reservoir
Upper Root Reservoir	High	Intermediate	Good	Town of Lenox	Lenox Mountain Brook	Upper Root Reservoir
Woolsey Dam	Significant	N/A	Fair	Town of Lenox	Unknown	Unnamed
King Pond Dam	N/A	N/A	N/A	Laura Shack	Unknown	King Pond
Shadowbrook Dam	N/A	N/A	N/A	Randall Todd Grimmett	Marsh Brook	Parson Marsh

Historic Data

Historically, dam failure has had a low occurrence in Berkshire County. However, many of the dams within the region are more than 100 years old.

Figure 3.26: Town of Lenox Dams



Vulnerability Assessment

People

All populations in a dam failure inundation zone would be exposed to the risk of a dam failure. The potential for loss of life is affected by severity of the dam failure, the warning time, the capacity of dam owners and emergency personnel to alert the public and the capacity and number of evacuation routes available to populations living in areas of potential inundation. Vulnerable populations are all populations downstream from dam failures that are incapable of escaping the area within the needed time frame. There is often limited warning time for a dam failure event. While dam failure is rare, when events do occur, they are frequently associated with other natural hazard events such as earthquakes, landslides, or severe weather, which limits their predictability and compounds the hazard. Populations without adequate warning of the event from a television, radio or phone emergency warning system are highly vulnerable to this hazard. This population includes the elderly, young, and large groups of people who may be unable to get themselves out of the inundation area. (Massachusetts Emergency Management Agency, 2013)

Built Environment

All critical facilities and transportation infrastructures in the dam failure inundation zone are vulnerable to damage. Flood waters may potentially cut off evacuation routes, limit emergency access, and destroy power lines and communication infrastructure. (Massachusetts Emergency Management Agency, 2013)

Natural environment

A dam failure would cause significant destruction to the natural environment. Before the dam changed the volume and area of water that would flow downstream of the dam, only vegetation able to withstand inundation would grow where the water flowed or saturated soils. Dam failure would likely cause the accumulation of downed trees downstream including at culverts and bridges leading to further damage.

Economy

Damage to buildings and infrastructure can impact a community's economy and tax base. Buildings and property located within or closest to the dam inundation areas have the greatest potential to experience the largest, most destructive surge of water.

Future Conditions

According to MEMA, dams are designed partly based on assumptions about a river's flow behavior, expressed as hydrographs. Changes in weather patterns can have significant effects on the hydrograph used for the design of a dam. If severe rain events cause hygrographic changes, it is conceivable that the dam can lose some or all of its designed margin of safety, also known as freeboard. If freeboard is reduced, dam operators may be forced to release increased volumes earlier in a storm cycle in order to maintain the required margins of safety. If the number of severe storms increases, or becomes the new norm, early releases of water will impact lands and waterways downstream more often.

Dams are constructed with safety features such as spillways and lower level outlets to allow release of additional water discharges. Spillways are put in place on dams as a safety measure in the event of the reservoir filling too quickly. Spillway overflow events, often referred to as "design failures," result in increased discharges downstream and increased flooding potential. Although climate change may not increase the probability of catastrophic dam failure, it may increase the probability of design failures. (Massachusetts Emergency Management Agency, 2013)

If climate change results in a greater number of severe precipitation events and shortens recurrence intervals them, as is predicted, it will require dam operators to become more vigilant in monitoring precipitation and temperature patterns. Individual rain events, particularly if occurring during periods of saturated or frozen soils that cannot absorb rainfall, may require that dam operators open spillways, flashboards and other safety features more often, causing a greater number of high discharge events and possible flooding on properties downstream of the dam.

Hazard Profile

Likely Severity

The Town of Lenox chose to examine the hazard of cybersecurity. Cybersecurity is defined as the defending of computers, servers, mobile devices, electronic systems, networks, and data from malicious attacks. The term can be divided into a few common categories, including: Network security, Application security, Information security, Operational security, Disaster recovery and business continuity and End-user education (Kaspersky 2020).

The damage rendered by cybersecurity can be significant. Municipalities may see their entire system compromised by cyber attacks and may need to expend significant financial resources to recover from an attack.

Probability

Increased computer usage, internet access and improved programming skills by the public, including potential hackers, all lead to an increase in the probability of a cyber-attack. The frequency of attacks impacting the government has increased over the last few years, leading to a higher probability that any one entity will be attacked. In 2018, government was the 7th most targeted industry for cybercrime and experienced 8% of the total attacks. Nation-state sponsored groups are the most likely to target this sector. These groups are likely to use, sell, or deliver compromised information to their respective governments, typically for economic or political gain (IBM 2019). The most likely reason for attacks on a community like Lenox is for ransom or to access personal information about residents.

As computers and connectivity become more pervasive in our lives, the number of vulnerabilities increases. Over the last three years, more than 42,000 vulnerabilities within software programs have been publicly disclosed. Vulnerabilities have increased over 5400% in the last five years (IBM 2019). These vulnerabilities provide more ways that criminals can access computer networks and compromise systems.

Geographic Areas Likely Impacted

The Town in its entirety is likely to be impacted. Town facilities are more likely to be targeted for cybercrime, however all residents are also at risk. In addition, the electrical grid and telecommunications network throughout town are at risk to attacks and could result in large sections of town being without power or communications.

Historic Data

Cyberattacks are a human-caused hazard, often spread by users who have inadvertently allowed access to their systems. Over the last 3 years, more than 11.7 billion records and over 11 Terabytes of data were leaked or stolen in publicly disclosed incidents. These compromised records contain information such as social security numbers, addresses, phone numbers, banking/payment card information, and passport data. In some cases, health data may also be stolen (IBM 2019).

Locally, at least two municipalities in the county and numerous municipalities in the state have been attacked with Ransomware. These attacks have cost the communities anywhere from tens of thousands of dollars to millions of dollars in ransom and countless hours restoring their systems and improving their resilience to a future attack. Luckily, little, if any, personal data was taken, but the impact on the municipalities ability to function was severely limited for some time.

Vulnerability Assessment

People

Cyberattacks rarely have direct impacts on humans, however the disruption they cause will impact people. Personal identifiable information that may be stolen can cause disruption to people's lives, impacting their finances, security, and future. Cyberattacks that impact the utilities may cause potential harm to those who rely on electricity for life support, heat, and water. Hospitals and medical facilities utilizing networked monitoring systems are vulnerable to hacking. Services provided by a municipality such as those necessary for purchasing a home can be put on hold as well.

Built Environment

Cyberattacks on the built environment may result in the loss of power, communications and equipment failure in government offices. Attacks on the utilities would likely result in temporary loss of service, however utilities can also be attacked where the systems are taken control of and purposely overloaded, damaging the physical infrastructure, which will result in a costlier recovery and a longer recovery time.

Government computer equipment can also be damaged or locked, preventing the use of that equipment unless a ransom is paid. This equipment can be replaced, but the data on the computers may not be recoverable, resulting in the loss of data unless the computers have been properly backed up.

Natural Environment

Cyberattacks pose a threat to the natural environment as well. Systems such as wastewater or drinking water treatment plants are vulnerable to ransomware. One study at Georgia Institute of Technology simulated a hacker gaining access to a water treatment plant and overdosing the system with chlorine. Hackers could also control pumps, valves, or many other parts of the system if they are connected to the internet (Toon, 2017).

Economy

The economy is most susceptible to the threat of cyberattacks due to the loss of utilities and computers causing a reduction in economic output. The power outage in 2003 that impacted most of the Northeast was a result of a cyber-attack. This outage caused an estimated $6 billion in economic damages over 2 days (IRMI 2020). The US government estimates that malicious cyber activity costs the US economy between $57 billion and $109 billion in 2016 (White House 2018). In addition, local government need to invest in cybersecurity or to respond to a cyber attack will result in higher taxes within that municipality.

Future Conditions

Continued expansion and connectivity of cyber assets will lead to a continued and growing threat to businesses, governments and individuals. Local governments will need to invest in cybersecurity to help mitigate the future risk of a cyber-attack. This will include upgrading computer systems, deploying security protections such as firewalls, and training users on identifying malicious activity and emails. Governments will also need to utilize professional computer staff or consultants to assist in protecting their assets and the data of their constituents.

References:

Kaspersky 2020 https://usa.kaspersky.com/resource-center/definitions/what-is-cyber-security

IRMI 2020 https://www.irmi.com/articles/expert-commentary/cyber-attack-critical-infrastructure

IBM 2019 https://www.ibm.com/security/data-breach/threat-intelligence

Toon 2017 https://rh.gatech.edu/news/587359/simulated-ransomware-attack-shows-vulnerability-industrial-controls

White House 2018 https://www.whitehouse.gov/wp-content/uploads/2018/03/The-Cost-of-Malicious-Cyber-Activity-to-the-U.S.-Economy.pdf

CHAPTER 4: MITIGATION STRATEGY

44 CFR § 201.6(c)(3)

The Mitigation Strategy lays out how Lenox intends to reduce losses identified in the Risk Assessment chapter. The goals and objectives of the Town guide the selection of actions to mitigate and reduce potential losses. The Mitigation Strategy includes a prioritized list of cost-effective, environmentally sound, and technically feasible mitigation actions. The Town will apply to fund projects that have been reviewed for benefits and costs of implementation.

At Lenox's November 2019 MVP Workshop, three top priorities were identified by participants. While in some instances the priorities voted on capture multiple projects, the broader categories of priority actions identified for the purposes of this planning document were:

Drinking Water • Stormwater • Forest Management • Shelters and Emergency Preparedness

Existing Protections

Lenox continues to look for ways to maintain its drinking water sources, through watershed management, and agreements with neighboring towns who have abundant sources. The Town continues to work on controlling invasive species in the properties it owns to aid in maintaining a healthy Forest environment. Lenox continues to work on updating its stormwater infrastructure to meet the climate changes occurring in the region. Lenox seeks to strategize how to engage the hard to reach residents that are part of the community. If there is an emergency, the Town of Lenox utilizes a CodeRED to alert residents of the hazardous conditions, and expanding the use of this system is just one piece of identified priority. In 2020 the Town applied for funding to assess and prioritize culvert replacements for flood resiliency.

The Town of Lenox has a floodplain zoning overlay to protect life, property, and the natural benefits of the floodplain in compliance with NFIP. The general boundaries of the Floodplain Overlay District (FPOD) are shown on the Town of Lenox Flood Insurance Rate Map (FIRM), dated 5 July 1982 as Zones A.A 1-30 to indicate the 100 year water surface elevations shown on the FIRM and further defined by the Flood Profiles contained in the Flood Insurance Study, dated 5 July 1982. Applicants are responsible for obtaining flood elevation data if not provided on the FIRM.

Land uses and activities determined to have low flood damage potential and that cause no obstruction to flood flows are allowed provided they are permitted in the underlying district and they do not require structures, fill, and storage of materials or equipment. These uses and activities include: 1. Agricultural uses such as farming, grazing, truck farming, horticulture; 2. Forestry and nursery uses; 3.Outdoor recreational uses, including fishing, boating, play areas; 4. Conservation of water, plants, wildlife; 5. Wildlife management areas, foot, bicycle, and/or horse paths; 6. Temporary non-residential structures used in connection with fishing, growing, harvesting, storage, or sale of crops raised on the premises; and 7. Buildings lawfully existing prior to the adoption of these provisions.

A special permit granted by the Board of Appeals is required prior to any structure or building erected, constructed, substantially improved, or otherwise created or moved. A special permit is also required prior to the dumping, fillings, excavation of transfer of earth or other materials. A special permit may be issued if the application is complaint with the following provisions: 1. The proposed use shall comply in all respects with the provisions of the underlying District, and 2. Within 10 days of receipt of the application, the Board shall transmit one copy of the development plan to the Conservation Commission, Planning Board, Board of Health, Building Commissioner, and Board of Public Works. Final action shall not be taken until reports have been received from the above Boards or until 35 days have elapsed, and 3. All encroachments, including fill, new construction, substantial improvements to existing structures, and other development are prohibited unless there is certification by a registered professional engineer provided by the applicant demonstrating the such encroachment shall not result in any increase in flood levels during the occurrence of the 100 year flood, and 4. The Board may specify such additional and conditions it finds necessary to protect the health, safety, and welfare of the public and the occupants of the proposed use.

By enforcing the FPOD the Town of Lenox preserves and maintains the natural flood control characteristics and the flood storage capacity of the floodplain and the groundwater table and water recharge areas within the floodplain.

The Town of Lenox is fortunate in having natural mitigative infrastructure in their preserved and maintained forests and wetlands. Lenox's undeveloped land serves as important green infrastructure performing ecosystem services including stormwater management, flood control and reduction, soil stabilization, wind mitigation, water filtration, and drought prevention amongst other benefits not easily quantified. There are many tools available for calculating ecosystem services such as FEMA's Ecosystem Service Benefits Calculator[13]. One study by the Trust for Public Land found that for every $1 invested through the Land and Water Conservation Fund, there was a return on that investment of $4 from the value of natural goods and services[14]. In the Town of Lenox, the natural features and facilities are managed and maintained for their services to the community by the Town and regional partners. The Town will continue to maintain the natural features for the beneficial ecosystem services provided, with goals to fully inventory and quantify their benefits. Table 3.17 provides a roadmap for Lenox to increase resiliency and will be updated with the new plan in five years. A table of Lenox's completed mitigation actions is included in Appendix B: Completed Mitigation Actions.

[13] https://www.fema.gov/media-library/assets/documents/110202

[14] http://cloud.tpl.org/pubs/benefits-LWCF-ROI%20Report-11-2010.pdf

The mitigation projects listed in table 3.17 fall within the primary *Categories of Actions*:

- Local plans and regulations
- Structural projects
- Natural systems protection
- Education programs
- Preparedness and response actions

Project *Cost* was estimated and categorized as follows:
High: Over $100,000
Medium: Between $50,000 - $100,000
Low: Less than $50,000
For some projects, cost is not applicable (N/A).

The column containing *Description of Action* is the brief summary of the mitigation action the community has identified to reduce their vulnerability to a hazard or more broadly increase resilience. The Benefit column will explain what the action mitigates or how it to increase resilience. The *Implementation Responsibility* will reflect ownership and/or jurisdiction of a facility or action that will be mitigated or otherwise receive funding for improved resilience.

Timeframe is listed at Short, Long, and Ongoing to reflect the timeframe identified for projects through the MVP Community Resilience Building process. A project that has been identified as short term is one that can and need to be implemented within a one to two-year timeframe. These projects are likely to pass a benefit-cost analysis, have the political and community support necessary, and are practicable. Long term projects require multiple steps before implementation, including studies, engineering, and gaining community support. The estimated time for long term projects is two to ten years. Ongoing projects are those that may be implemented immediately but will require constant investment of resources for maintenance or other project requirements such as education.

The *Priority* of a project is determined by factors including conditions due to climate change or disaster events and recovery priorities; local resources, community needs, and capabilities; State or Federal policies and funding resources; hazard impacts identified in the risk assessment; development patterns that could influence the effects of hazards; and partners that have come to the table. *Resources and Funding* listed for each action are known potential technical assistance, materials and funding for the type of project identified.

Table 4.1: Mitigation Action Plan - Lenox

Category of Action	Description of Action	Benefit	Cost	Implementation Responsibility	Timeframe / Priority	Resources / Funding
Local Plans and Regulations	Encourage FEMA and MEMA to update Berkshire County's FEMA floodplain data and maps. Once completed, the Town should incorporate new information into existing and future planning efforts.	New FEMA maps would be more accurate and allow for a more accurate assessment of the flooding risk.	Low	FEMA and MEMA	Long/ Medium	FEMA
Local Plans and Regulations	Determine which major transportation routes are in inundation areas for dams of High or Significant Hazard	Determining if the major routes are in an inundation area will allow responders to direct traffic away from the area during a disaster	Low	Lenox Planning Board, Department of Public Works, Dam Owners	Short/High	Town, DLTA
Local Plans and Regulations	Improve the development fee system to ensure that needed improvement costs are borne by new development	Improving the development fee system will ensure that the town is not paying for upgrades to infrastructure due to the presence of the new development	Low	Lenox/Lee Building Inspections	Short/Medium	Town
Local Plans and Regulations	Develop bylaws that require on-site containment of stormwater	On-site bylaws will help reduce the amount of runoff and reduce the load on stormwater systems and thus reducing the risk of flooding	Low	Lenox Planning Board	Short/Medium	Town, EOEEA
Natural Systems Protection	Encourage the use of low-impact development techniques, especially in flood-prone areas	Low-Impact development techniques will help eliminate runoff, thus reducing the risk of flooding due to over capacity stormwater systems	Low	Lenox Planning Board, Town Planner	Short/Medium	Town

Category of Action	Description of Action	Benefit	Cost	Implementation Responsibility	Timeframe / Priority	Resources / Funding
Local Plans and Regulations	Develop an inundation map to accompany the EAP that was recently developed for the Upper & Lower Root Reservoirs	Developing an inundation map will enable the town to more accurately plan for a dam failure	Low	Department of Public Works	Short/High	Town
Preparedness and Response Actions	Work with the City of Pittsfield to make sure the Farnham Dam is inspected, in good condition and has an EAP that is on file with both Lenox and Pittsfield EMDs	Ensuring the condition of the dam will prevent failure and subsequent flooding	Low	Department of Public Works, City of Pittsfield	Ongoing/High	Town
Local Plans and Regulations	Develop bylaws that require on-site containment of stormwater	On-site bylaws will help reduce the amount of runoff and reduce the load on stormwater systems and thus reducing the risk of flooding	Low	Lenox Planning Board, Town Planner	Short/Medium	Town
Structural Projects	Continue to upgrade the main water line out of the reservoirs	Upgrading the water lines will ensure their ability to withstand a disaster	Medium	Department of Public Works	Ongoing/High	Town, FEMA
Preparedness and Response Actions	Ensure that suspended water lines are protected during a flood event	Protecting the water lines will ensure their ability to withstand a disaster	Medium	Department of Public Works	Ongoing/High	Town, FEMA
Preparedness and Response Actions	Conduct local disaster response drills and feature them in local news media	Conducting response drills better prepares communities for disasters and publicizing the drills raises the public's awareness of the potential hazards	Low	Lenox Fire and Police Departments, Central Berkshire REPC	Ongoing/Medium	Town, MEMA

Category of Action	Description of Action	Benefit	Cost	Implementation Responsibility	Timeframe / Priority	Resources / Funding
Preparedness and Response Actions	Seek funding to support equipping current shelters, replacing oldest and unusable materials first	Having properly equipped shelters will enable them to be more readily utilized in times of a disaster	Low	Lenox Fire and Police Departments, Central Berkshire REPC	Ongoing/Medium	Town, MEMA
Preparedness and Response Actions	Formalize remaining local agreements for use of shared mass care shelters in the event of a disaster	Agreements to share shelters assists communities who do not have enough capacity to shelter their residents during a disaster	Low	Lenox Fire and Police Departments, Central Berkshire REPC	Short/Medium	Town, MEMA
Preparedness and Response Actions	Determine ability of town governmental centers to withstand a variety of natural hazard events	Ensuring town governmental centers ability to withstand disasters helps maintain response during disasters	Low	Lenox Fire and Police Departments, Central Berkshire REPC	Short/Medium	Town, MEMA
Preparedness and Response Actions and Education and Awareness Programs	Improve record- keeping of local natural disasters and their impacts	Improved record keeping will enable the community to better assess its risk as well as make it more competitive for grants	Low	Lenox Fire and Police Departments, Central Berkshire REPC	Ongoing/Medium	Town
Local Plans and Regulations	Create and disseminate survey through multiple mediums and outreach initiatives to determine best approaches to get information to vulnerable residents.	Ensure vulnerable populations have access to emergency management information such as shelter locations, hazardous condition warnings and so forth.	Low	Town - Emergency Management Director (Fire, Police, DPW Departments)	Ongoing / High	Town
Local Plans and Regulations	Develop a system of check-up calls to vulnerable populations (seniors - make signing up for this service optional to respect	Reduce social isolation and ensure vulnerable populations have access to emergency management information.	Low	Town - Office of Aging, Volunteer groups, Local	Ongoing / High	Town, FEMA

Category of Action	Description of Action	Benefit	Cost	Implementation Responsibility	Timeframe / Priority	Resources / Funding
	people's willingness to accept assistance).			Faith Organizations		
Local Plans and Regulations	Create a 'neighbor to neighbor' program as an informal check-up system to strengthen community bonds.	Establish a method to check on isolated residents and improve social resilience. Reduce social isolation and ensure vulnerable populations have access to emergency management information and supplies.	Low	Town, Non-Profit Organizations, Volunteer Group	Ongoing / High	Town
Education and Awareness Programs	Work to expand partnerships with VNA's, Meals on Wheels, hospitals, and faith organizations.	Expand the reach of organizations that serve meals to vulnerable populations / those in-need.	Low	Town, VNA's, Meals on Wheels, hospitals and faith organizations	Ongoing / High	Town
Local Plans and Regulations	Undergo communications planning for single person households.	Ensure effective dissemination of emergency management information.	Low	Town- Volunteer group	Ongoing / Low	Town, FEMA
Education and Awareness Programs	Promote CodeRED sign-up through Public Service Announcements (PSAs).	Enhance communication capabilities to broadcast emergency event.	Low	Town - Fire, Police, DPW Utility billing	Ongoing / High	Town
Education and Awareness Programs	Perform drills of CodeRED, such as simulating dam failure, and coordinate with Pittsfield.	Ensure proper emergency management procedures are conducted in a timely and efficient manner and that residents are familiar with protocol/procedures during emergency event.	Low	Town - Fire, Police, DPW (Water Department)	Ongoing / Medium & Long	Town

Category of Action	Description of Action	Benefit	Cost	Implementation Responsibility	Timeframe / Priority	Resources / Funding
Preparedness and Response Actions	Establish better sheltering, heating, and cooling stations for emergencies and weather-related extremes.	Power supply redundancies for emergency situations along with additional sheltering capacity.	High	Town - DPW, Fire, Police, Local Power Companies	Ongoing / Medium	Town, FEMA
Local Plans and Regulations	Explore and implement transportation alternatives for those who can no longer drive.	Ensure vulnerable populations have access to emergency services, evacuation and other transportation needs, particularly during an emergency event.	High	Town - Office of Aging, Volunteer groups, Local Faith Organizations	Ongoing / Medium	Town, National Aging and Disability Transportation Center (NADTC)
Local Plans and Regulations	Equip emergency kits with information such as phone numbers to call in case of emergency, list of hospitals or other medical facilities, shelter locations and other essential facilities.	Ensure that residents know shelter locations prior to disaster and prevent loss of life.	Low	Town - DPW utility billing, local realtors	Ongoing / Low	Town, FEMA
Local Plans and Regulations	Coordinate all Hotels'/lodging establishments' plans for evacuation and sheltering in place with the Town wide preparedness plans.	Enhance emergency preparedness coordination and effective response among multiple entities to increase efficiency and maximize protection of human life and property during hazardous events.	Low	Town - Fire, Police, local lodging owners	Ongoing / Medium	Town, FEMA
Local Plans and Regulations	Study feasibility of equipping all hotel/lodging rooms with emergency kits.	Ensure all visitors to the Town have access to emergency supplies and know shelter locations prior to disaster and prevent loss of life.	Medium	Town, Fire, Police and hotel/lodging establishments	Ongoing / Medium	Town

Category of Action	Description of Action	Benefit	Cost	Implementation Responsibility	Timeframe / Priority	Resources / Funding
Local Plans and Regulations	Enhance communication with nursing home managers, and coordinate assisted living home's emergency plans with the Town.	Enhance emergency preparedness coordination and effective response among nursing home and assisted living managers that care for elderly populations to reduce the risk of loss of life during hazardous conditions.	Low	Town - Fire, Police, and local nursing homes	Ongoing / Low	Town
Education and Awareness Programs	Identify effective methods of conduct emergency preparedness outreach among second homeowners and seasonal visitors and include emergency phone numbers, hospital locations, and identity assistance centers.	Enhance emergency preparedness awareness among seasonal travelers/second homeowners to ensure efficient response to hazardous conditions.	Low	Town - Fire, Police, DPW Utility billing	Ongoing / Medium & High	Town
Local Plans and Regulations	Study feasibility of providing emergency kits to second homeowners and seasonal travelers.	Protect vulnerable populations.	Low	Town - Fire, Police, DPW	Ongoing / Low	Town, FEMA
Local Plans and Regulations	Identify community hubs (community center, bars, social clubs, etc.) and target emergency preparedness communication.	Expand reach of emergency preparedness information to ensure adequate emergency response among wide swath of residents.	Low	Town - Local hub owners	Short / High	Town
Education and Awareness Programs	Utilize faith-based organizations for communication and outreach.	Expand reach of emergency preparedness information to ensure adequate emergency response among wide swath of residents, particularly vulnerable populations such as	Low	Town - Local faith organizations	Ongoing / Low	Town

Category of Action	Description of Action	Benefit	Cost	Implementation Responsibility	Timeframe / Priority	Resources / Funding
		those experiencing homelessness.				
Local Plans and Regulations	Capitalize on community networks to improve community resilience.	Utilize existing social networks to enhance community response to emergency situation.	Low	Town - Town employees with web access	Ongoing / Low	Town
Local Plans and Regulations	Create program to build volunteer capacity town wide and explore Citizen Reserve Corps and Medical Reserve Corps to encourage more volunteerism.	Build capacity for trained volunteers ready for disaster response deployment.	Low	Town - Fire, Police, Local volunteer organizations	Ongoing / High	Town
Education and Awareness Programs	Purchase a digital sign on major roads for emergency message communication.	Increase effectiveness and reach of municipal emergency communication messaging.	Medium	Town - DPW	Short / High	Town, FEMA
Local Plans and Regulations	Prevent building critical facilities in flood-prone areas.	Minimize the risk of damage to property and loss of life from hazards such as flooding.	Low	Town - All Town Departments	Ongoing / Medium	Town
Structure and Infrastructure Projects & Education and Awareness Programs	Install an interactive digital map kiosk in Town Hall for residents to utilize.	Increase awareness of hazard-prone areas within municipal borders to better inform residents of areas susceptible to damage from disaster event.	Low	Town - Town Hall Adminstration	Ongoing / Medium	Town

Category of Action	Description of Action	Benefit	Cost	Implementation Responsibility	Timeframe / Priority	Resources / Funding
Education and Awareness Programs	Provide at-home access to interactive map of infrastructure, possibly through ArcGIS Online with BRPC.	Increase awareness of hazard-prone areas within municipal borders to better inform residents of areas susceptible to damage from disaster event.	Low	Town - Town Admins.	Ongoing / Medium	Town
Local Plans and Regulations	Explore alternative emergency communication options such as satellite radio.	Improve communication to maximize reach to reduce loss of life and property.	Low	Town, DPW and Utility Prodiver	Ongoing / High	Town
Education and Awareness Programs	Disseminate information relevant to emergency education, including the location of warming and cooling shelters and regional shelters, in as many mediums as possible including by mail, newspaper, and information on the Town website to inform residents of procedures during emergency situations.	Ensure that residents know shelter locations prior to disaster and prevent loss of life.	Low	Town - DPW utility billing, and Town Admin.	Ongoing / High	Town
Structure and Infrastructure Projects & Education and Awareness Programs	Increase emergency wayfinding signage in recreational areas.	Increase effectiveness and reach of municipal emergency communication messaging.	Low	Town - Town Admins, and DPW	Ongoing / High	Town, FEMA

Category of Action	Description of Action	Benefit	Cost	Implementation Responsibility	Timeframe / Priority	Resources / Funding
Local Plans and Regulations	Evaluate most effective approach to boost cell phone coverage town wide, such as through cell phone reception booster acquisition and strategic locations.	Create robust communication system capable of providing town wide cell phone coverage to ensure emergency communication information can be received and emergency services can be requested.	Medium	Town Admins, DPW, & Utility Provider	Ongoing / High	Town, FEMA
Local Plans and Regulations	Maintain mutual aid agreements with other towns.	Strengthens the ability of the Town, along with that of the surrounding municipalities, to effectively cope with emergency events.	Low	Town Admins, Fire and Police	Ongoing / High	Town
Education and Awareness Programs	Assist homeowners and business owners with winter walkway maintenance through better advertising of sand and salt supplies available at DPW station.	Ensure safety supplies are readily available to homeowners and business owners to reduce the risk of injury or damage to property.	Low	Town DPW	Ongoing / Medium	Town
Local Plans and Regulations	Enforce snow walkway removal.	Reduce the risk of injury or loss of life and damage to property.	Low	Town Police	Ongoing / Medium	Town
Local Plans and Regulations	Improve mapping of electrical lines to have GIS layers available after a disaster.	Provide municipal officials and state or federal agencies with better tools to identify and target repairs to particular segments of power infrastructure, thereby reducing the risk of loss of life and damage to property, and improving the efficiency of the	Medium	Utility Providers	Long / Medium	Town

Category of Action	Description of Action	Benefit	Cost	Implementation Responsibility	Timeframe / Priority	Resources / Funding
		Public Assistance reimbursement process.				
Local Plans and Regulations	Continue trimming and removal of downed timber / excess brush year-round.	Reduce the risk of damage to critical infrastructure, particularly during hazardous conditions.	Medium	Town DPW, Utility Providers	Ongoing / High	Utility, Town
Local Plans and Regulations & Structure and Infrastructure Projects	Selectively bury power lines underground.	Reduce the risk of damage to critical infrastructure, particularly during hazardous conditions.	High	Town DPW, Utility Provider	Ongoing / High	Town, Utility, EEA
Local Plans and Regulations & Structure and Infrastructure Projects	Create Town program to identify feasibility and encourage adoption of renewable energy sources for critical facilities.	Ensure utilization of best available technologies for greater resilience.	Medium	Town DPW, Utility Provider	Short / High	Town
Local Plans and Regulations & Structure and	Investigate the use of solar energy and feasibility of solar micro-grid.	Strengthen grid resilience and help mitigate grid disturbances. Microgrids can function as a grid resource for faster system response and recovery.	Low	Town DPW, Utility Provider	Short / High	Town

Category of Action	Description of Action	Benefit	Cost	Implementation Responsibility	Timeframe / Priority	Resources / Funding
Infrastructure Projects						
Local Plans and Regulations	Acquire additional back-up generators or solar-powered back-up generators.	Provide additional sheltering capacities	Medium	Town DPW	Ongoing / Medium	Town
Local Plans and Regulations	Create town program to incentivize homeowner solar panel installation and possibly conduct property analysis to inform homeowners on suitability of solar panel installation.	Ensure utilization of best available technologies for greater resilience.	Medium	Town Admin, Utility Provider	Short / High	Town, DOER
Local Plans and Regulations & Structure and Infrastructure Projects	Enhance capabilities to store solar power/energy.	Reduce climate forcers and establish local back-up energy sources that are not dependent on petroleum supplies.	High	Town Admin, Utility Provider	Ongoing / High	Town, DOER
Local Plans and Regulations	Assess/plan ownership models, incentives, and group purchasing potential to expand Lenox's solar capabilities.	Ensure utilization of best available technologies and resource sharing among organizational and municipal partners for greater resilience.	Low	Town, Utility Provider	Ongoing / High	Town, DOER
Education and Awareness Programs	Encourage the purchase of flood insurance for homeowners in at-risk areas.	Reduce the magnitude of disruption for homeowners that experience property damage from storms and floods.	Low	Town Admin, Local Realtors	Ongoing / Low	Town

Category of Action	Description of Action	Benefit	Cost	Implementation Responsibility	Timeframe / Priority	Resources / Funding
Local Plans and Regulations	Incentivize roof replacement or maintenance with ice guards – and bundle properties for improved rates.	Increase the resilience of structures, homes and businesses, to withstand disturbances and minimize debris generation from structural deterioration during hazardous weather conditions.	Medium	Town Admin, local roof companies	Ongoing / Low	Town
Education and Awareness Programs	Hold workshops for homeowners on flood hazard controls, planting, drainage, pumps and other equipment to prevent basement flooding.	Adequately prepare residents to reduce the risk of damage to property.	Low	Town DPW	Ongoing / Medium	Town, FEMA
Education and Awareness Programs	Provide homeowners with education to protect homes from ice dams with potential partnership with CET (Center for Eco Technology).	Increase the resilience of homes and work to utilize energy efficient technologies and low waste products.	Low	Town DPW, CET	Short & Ongoing / Low	Town
Education and Awareness Programs	Initiate public education on household conservation and management of septic systems and wells.	Adequately prepare residents to reduce the risk of damage to property.	Low	Town DPW	Ongoing / Low	Town
Local Plans and Regulations	Address illegal hookups to municipal stormwater/wastewater systems.	Reduce the burden placed on municipal stormwater and wastewater systems, thereby reducing the likelihood of critical system failures.	Low	Town DPW	Ongoing / Low	Town
Local Plans and Regulations	Complete GIS mapping of infrastructure including hydrants, culverts, valves, etc.	Create inventory of existing roadway assets to better maintain inventory, track repairs and damage, and target specific problem areas with practical solutions.	Medium	Town DPW	Ongoing / Low	Town

Category of Action	Description of Action	Benefit	Cost	Implementation Responsibility	Timeframe / Priority	Resources / Funding
Local Plans and Regulations	Asses septic share responsibility around Lake Laurel area.	Reduce nutrient overload due to nonpoint source pollution from undersized and old septic systems after rain events.	Low	Town DPW	Ongoing / High	Town
Education and Awareness Programs	Implement bat-box education/building program.	Reduce the prevalence / spread of insect-born disease and illness among City residents.	Low	Town Community Center, Local Audobon	Ongoing / High	Town, EOEEA
Local Plans and Regulations	Create Laurel Lake neighbor program to remove invasive species and replace with native species.	Enable the restoration of natural landscapes with native species.	Low	Town DPW	Ongoing / High	Town, EOEEA
Local Plans and Regulations	Study water availability projections over the next 20-years, 50-years and 100-years for the Town of Lenox that accounts for climate change projections.	Improve decision making power over the future of local water resources.	Low	Town Water Department	Ongoing / High	Town, FEMA
Local Plans and Regulations	Identify potential alternative drinking water source(s) to supplement during periods of drought.	Create redundancy for fresh drinking water supplies and ensure drinking water is available during periods of hazards and recovery.	Low	Town Water Department	Ongoing / High	Town
Education and Awareness Programs	Educate residents on water-use reduction practices and products such as low-flow shower/faucet heads.	Reduce the overuse of water resources to ensure longevity and availability of water supplies, especially during emergency events.	Low	Town Water Department	Ongoing / High	Town

Category of Action	Description of Action	Benefit	Cost	Implementation Responsibility	Timeframe / Priority	Resources / Funding
Local Plans and Regulations & Natural Systems Protection	Assess upgrades to pump stations and flood mitigation solutions and research new technologies, with a focus on engineered wetland treatment systems, that might allow moving the wastewater treatment plant out of the floodplain.	Establish more resource efficient methods of wastewater treatment utilizing nature-based solutions that allow for moving wastewater treatment out of the floodplain.	Low	Town DPW and Wastewater Department	Long / Low	Town, EOEEA
Local Plans and Regulations	Complete tree cutting to improve access to facilities during storms.	Ensure emergency service access to residents, particularly isolated residents, to reduce the risk of loss of life during emergency events.	Low	Town DPW and Utility Providers	Short / High	Town
Natural Systems Protection	Utilize green infrastructure and allow for groundwater recharge through engineered wetlands.	Increase resilience through the use of nature-based solutions, provide habitat for natural species, and enhance ecosystem services afforder within municipal borders.	Medium	Town DPW	Short / High	Town, EOEEA
Local Plans and Regulations & Natural Systems Protection	Limit the use of pesticides on agricultural and private lands	Reduce toxins in the local environment.	Low	Town DPW, Local residents	Short / High	Town
Local Plans and Regulations & Natural Systems Protection	Explore alternatives to toxic pesticides for managing invasive species.	Reduce toxins in the local environment.	Low	Town DPW	Short / High	Town

Category of Action	Description of Action	Benefit	Cost	Implementation Responsibility	Timeframe / Priority	Resources / Funding
Local Plans and Regulations, Education and Awareness Programs & Structure and Infrastructure Projects	Establish community gardens for food independence and provide training for sustainable and social resilience.	Increase agricultural knowledge among residents to increase capacity to grow food and reduce dependency on imports.	Low	Town Community Center	Ongoing / High	Town, EOEEA
Local Plans and Regulations	Develop a list of buildings that have back-up generators.	Improve municipal identification/designation of structures that can serve as shelter locations to reduce the risk of loss of life during a disaster.	Low	Town Admin, and DPW	Short / High	Town
Education and Awareness Programs	Create a map of short and long-term shelters.	Ensure that residents know shelter locations prior to disaster and prevent loss of life.	Low	Town Admin, Fire Department	Short / High	Town
Local Plans and Regulations	Coordinate with BRPC for guidance on how to create an emergency kit.	Ensure emergnecy kits are prepared for times of disaster and ensure equitable access and distribution of emergency kits to residents for adequate emergency preparedness.	Low	Town Admin	Short / High	Town, FEMA
Education and Awareness Programs	Conduct public awareness campaign on emergency preparedness town wide.	Ensure residents are prepared to follow proper emergency management procedures during emergency events.	Low	Town Admin, DPW utility bills	Short / High	Town

Category of Action	Description of Action	Benefit	Cost	Implementation Responsibility	Timeframe / Priority	Resources / Funding
Local Plans and Regulations	Create program to build volunteer capacity town wide.	Build capacity for trained volunteers ready for disaster response deployment.	Low	Town Admin and volunteers	Ongoing / High	Town
Local Plans and Regulations	Recruit and provide training to staff and volunteers for shelter management practices.	Ensure best shelter management practices are implemented and followed during emergency events.	Low	Town Admin, and volunteers	Ongoing / High	Town
Local Plans and Regulations	Increase transportation services - potential collaboration and coordination with major employers focused on devising solutions for low-income workers needing transportation to employment.	Build a diverse and resilient economy that can withstand a diverse set of disturbances by ensuring access to job-sites/employment for workers, especially low-wage workers.	Medium	Town Admin, Large Employers	Short / High	Town
Local Plans and Regulations	Engage in conversations with BRTA to advocate for establishing new routes through Lenox along with expanding services in the evenings and weekends.	Provide additional alternatives to single-occupancy vehicle (SOV) trips thereby reducing individual contributions of greenhouse gas emissions producing climate change hazards.	Low	Town Admin, BRTA	Short / High	Town
Local Plans and Regulations	Consider viability of Town purchasing a vehicle for shuttling folks to destinations and cultural events such as Tanglewood.	Provide additional alternatives to single-occupancy vehicle (SOV) trips thereby reducing individual contributions of greenhouse gas emissions producing climate change hazards.	Medium	Town Admin	Short / High	Town, MassDOT
Local Plans and Regulations	Explore hacking prevention tactics/plan to ensure protection of sensitive Town information and to prevent	Reduce the risk of losing sensitive town information that could hinder critical operations.	Low	Town IT Contractor	Ongoing / High	Town

Category of Action	Description of Action	Benefit	Cost	Implementation Responsibility	Timeframe / Priority	Resources / Funding
	disruptions of normal town wide functions.					
Natural Systems Protection	Continue remediation of the floodplain.	Ensure floodplain is able to naturally slow, detain, and retain floodwaters to prevent damage to property and loss of life and recharge groundwaters.	Medium	Town DPW	Short & Long / High	Town, EOEEA, DER
Local Plans and Regulations	Develop zoning to prohibit development in the floodplain unless there is a compatible use.	Prevent floodplain development and loss of life and property.	Low	Town Land Use and Zoning Board	Short & Long / High	Town
Local Plans and Regulations	Identify oil and wastewater pipelines on vulnerable bridges.	Inventory critical infrastructure that is susceptible to damage from natural hazards and adequately plan for upgrades to reduce risk of damage to property or loss of life.	Low	Town DPW and Berkshire Gas	Short & Long / High	Town
Local Plans and Regulations	Formulate action plan for the wastewater facility and Clifford Oil in case of flooding.	Minimiize the risk of property damage due to flooding.	Low	Town DPW and Clifford Oil	Short & Long / High	Town
Local Plans and Regulations	As PCB remediation continues, ensure that G.E. coordinates with Lenox's Hazard Mitigation Plan.	Ensure coordination and capatability among priorities listed in the Town's Hazard Mitigation Plan and G.E.'s PCB clean-up efforts to encourage alignment with community values.	Low	Town Admin and , G.E.	Ongoing / High	Town

Category of Action	Description of Action	Benefit	Cost	Implementation Responsibility	Timeframe / Priority	Resources / Funding
Local Plans and Regulations	Evaluate increased flood risk or changes in the floodplain due to planned dam removal as result of G.E. PCB settlement.	Reduce the risk of damage to property and loss of life.	Low	Town Admin and , G.E.	Ongoing / High	Town
Education and Awareness Programs	Develop and make educational resources on PCB contamination available to developers near Woods Pond.	Ensure PCB contamination history is known among developers to ensure compatible land-use to maximize public safety.	Low	Town Land Use and Zoning Board	Ongoing / Medium & High	Town
Education and Awareness Programs	Provide education on PCB contamination for residents and visitors.	Ensure PCB contamination history is known among residents to maximize public safety.	Low	Town Land Use and Zoning Board	Ongoing / Medium & High	Town
Local Plans and Regulations	Explore ways to expand meals on wheels services.	Expand the reach of organizations that serve meals to vulnerable populations / those in need.	Low	Town Office of Aging and Community Center	Ongoing / High	Town
Local Plans and Regulations	Provide more opportunities and encourage volunteering for the fire department.	Build capacity for trained volunteers ready for disaster response deployment.	Low	Town Fire Department	Ongoing / High	Town
Local Plans and Regulations	Explore additional ways to support REPC.	Maximize the effectiveness of REPC.	Low	Town Admin	Ongoing / High	Town
Local Plans and Regulations	Identify erosion vulnerability along roadways.	Reduce the risk of injury, loss of life, or damage to property as a result of poor roadway conditions for motorists.	Low	Town DPW	Ongoing / Medium & High	Town, EOEEA
Local Plans and Regulations & Structure and	Perform permeable surface analysis along Town roadways and parking lot to identify opportunities for enhanced stormwater management.	Increase the use of permeable surfaces to foster natural percolation, groundwater recharge, and reduce the	Low	Town DPW	Ongoing / Medium & High	Town, EOEEA

Category of Action	Description of Action	Benefit	Cost	Implementation Responsibility	Timeframe / Priority	Resources / Funding
Infrastructure Projects		strain on municipal wastewater systems.				
Local Plans and Regulations & Structure and Infrastructure Projects	Maintain dirt roads in a "state of good repair."	Reduce the risk of injury, loss of life, or damage to property as a result of poor roadway conditions for motorists.	High	Town DPW	Ongoing / Medium	Town, MassDOT
Local Plans and Regulations	Study the feasibility of creating a municipal position that has the responsibility of inventorying all the municipal buildings, documenting their accessibility issues, and prioritizing repairs to make more accessible.	Ensure accessibility to all municipal buildings, particularly among those with mobility limitations, especially during emergency events, to reduce the risk of loss of life.	Low	Town Admin and DPW	Short / High	Town
Local Plans and Regulations	Support "Villages of the Berkshires" formation to provide service and support to those living at home.	Improve social resiliency of Lenox and establish better communication and care for the aging populations.	Medium	Town Office of Aging and Community Center	Ongoing / High	Town
Local Plans and Regulations	Update the Capital Improvement Plan.	Integrate hazard mitigation and climate change actions in the CIP.	Low	All Town Departments	Ongoing / High	Town
Local Plans and Regulations	Assess school buildings for long term sheltering capacity.	Expand municipal sheltering capacities to shelter residents during hazardous events.	Low	Town School Admins and Emergency Management Director	Short / High	Town, FEMA

Category of Action	Description of Action	Benefit	Cost	Implementation Responsibility	Timeframe / Priority	Resources / Funding
Local Plans and Regulations	Encourage greater energy efficiency in long-term capital plans.	Proactively improve the energy efficiency and resiliency of the built environment.	Low	Town Admin and Town DPW	Short / High	Town, DOER
Structure and Infrastructure Projects	Develop roof replacement plan for High School.	Reduce the risk of damage from hazardous weather to public school facilities.	Low	Town School Admins	Short / High	Town
Structure and Infrastructure Projects	Ensure all municipal buildings are ADA compliant.	Ensure accessibility to all municipal buildings, particularly among those with mobility limitations, especially during emergency events, to reduce the risk of loss of life.	Medium	Town Admins	Low / Short	Town
Local Plans and Regulations	Develop culvert monitoring list and conduct ongoing maintenance.	Increase resilience at road-stream crossings	Low	Town DPW	Ongoing / Medium	Town
Structure and Infrastructure Projects	Implement culvert rightsizing based on order of priority.	Reduce the risk of flooding and road damage due to clogged culverts. Increase connectivity of aquatic passage.	High	Town DPW	Ongoing / Medium	Town, EOEEA, DER
Structure and Infrastructure Projects & Natural Systems Protection	Assess feasibility for implementing green infrastructure solutions along/near bridges and culverts to minimize the impacts of stormwater runoff (non-point source pollution).	Reduce toxins in the local environment by utilizing nature-based solutions that increase resilience.	High	Town DPW	Ongoing / Medium	Town, EOEEA, DER
Structure and Infrastructure Projects & Natural	Replace road-stream crossings up to the MA River and Stream Crossing Standards on Plunkett, Dugway, East, Martha,	Ensure resilience of road-stream crossings and thus roadway stability.	High	Town DPW	Ongoing / High	Town, EOEEA, DER

Category of Action	Description of Action	Benefit	Cost	Implementation Responsibility	Timeframe / Priority	Resources / Funding
Systems Protection	Birchwood, Edgewood and Sullivan Streets.					
Structure and Infrastructure Projects	Update storm and wastewater sewer systems.	Establish more resource efficient methods of storm and wastewater treatment, with particular emphasis on utilizing nature-based solutions.	High	Town DPW	Ongoing / High	Town
Structure and Infrastructure Projects & Natural Systems Protection	Increase the size of and improve swale along Plunkett Street.	Reduce non-point source pollution while increasing effectiveness of green infrastructure to mitigate impacts from stormwater such as flooding and roadway undermining.	Medium	Town DPW	Ongoing / Medium	Town, EOEEA, DER
Local Plans and Regulations	Look to California Carbon Market (Audubon) as model for conserving forests.	Preserve natural areas, maximize carbon storage and work to decarbonize other activities that contribute to local and global greenhouse gas emissions.	Low	Town Land Use, local Audubon, and BNRC	Short & Ongoing / Medium & High	Town
Local Plans and Regulations	Reduce strain on septic systems and wastewater treatment plant by creating an efficient toilet purchase program through the Town.	Reduce pressure on existing sytems.	Low	Town DPW and Wastewater Department	Ongoing / High	Town
Local Plans and Regulations & Natural	Develop zoning to protect riparian buffers.	Protect and preserve natural areas that work to mitigate the impacts of flooding thereby minimizing the risk of	Low	Town DPW	Ongoing / Medium	Town

Category of Action	Description of Action	Benefit	Cost	Implementation Responsibility	Timeframe / Priority	Resources / Funding
Systems Protection		damage to property and injury or loss of life.				
Natural Systems Protection	Engage in activities to restore riparian buffers.	Restore natural areas that provide flood protection and natural habitat for native species.	Medium	Town DPW	Ongoing / Medium	Town, EOEEA, DER
Local Plans and Regulations & Natural Systems Protection	Implement water temperature monitoring program of freshwater resources important to fish species.	Preserve native habitats that attract tourists, thereby ensuring economic development.	Medium	Mass Wildlife	Ongoing / Medium	Town, EOEEA
Local Plans and Regulations & Natural Systems Protection	Develop system to monitor runoff loads into important fresh water supplies.	Reduce non-point source pollution and the prevelance and spread of other pollution (i.e. toxic chemicals) by enhancing detection abilities.	Medium	Town DPW	Ongoing / Medium	Town, EOEEA, MassDEP
Education and Awareness Programs	Develop educational resources outlining fisheries management practices.	Equip residents with knowledge and best management practices to ensure the continued productivity of the resources and the accomplishment of other fisheries objectives.	Low	Town Utility billing	Ongoing / Medium	Town
Local Plans and Regulations	Consider beaver activity when constructing trails.	Minimize developing in areas susceptible to flooding and other issues brought about by	Low	Town Land Use	Ongoing / High	Town

Category of Action	Description of Action	Benefit	Cost	Implementation Responsibility	Timeframe / Priority	Resources / Funding
		beaver activites to prevent damage to property.				
Structure and Infrastructure Projects	Implement beaver deceivers in areas deemed appropriate.	Minimize the risk of flooding and roadway washouts due to beaver activities (i.e. clogging/plugging cluverts).	Low	Town DPW	Ongoing / High	Town, EOEEA, DER
Local Plans and Regulations	Explore various models for responding to beaver dam failures and/or breaks.	Increase emergency preparedness response to dam breaks/failures thereby reducing the risk of injury or loss of life.	Low	Town DPW	Ongoing / High	Town, EOEEA
Local Plans and Regulations	Prevent development on Yokun Brook where there is heavy beaver activity.	Prevent development in floodplain areas.	Low	Town DPW	Ongoing / High	Town
Local Plans and Regulations	Allow upscaling of beaver dams for flood control in undeveloped areas.	Provide flood protection in developed areas by utilizing undeveloped areas as natural flood management zones.	Low	Town DPW	Ongoing / High	Town
Local Plans and Regulations	Engage in conversations to ensure cultural and historical institutions and properties are storm ready.	Reduce the risk of damage to historic or culturally significant properties from natural hazards.	Low	Town Admin and Local Cultural properties	Ongoing / High	Town
Local Plans and Regulations	Coordinate emergency preparedness response among cultural and historical institutions and properties with federal programming.	Adequately prepare historic and culturally significant properties to be resilient to natural hazards.	Low	Town Admin and Local Cultural properties	Ongoing / High	Town, FEMA
Structure and Infrastructure Projects	Secure funding and implement retrofits to cultural and historical properties and	Adequately prepare historic and culturally significant	Low	Town Admin and Local Cultural properties	Ongoing / High	Town, FEMA

Category of Action	Description of Action	Benefit	Cost	Implementation Responsibility	Timeframe / Priority	Resources / Funding
	institutions to ensure effective emergency response.	properties to be resilient to natural hazards.				
Local Plans and Regulations	Assess options to better manage stormwater along Housatonic Street.	Reduce strain on municipal wastewater systems and utilize nature-based solutions to reduce non-point source pollution, prevent flooding and encourage natural infiltration/aquifer recharge.	Low	Town DPW	Long / High	Town, EOEEA, MassDEP
Local Plans and Regulations	Perform analysis of potential siting for and sizing of rain gardens with a catch basin assessment.	Utilize nature-based solutions in appropriate areas to prevent flooding and impacts of non-point source pollution.	Low	Town DPW	Ongoing / Medium	Town, EOEEA
Local Plans and Regulations	Assess where stormwater is collected from impervious surfaces and identify opportunities to mitigate on-site.	Minimize the impacts of non-point source pollution and strain on municipal stormwater systems.	Low	Town DPW	Ongoing / Medium	Town, EOEEA
Local Plans and Regulations & Natural Systems Protection	Develop zoning to require green infrastructure (curb cuts and bioswales) integration into new developments for stormwater infiltration.	Utilize nature-based solutions in appropriate areas to prevent flooding and impacts of non-point source pollution.	Low	Town DPW	Ongoing / Medium	Town
Structure and Infrastructure Projects & Natural Systems Protection	Design stormwater infrastructure to also provide habitat for native species.	Utilize nature-based solutions to prevent flooding and impacts of non-point source pollution while maximizing native habitat space for production of ecosystem services.	Medium	Town DPW	Ongoing / Medium	Town, EOEEA, DER

Category of Action	Description of Action	Benefit	Cost	Implementation Responsibility	Timeframe / Priority	Resources / Funding
Local Plans and Regulations & Natural Systems Protection	Perform analysis of use of rain gardens on private property to mitigate roof and other stormwater runoff.	Utilize nature-based solutions in appropriate areas to prevent flooding and impacts of non-point source pollution.	Low	Town DPW and resident volunteers	Ongoing / Long	Town, EOEEA
Education and Awareness Programs	Educate homeowners on rain gardens as green infrastructure approach to mitigate runoff.	Utilize nature-based solutions in appropriate areas to prevent flooding and impacts of non-point source pollution.	Low	Town Utility billing	Ongoing / Long	Town, EOEEA
Local Plans and Regulations	Amend zoning bylaws/enhance storm water management requirements that are enforceable and incorporate into Master Plan updates.	Minimize the risk of flooding and damage to property and the conveyance of non-point source pollution.	Low	Town Land Use and Zoning Board	Long / High	Town
Local Plans and Regulations	Develop and provide incentives to developers to incorporate green infrastructure designs.	Increased adoption of nature-based solutions and green infrastructure approaches to increase resilience to natural hazards.	Low	Town Admin	Long / High	Town
Local Plans and Regulations	Build on Town stretch code to be more robust and require greater energy efficiency.	Proactively improve the energy efficiency and resiliency of the built environment.	Low	Town Admin	Long / High	Town, DOER
Local Plans and Regulations & Natural Systems Protection	Create an impervious surface tax on developers of projects that have large footprints with large areas of impervious surfaces.	Generate tax revenue to fund other resiliency projects in Town.	Low	Town Admin	Long / High	Town

Category of Action	Description of Action	Benefit	Cost	Implementation Responsibility	Timeframe / Priority	Resources / Funding
Local Plans and Regulations	Assess and implement (if viable) ordinance that reduces restrictions on chicken ownership and potentially loosens restrictions on property set-back requirements as natural pest management approach.	Increase utilization of natural pest management approach to, among other benefits, reduce the spread/prevelance of diseases.	Low	Town Admin	Ongoing / High	Town
Education and Awareness Programs	Educate residents on use of chickens for controlling tick population to mitigate spread of disease.	Increase utilization of natural pest management approach to, among other benefits, reduce the spread/prevelance of diseases.	Low	Town Utility billing	Ongoing / Medium	Town, EOEEA
Local Plans and Regulations	Provide financial assistance for tree management on private property.	Reduce the build-up of debris thereby minimizing risk of damage to property from natural hazards.	Medium	Town Admin	Ongoing / Medium	Town
Local Plans and Regulations	Target and remove Japanese Barberry.	Proactively mitigate invasive species.	Low	Town DPW	Ongoing / Medium	Town, EOEEA
Local Plans and Regulations & Natural Systems Protection	Continue to look for approaches to bolster natural areas and enhance their abilities to mitigate various hazards resulting from climate change.	Increase the resilience of natural areas.	Low	Town DPW	Ongoing / High	Town, EOEEA, DER
Local Plans and Regulations	Evaluate Kennedy Park for carbon storage potential and protect these natural resources.	Improve resiliency of local forests and strategically guide development while mitigating climate change.	Low	Town Land Use and DPW	Ongoing / High	Town, EOEEA

Category of Action	Description of Action	Benefit	Cost	Implementation Responsibility	Timeframe / Priority	Resources / Funding
Local Plans and Regulations & Natural Systems Protection	Identify and apply for grant programs to pay for invasive species removal from Kennedy Park.	Strategically eliminate threats posed by invasive species.	Low	Town Land Use	Ongoing / High	Town, EOEEA
Local Plans and Regulations & Natural Systems Protection	Identify and implement drinking water best management practices that are appropriate for local, natural areas/natural watershed to preserve water quality.	Protect Town's water supply.	Low	Town Water Department	Ongoing / High	Town
Local Plans and Regulations & Natural Systems Protection	Continue to manage Hardy Kiwi (removal).	Strategically eliminate threats posed by invasive species.	Low	Town Land Use	Ongoing / High	Town, EOEEA
Local Plans and Regulations & Education and Awareness Programs	Engage with private landowners including homeowners, hotels, resorts, and cultural venues with forest management techniques and invasive species removal.	Create a more informed public to prevent the spread of invasive species.	Low	Town Land Use	Ongoing / High	Town
Local Plans and Regulations	Engage in coordinated group purchasing program with other municipalities to reduce the overall costs of a private company conducting ash tree removal services.	Strategically eliminate threats posed by invasive species.	Low	Town Land Use	Ongoing / High	Town

Category of Action	Description of Action	Benefit	Cost	Implementation Responsibility	Timeframe / Priority	Resources / Funding
Local Plans and Regulations	Update and expand Lenox's Forest Management Plan to include more guidance on invasive species and tree debris management.	Provide a path for eliminating invasive species.	Low	Town Land Use	Ongoing / High	Town, EOEEA
Local Plans and Regulations	Promote replanting via Town-wide tree program.	Improve resiliency of local forests and provide alternative incentives for forest landowners to strategically guide development while mitigating climate change.	Low	Town DPW	Short / High	Town
Education and Awareness Programs	Educate homeowners on safe burn practices/permit procedures for best forest management practices.	Reduce the risk of wildfire and debris build-up thereby minimizing the risk of damage to property from natural hazards.	Low	Town Utility billing	Short / High	Town
Local Plans and Regulations	Conduct Town wide asset mapping of entire forest, including street trees, to determine composition and better understand strengths and vulnerabilities of existing tree inventory.		Medium	Town Land Use	Ongoing & Long / Medium & High	Town, EOEEA
Local Plans and Regulations & Structure and Infrastructure Projects	Install bat boxes throughout Town.	Reduce the prevalence / spread of insect-born disease and illness among City residents	Low	Town DPW	Ongoing / High	Town, EOEEA

Category of Action	Description of Action	Benefit	Cost	Implementation Responsibility	Timeframe / Priority	Resources / Funding
Education and Awareness Programs	Promote planting of native plant species among homeowners.	Improve resiliency of local forests.	Low	Town Utility billing	Ongoing / High	Town, EOEEA
Local Plans and Regulations & Natural Systems Protection	Plant native species at municipal sites.	Establish resilient landscapes at municipal sites.	Low	Town DPW	Ongoing / High	Town, EOEEA
Local Plans and Regulations & Natural Systems Protection	Create programs that encourage growth of meadows and with native species to enhance health of pollinator species.	Establish resilient landscapes.	Low	Town Land Use	Ongoing / High	Town, EOEEA
Local Plans and Regulations & Natural Systems Protection	Analyze requirements for mowing operations and its impact on native species.	Establish resilient landscapes.	Low	Town DPW	Ongoing / High	Town
Local Plans and Regulations	Consider how to integrate pollinator species planting program into future development of solar arrays.	Establish resilient landscapes while increasing renewable energy production.	Low	Town DPW	Ongoing / High	Town, EOEEA

CHAPTER 5: PLAN ADOPTION

44 CFR § 201.6(c)(5)

This plan has been formally adopted by the governing body of the Town of Lenox.

Town of Lenox

A RESOLUTION OF ADOPTING THE

the Lenox Hazard Mitigation and Climate Adaptation Plan

WHEREAS the Town of Lenox recognizes the threat that natural hazards pose to people and property within the Town of Lenox; and

WHEREAS the Town of Lenox has prepared a hazard mitigation plan, hereby known as the Lenox Hazard Mitigation and Climate Adaptation Plan in accordance with the Disaster Mitigation Act of 2000; and

WHEREAS the Lenox Hazard Mitigation and Climate Adaptation Plan identifies mitigation goals and actions to reduce or eliminate long-term risk to people and property in the Town of Lenox from the impacts of future hazards and disasters; and

WHEREAS adoption by the Lenox Select Board demonstrates their commitment to the hazard mitigation and achieving the goals outlined in the Lenox Hazard Mitigation and Climate Adaptation Plan.

NOW THEREFORE, BE IT RESOLVED BY THE TOWN OF LENOX, MASSACHUSETTS, THAT:

In accordance with M.G.L. c. 40. the Lenox Select Board adopts the Lenox Hazard Mitigation and Climate Adaptation Plan.

ADOPTED by a vote of ____ in favor and ____ against, and ____ abstaining, this _____ day of

___________, ______.

Signature

Print Name

Title

ATTEST:

CHAPTER 6: PLAN MAINTENANCE

44 CFR § 201.6(c)(4)

44 CFR § 201.6(c)(4) asks for a section of local hazard mitigation plans to describe the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle, a process by which Lenox will incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate, and how the community will continue public participation in the plan maintenance process (44 CFR § 201.6(c)(4)(iii)).

Plan Review and Updates

§201.6(c)(4)(i) (iii)

The Town of Lenox will officially review needed updates for the Lenox HMCAP on an annual basis. The Town Planner and Land Use Director will facilitate the plan review and update process in accordance with FEMA guidance. The Department of Public Works will also play a significant role in updating the Lenox HMCAP, specifically in tracking completed hazard mitigation actions and new vulnerabilities. Active members of the plan review team will depend on specific needs of the community at that time and will be representative of resident and stakeholder interests. Updates will account for completed mitigation actions, new development, changing problem areas, and input from public involvement.

Annual review is scheduled to occur during development of the annual Capital Improvement Plan update and proposal Capital budget. Relevant updates will be shared with BRPC to update GIS data.

While the HMCAP must be updated every five years, the Town will begin the process of organizing and identifying funding for the plan update to be approved by FEMA every 3.5 years.

Integration in Future Planning

§201.6(c)(4)(ii)

The Lenox HMCAP will be utilized in all applicable future planning efforts in the Town, including integration of the action plan into any new or updated plans.

The final adopted HMCAP will made publicly available on the Town and BRPC websites for reference and comment. Any regional plans developed by BRPC or the Commonwealth should refer to the publicly available Lenox HMCAP to ensure consistency with the vision for community resilience to hazards.

APPENDICES:

APPENDIX A: MEETING DOCUMENTATION

I. Attendance Rosters
II. CRB Workshop Presentation
III. Public Listening Session Presentation

APPENDIX B: COMPLETED OR WITHDRAWN MITIGATION ACTIONS

APPENDIX C: COMPLETED CAPABILITY ASSESSMENT

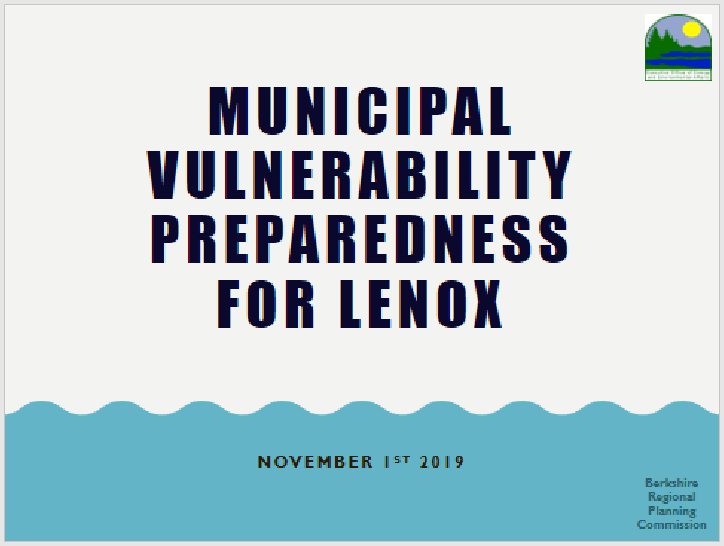
APPRENIX D: REQUEST FOR COMMENT FROM REGIONAL PARTNERS AND JURISDICTIONS

APPENDIX E: COMPLETED COMMUNITY RESILIENCE BUILDING WORKSHOP CONSOLIDATED MATRIX

APPENDIX F: TOP RESULTS FROM PUBLIC VOTING ON PROPOSED MITIGATION ACTIONS

APPENDIX A: MEETING DOCUMENTATION

CRB Workshop Presentation



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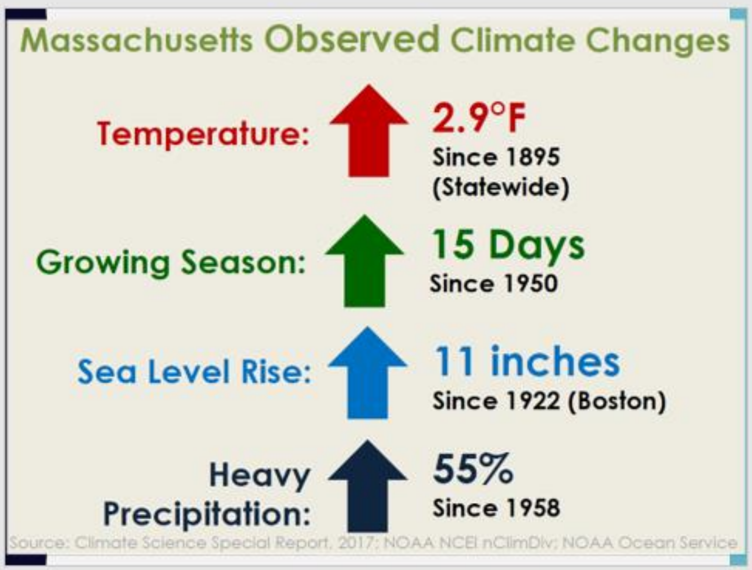
YOUR HAZARD MITIGATION PLAN
Inland Flooding
Vector-Borne Disease
Severe Winter Storm
Drought
Average/Extreme Temperatures
Tornadoes
Landslide
Wildfires
Other Severe Weather
Erosion
Invasive Species
Earthquake
Cyber Security
Hurricanes/Tropical Storms
Dam Failure
Berkshire Regional Planning Commission

5


WHAT IS HAPPENING NOW?
CHANGES IN PRECIPITATION AND TEMPERATURE

6


Massachusetts Observed Climate Changes
Temperature:
2.9°F
Since 1895 (Statewide)
Growing Season:
15 Days
Since 1950
Sea Level Rise:
11 inches
Since 1922 (Boston)
Heavy Precipitation:
55%
Since 1958
Source: Climate Science Special Report, 2017; NOAA NCEI nClimDiv; NOAA Ocean Service

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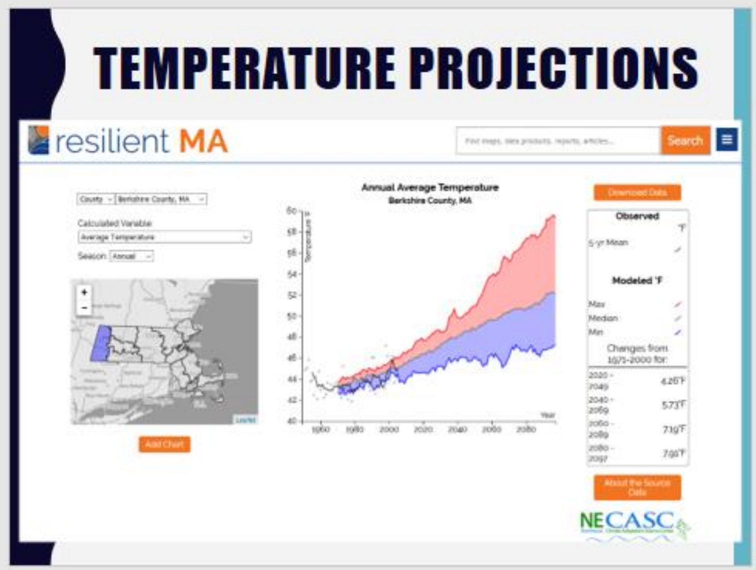

TEMPERATURE PROJECTIONS
resilient MA
Search
Annual Average Temperature
Berkshire County, MA
Observed
Modeled °F
NECASC

8

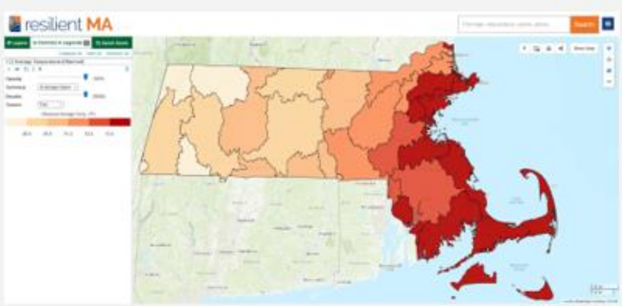
OF NIGHTS WHERE MINIMUM TEMPERATURE GREATER THAN 70°F

9

OBSERVED AVERAGE TEMPERATURE FALL 1960S

10

OBSERVED AVERAGE TEMPERATURE FALL 2000S



11

OBSERVED AVERAGE TEMPERATURE SPRING 1960S

12

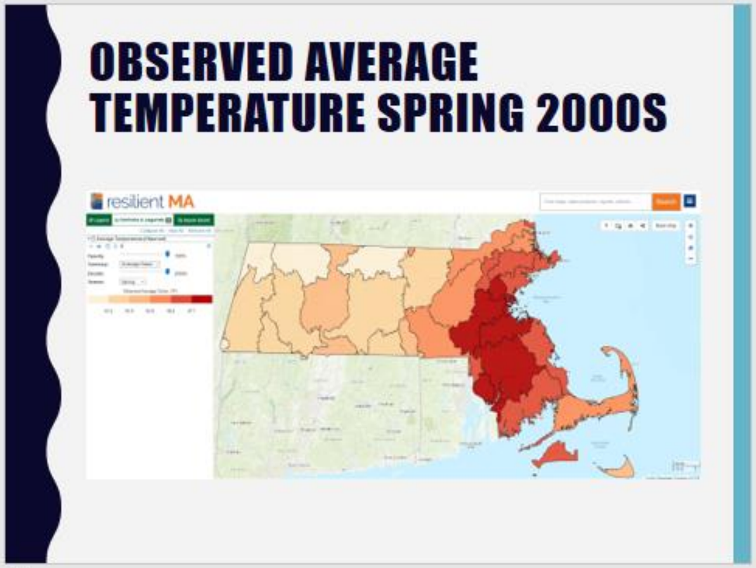

OBSERVED AVERAGE TEMPERATURE SPRING 2000S
resilient MA

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Photo Credit: NPR
Temperature increase or other effects of climate change depend on location.
Somali refugees fleeing in part due to drought
Venezuelan refugees fleeing in part due to flooding
Photo Credit: Colombia Reports

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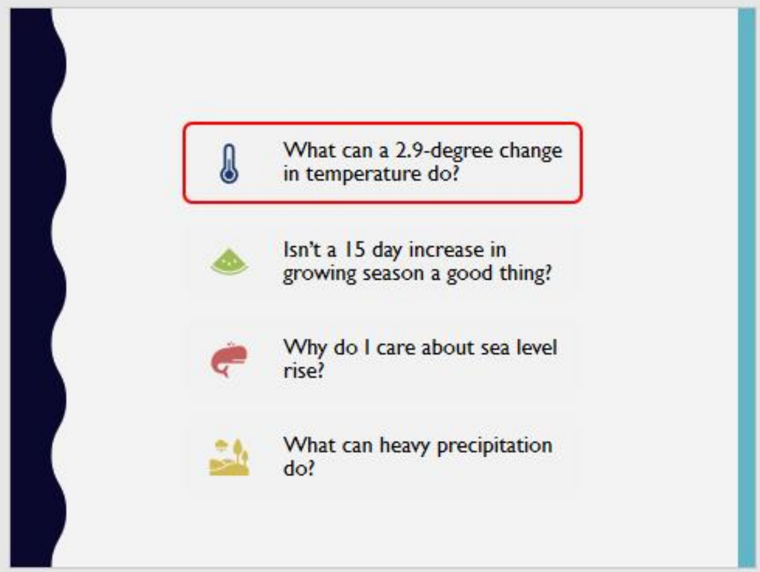
BREAKING IT DOWN
What can a 2.9-degree change in temperature do?
Isn't a 15 day increase in growing season a good thing?
Why do I care about sea level rise?
What can heavy precipitation do?

15


What can a 2.9-degree change in temperature do?
Isn't a 15 day increase in growing season a good thing?
Why do I care about sea level rise?
What can heavy precipitation do?

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CHANGE IN AVERAGE TEMPERATURE

LESS SNOW OR CHANGE IN SNOW PATTERNS AND THE ECONOMIC IMPACTS ON OUR LOCAL SKI MOUNTAINS

17

CHANGE IN AVERAGE TEMPERATURE

- Snow melting or rain when the ground is frozen leads to more flooding and dangerous road conditions

18

WINTER WEATHER CHANGES

ICE JAMS

19

CHANGE IN AVERAGE TEMPERATURE

- Drought – despite more intense rain events, the increased temperature evaporates moisture more quickly

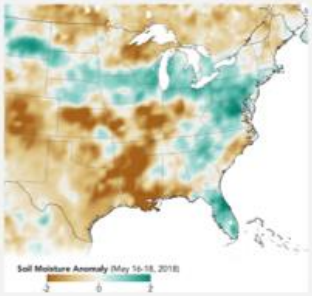
Springfield Park Brush Fire in April 2017 during the Massachusetts 48-week drought

Photo Credit: Matthew Kudlata via Berkshire Eagle

20

CHANGE IN AVERAGE TEMPERATURE

- Agricultural impacts – plants rotting or drying out and increased pests



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CHANGE IN AVERAGE TEMPERATURE

- Health impacts – heat is dangerous for the elderly, children, and people with disabilities

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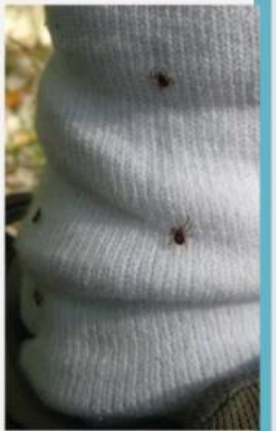
CHANGE IN AVERAGE TEMPERATURE

- Climate determines habitat, and changes in temperature and other factors lead to new plant and animal ranges and increased survival rates (think ticks living through the winter)



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Invasive and Pest Insects in Berkshire County Threatening Forest Health

Insect	Origin	Host Trees	DCR-Management Approach
Gypsy Moth	Introduced (Invasive)	Oaks, other deciduous species	Discovered in 1869, the current management approach relies on natural population controls- naturally abundant virus and fungus populations regulate gypsy moth population cycles.
Hemlock Woolly Adelgid	Introduced (Invasive)	Eastern hemlock	Discovered in 1989, two biocontrol species, Psedudoscymnus tsugae and Laricobius nigrinus, have been released in MA to limited establishment success.
Southern Pine Beetle	Native	Pitch pine	Population densities are being monitored through annual trapping. The impacts of climate change could significantly alter southern pine beetle generation periods and devastate pitch pine stands.
Emerald Ash Borer	Introduced (Invasive)	All ash species	Discovered in 2012, three biocontrol species, Tetrastichus planipennisi, Spathius galinae, and Oobius agrili, have successfully been released in MA. Continued releases are planned.
White Pine Needlecast	Native	Eastern white pines	White pine defoliation is being monitored across the state. Needlecast has been identified to be caused by multiple fungal pathogens; the most prevalent agent in Massachusetts is Lecanosticta acicola.

INCREASED INSECT SURVIVAL

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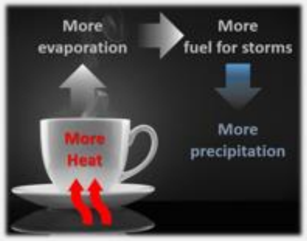
CHANGE IN AVERAGE TEMPERATURE



A one (1) degree Fahrenheit rise in ocean temperature can increase a hurricane's wind speed by 15 to 20 miles per hour – enough to shift a storm to the next category of severity.

https://www.yaleclimateconnections.org/2016/08/warmer-oceans-stronger-hurricanes/

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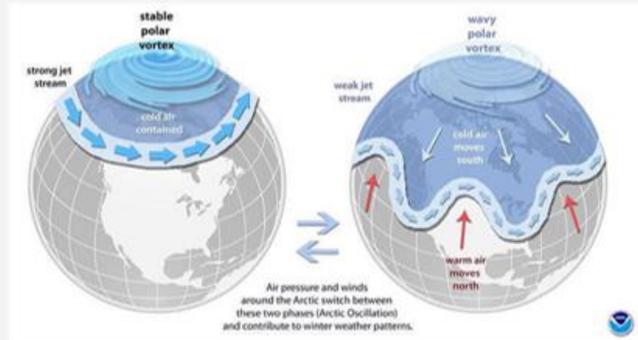
CHANGE IN AVERAGE TEMPERATURE



26

- What can a 2.9-degree change in temperature do?
- Isn't a 15 day increase in growing season a good thing?
- Why do I care about sea level rise?
- What can heavy precipitation do?

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CHANGING GROWING SEASON

- Early indicator: **Maple Syrup**
- According to the Maple Research Center at the University of Vermont, maple sugaring season on average starts earlier and ends earlier than it did 50 years ago, with an overall shorter season.
- Maple syrup is produced in a very short season in late winter during the alternating freezing and thawing cycles that control the flow of maple sap.
- Fewer freezing and thawing cycles mean the maple trees produce less sap.
- In addition, maple trees rely on snowpack during this time to protect their roots from freezing. Less snow can potentially affect the health of sugar maple trees.

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CHANGING GROWING SEASON

- Lengthening growing seasons mean insects spawning multiple generations per season and producing more generations per year.
- In addition to adding more insects to the environment, this can lead to pests developing greater resistance to insecticides. https://www.climatehubs.usda.gov/growing-seasons-changing-climate
- Farmers depend on knowing the Growing Degree Days to know when pests will hatch and when they need to apply pesticides or take other mitigative action to protect crops. https://ag.umass.edu/fruit/fact-sheets/winter-moth-in-new-england-fruit-crops


Winter Moth Larva

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- What can a 2.9-degree change in temperature do?
- Isn't a 15 day increase in growing season a good thing?
- Why do I care about sea level rise?
- What can heavy precipitation do?

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SEA LEVEL RISE

Impact on people's livelihood	Your summer vacation destination	Where your tax money goes
Important ecosystems	Climate refugees	

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SEA LEVEL RISE

Photo Credit: Jonas Gratzer/LightRocket via Getty Images via NPR

Photo Credit: AP Photo/Stephan Savoia

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What can a 2.9-degree change in temperature do?

Isn't a 15 day increase in growing season a good thing?

Why do I care about sea level rise?

What can heavy precipitation do?

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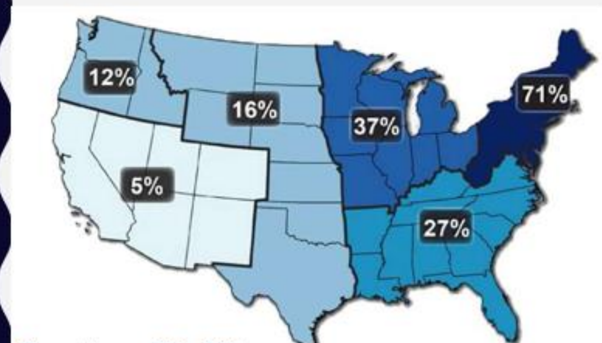
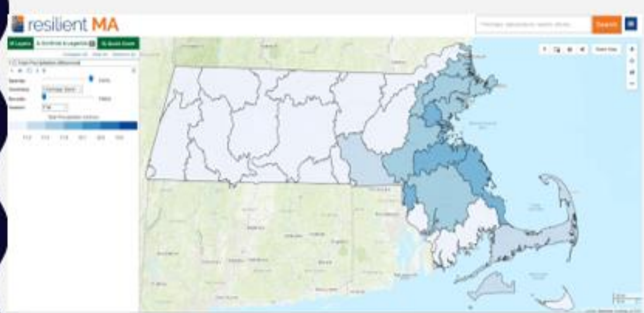
INCREASED INTENSE PRECIPITATION



Observed increase 1958 to 2012

34

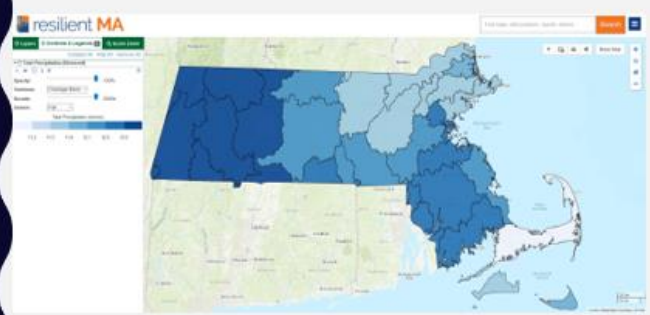
OBSERVED TOTAL PRECIPITATION 1960S FALL



Observed Total Precipitation Fall 1960s

35

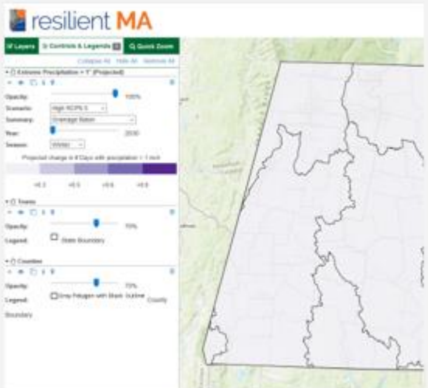
OBSERVED TOTAL PRECIPITATION 2000S FALL



Observed Total Precipitation Fall 2000s

36

PROJECTIONS: EXTREME PRECIPITATION > 1" 2030 WINTER



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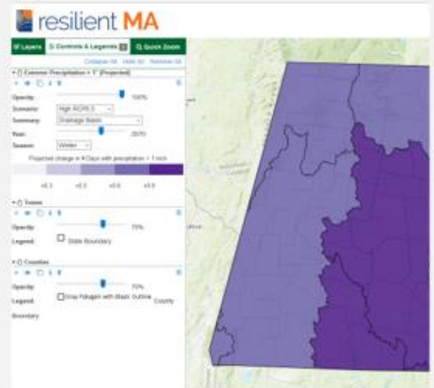
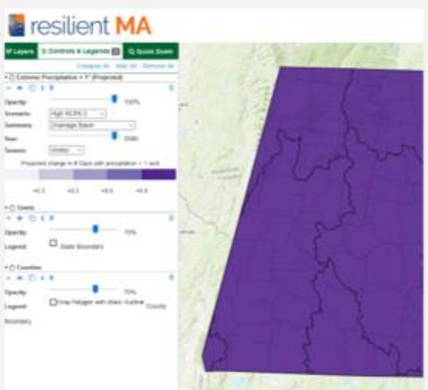
PROJECTIONS: EXTREME PRECIPITATION > 1" 2070 WINTER



38

PROJECTIONS: EXTREME PRECIPITATION > 1" 2090 WINTER



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LOCAL PROJECTIONS FOR TOTAL PRECIPITATION

- Between the 2030s and 2050s the Housatonic Basin will see an annual increase total precipitation exceed 3 inches
- By the 2090s, an increase of total precipitation of over 6 inches.

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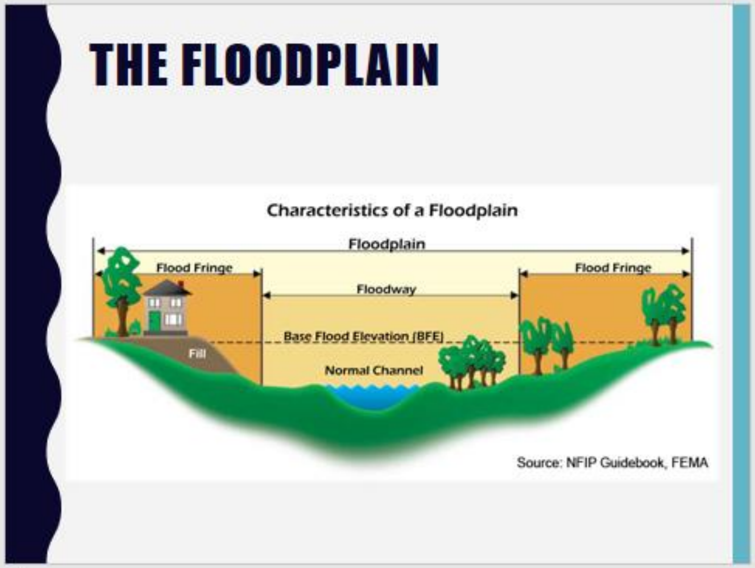
THE FLOODPLAIN
Characteristics of a Floodplain
Floodplain
Flood Fringe
Floodway
Flood Fringe
Base Flood Elevation (BFE)
Fill
Normal Channel
Source: NFIP Guidebook, FEMA

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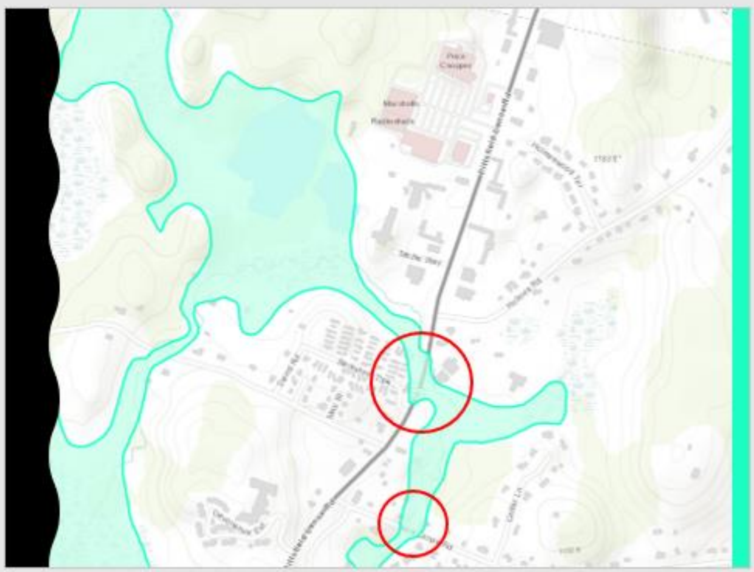
The Spruces
After
Hurricane Irene
in 2011
The Berkshire Eagle

42



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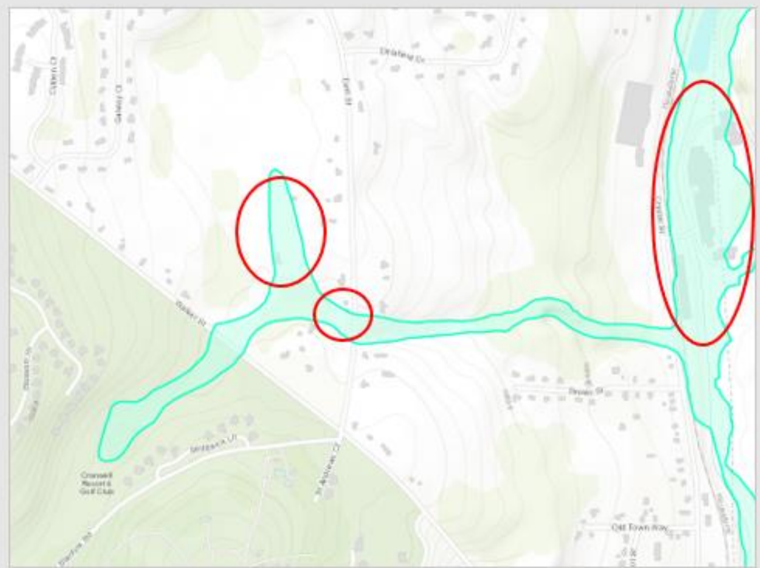
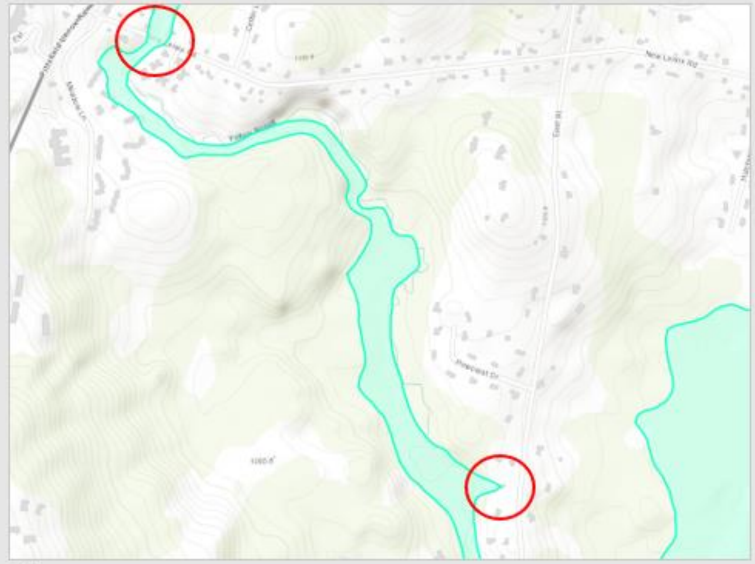


44


East St

45



46


New Lenox Rd

47


INCREASED PRECIPITATION AND INFRASTRUCTURE
• Road damage
• Dam Failure
• Culvert washouts
• Stormwater management issues
Photo Credit: Pennsylvania State Conservation Commission
Photo Credit: Mass Office of Energy and Environmental Affairs

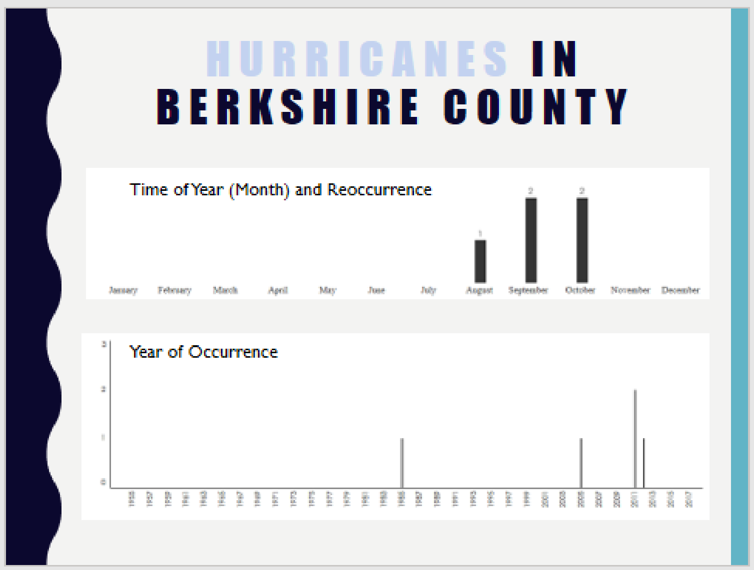
48


12 Severe Storm(s)
10 Hurricane
9 Snow
7 Flood
3 Fire
2 Coastal Storm
2 Tornado
1 Fishing Losses
1 Other
1 Severe Ice Storm
1 Terrorist
Number of Declarations
49 DECLARED DISASTERS
IN MASSACHUSETTS
SINCE 1953

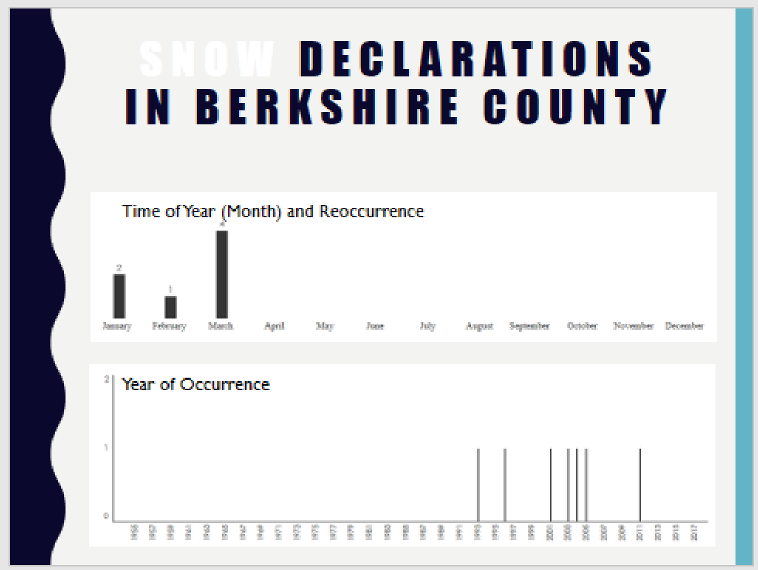
49


7 Snow
6 Severe Storm(s)
5 Hurricane
1 Flood
1 Severe Ice Storm
Number of Declarations
20 DECLARED DISASTERS
IN BERKSHIRE COUNTY
SINCE 1953

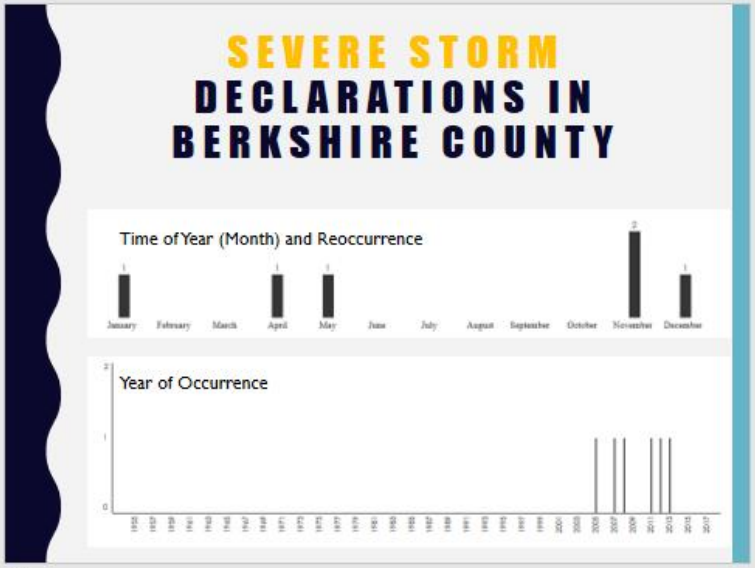
50


HURRICANES IN
BERKSHIRE COUNTY
Time of Year (Month) and Reoccurrence
January
February
March
April
May
June
July
August
September
October
November
December
Year of Occurrence

51


SNOW DECLARATIONS
IN BERKSHIRE COUNTY
Time of Year (Month) and Reoccurrence
January
February
March
April
May
June
July
August
September
October
November
December
Year of Occurrence

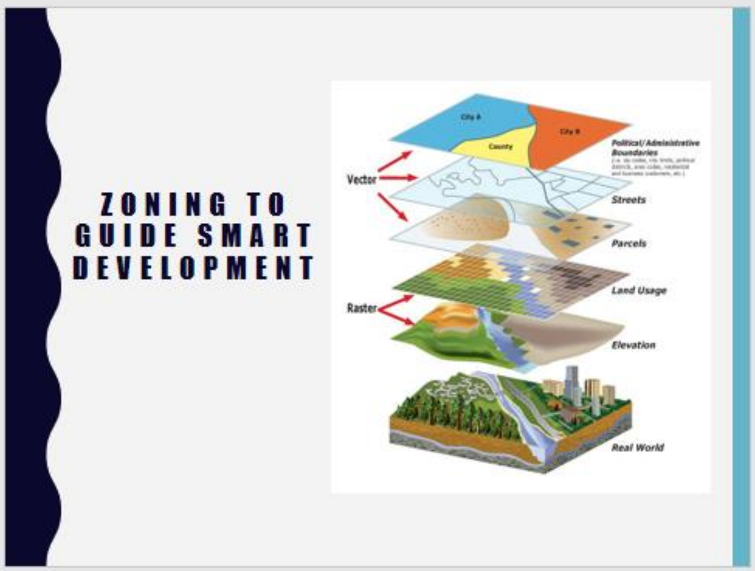
52


SEVERE STORM
DECLARATIONS IN
BERKSHIRE COUNTY
Time of Year (Month) and Reoccurrence
January February March April May June July August September October November December
Year of Occurrence

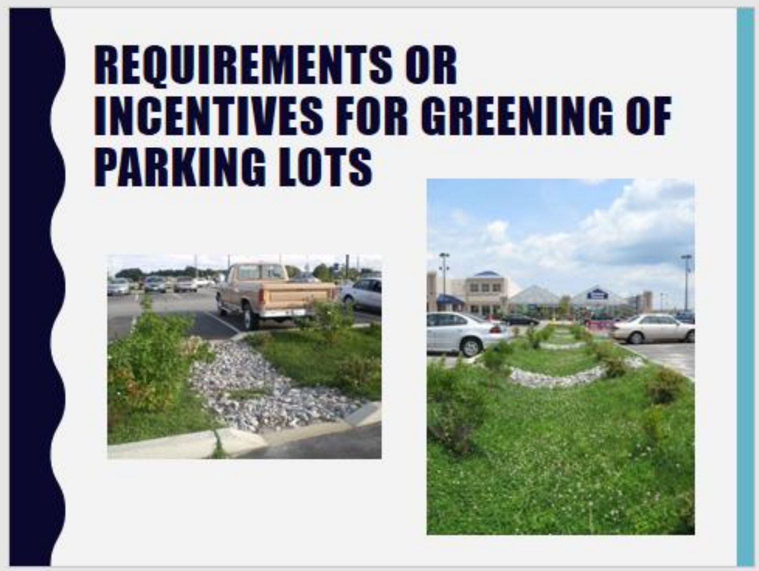
53


LAWN RUNOFF
GUTTER RUNOFF
STREET RUNOFF
STREET RUNOFF
NOW WE ARE
LOOKING FOR BETTER
ALTERNATIVES

54


ZONING TO
GUIDE SMART
DEVELOPMENT
Vector
Raster
Political/Administrative Boundaries
Streets
Parcels
Land Usage
Elevation
Real World

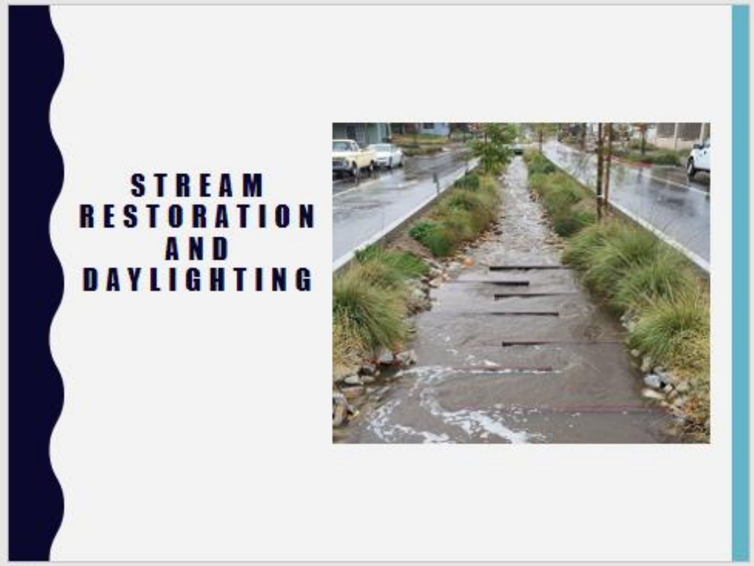
55


REQUIREMENTS OR
INCENTIVES FOR GREENING OF
PARKING LOTS

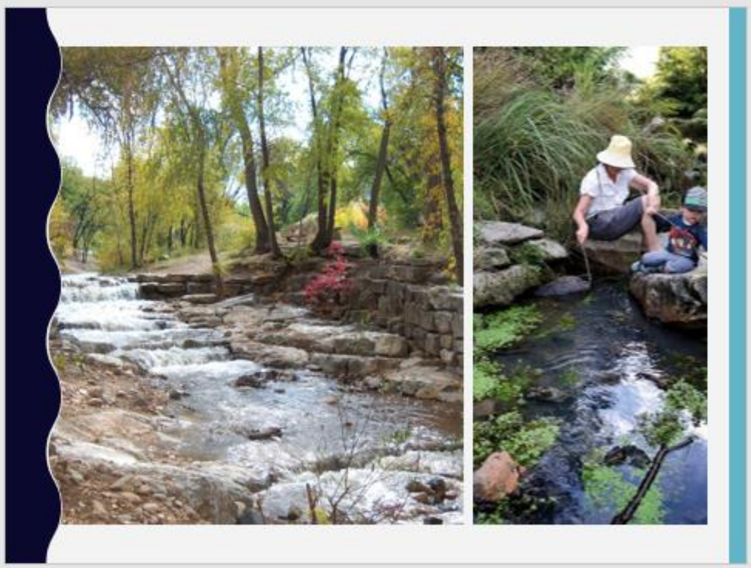
56


Porous Pave
RECYCLED TIRE PERMEABLE SURFACING
porouspaveinc.com
Examples of Porous Pavements
Permeable Pavers
Permeable Concrete
Grass Pavers
PERMEABLE PAVEMENT

57


STREAM
RESTORATION
AND
DAYLIGHTING

58



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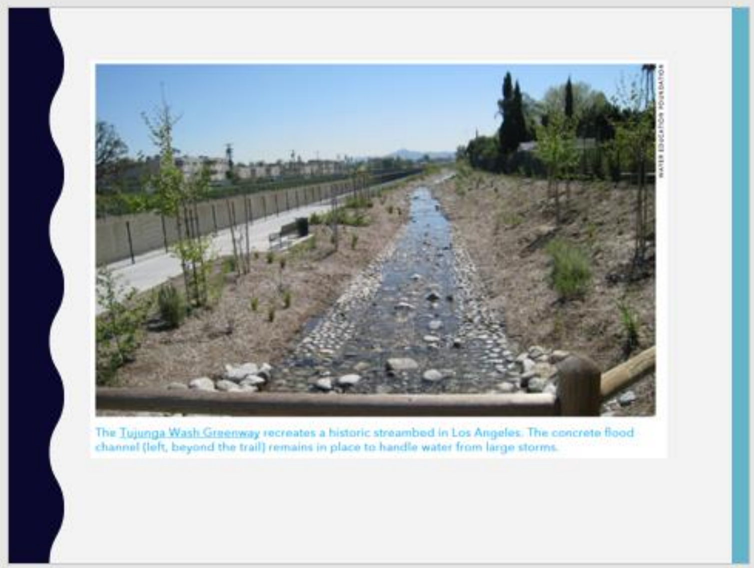
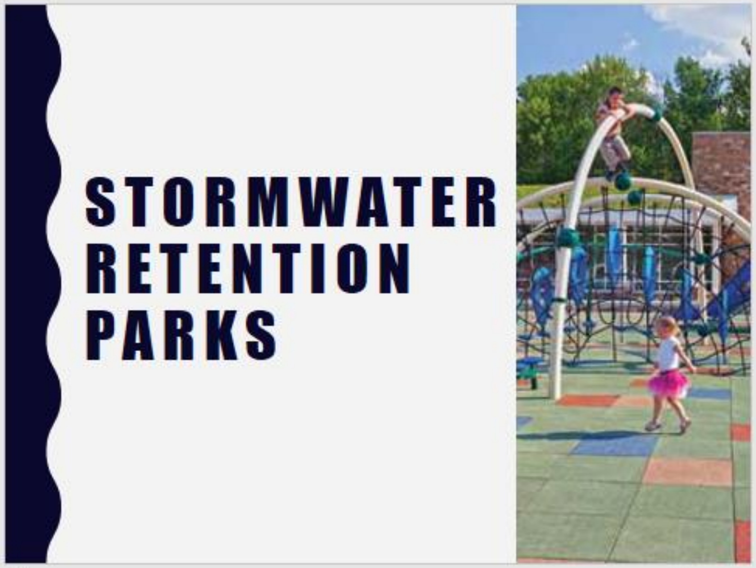

The Tujunga Wash Greenway recreates a historic streambed in Los Angeles. The concrete flood channel (left, beyond the trail) remains in place to handle water from large storms.

60


STORMWATER
RETENTION
PARKS

61

62

63


THIS PARK CAN HOLD TWO MILLION GALLONS OF STORMWATER

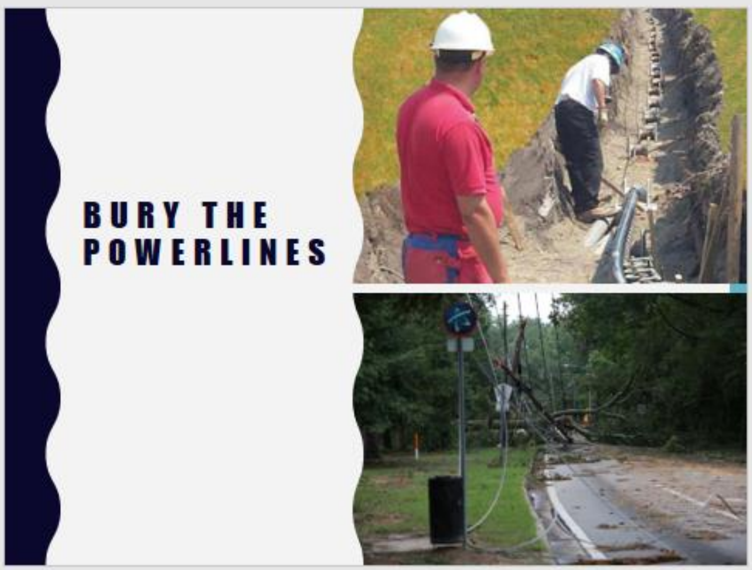
64


BIOSWALES… THEY CAN GO ANYWHERE

65


LIVING FENCES TO MITIGATE WIND AND DRIFTING SNOW

66


BURY THE POWERLINES

67


FEMA TOOLS FOR EVALUATING ECOSYSTEM SERVICES
Benefit-Cost Analysis Tools for Drought, Ecosystem Services, and Post-Wildfire Mitigation for Hazard Mitigation Assistance
Ecosystem Service Benefits Calculator
Aquifer Storage and Recovery Benefit Cost Analysis Calculator Tool
Supplemental Guidance for Conducting a Benefit Cost Analysis for Floodplain and Stream Restoration Projects

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COMMUNITY NETWORKS ARE KEY TO RESILIENCE

69

COMMUNICATION

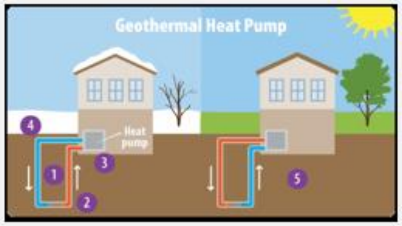
- How can we inform community members on hazards and ways to stay safe?
- How will we check on our most vulnerable populations in hazardous conditions?
- How will we come together to recover from a disaster event to be stronger for next time?

70

SIMPLE ACTIONS FOR YOUR HOME OR BUSINESS

71

GEOTHERMAL – OFF THE GRID OPTION



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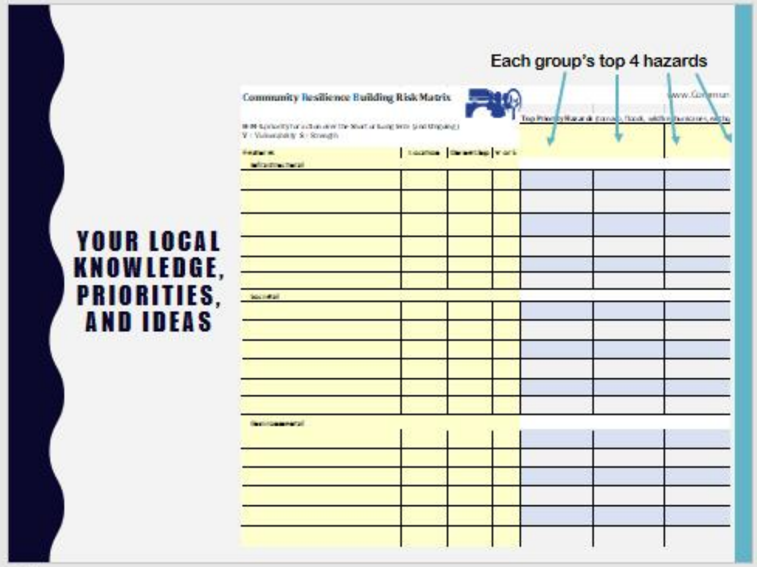
INSECT AND TICK CONTROL

73


YOUR LOCAL KNOWLEDGE, PRIORITIES, AND IDEAS
Each group's top 4 hazards
Community Resilience Building Risk Matrix

74


"FEATURES"
Infrastructural: municipal infrastructure, housing, utilities, commercial bldgs., municipal bldgs. and operations
Societal: collective ability to respond – first responders, health services, goods and services
Environmental: natural systems that protect, provide services or pose risk
Berkshire Regional Planning Commission

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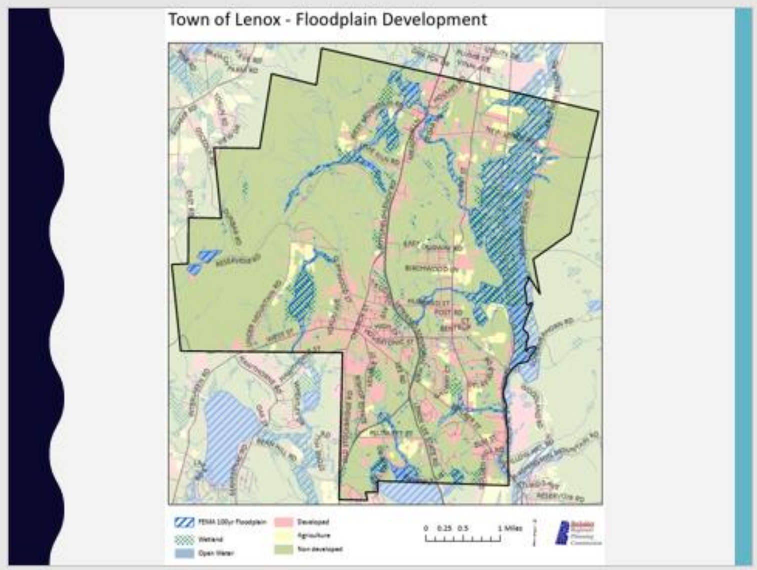
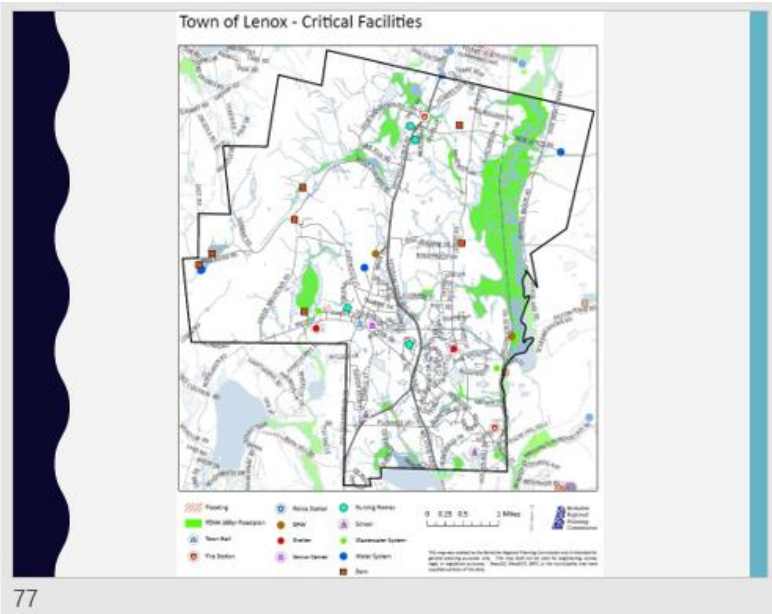

Town of Lenox - Floodplain Development

76


Town of Lenox - Critical Facilities
77


ACTIONABLE SOLUTIONS FOR THE MVP PLAN
1
Develop Your Actions
2
Prioritize them H-M-L and Time
3
Choose the Top 4 Priorities that your think are the greatest risks and should be addressed
4
Bring your Top 4 to the Full Group
Berkshire Regional Planning Commission
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Public Listening Session Water Bill Letter

Dear Lenox Resident,

We hope that you and your family are well!

For the past year, Lenox has been working to become an "MVP" Community, meaning it is working to plan for resilience in the face of climate change through hazard mitigation and emergency preparedness. This state administered program makes the community eligible for action funding. A day long workshop in November identified three priority categories: forest health, water resources and infrastructure, and emergency response volunteer capacity. We want to share with you the other categories and the range of challenges and opportunities.

A listening session was planned for March 10th. Due to COVID-19 concerns, the listening session was postponed. We hope that you will join us virtually on May 7th, 2020 at 5:30 p.m. to participate in a webinar style listening session. The link to the webinar is:

Via computer/smart phone/tablet:

https://zoom.us/j/96287569730?pwd=V2lIQVhKcHFZK0VFNXNtM2NOeUhwdz09

Meeting ID: 962 8756 9730

Password: 494033

By Phone:

One tap mobile

+13126266799,,96287569730#,,#,494033# US (Chicago)

+16465588656,,96287569730#,,#,494033# US (New York)

Dial by your location

+1 312 626 6799 US (Chicago)

+1 646 558 8656 US (New York)

+1 346 248 7799 US (Houston)

+1 669 900 9128 US (San Jose)

+1 253 215 8782 US

+1 301 715 8592 US

Meeting ID: 962 8756 9730

Password: 494033

Find your local number: https://zoom.us/u/ac3SNayT1P

We also hope you that you will complete a survey to further aid us in finalizing our Municipal Vulnerability Program plan. The link to the survey is:

Your input is valued and we hope to see you on May 7th, even if remotely, and look forward to having these conversations in person in the not too distant future.

Public Listening Session Presentation

APPENDIX B: COMPLETED OR WITHDRAWN MITIGATION ACTIONS

Table B.1: Completed Mitigation Actions since 2012

Category of Action	Description of Action	Benefit	Notes
Local Plans and Regulations	Encourage FEMA and MEMA to update Berkshire County's FEMA floodplain data and maps. Once completed, the Town should incorporate new information into existing and future planning efforts.	New FEMA maps would be more accurate and allow for a more accurate assessment of the flooding risk.	This 2005/2012 action is in the updated plan.
Local Plans and Regulations	Continue to strictly enforce floodplain bylaws and encourage the flood-proofing or relocation of existing structures in floodplain zones.	Tougher enforcement of existing bylaws would ensure that properties within a floodplain were properly protected.	Lenox continues to strictly enforce the floodplain bylaws and this 2005/2012 action qualifies as complete.
Local Plans and Regulations	Limit the expansion of infrastructure in hazard-prone areas.	Limiting the expansion of infrastructure and development would reduce the future risk of hazards.	This action is removed and replaced with more specific actions for the updated plan.
Local Plans and Regulations	Determine which major transportation routes are in inundation areas for dams of High or Significant Hazard.	Determining if the major routes are in an inundation area will allow responders to direct traffic away from the area during a disaster.	This action is included in the updated plan.

Category of Action	Description of Action	Benefit	Notes
Local Plans and Regulations/ Structural Projects/ Natural Systems Protection	Continue to prioritize and improve stormwater management systems that are located in hazard prone areas or are inadequate.	Improving stormwater management systems will reduce the risk of localized flooding due to improperly maintained systems or undersized systems.	This action is removed and replaced with more specific actions for the updated plan.
Local Plans and Regulations	Improve the development fee system to ensure that needed improvement costs are borne by new development.	Improving the development fee system will ensure that the town is not paying for upgrades to infrastructure due to the presence of the new development.	This action is included in the updated plan.
Local Plans and Regulations	Develop bylaws that require on-site containment of stormwater.	On-site bylaws will help reduce the amount of runoff and reduce the load on stormwater systems and thus reducing the risk of flooding.	This action is included in the updated plan.
Natural Systems Protection	Encourage the use of low-impact development techniques, especially in flood-prone areas.	Low-Impact development techniques will help eliminate runoff, thus reducing the risk of flooding due to over capacity stormwater systems.	This action is included in the updated plan.
Preparedness and Response Actions	Work with the City of Pittsfield to make sure the Farnham Dam is inspected, in good condition and has an EAP that is on file with both Lenox and Pittsfield EMDs.	Ensuring the condition of the dam will prevent failure and subsequent flooding.	This action is included in the updated plan.
Structural Projects	Continue to upgrade the main water line out of the reservoirs.	Upgrading the water lines will ensure their ability to withstand a disaster.	This action is included in the updated plan.

Category of Action	Description of Action	Benefit	Notes
Preparedness and Response Actions	Ensure that suspended water lines are protected during a flood event.	Protecting the water lines will ensure their ability to withstand a disaster.	This action is included in the updated plan.
Preparedness and Response Actions	As necessary, explore new groundwater supply options.	Obtaining new groundwater supply options will enable the town to better withstand potential droughts.	This action is removed and replaced with stakeholder preferred actions.
Preparedness and Response Actions	Investigate ways to increase water capacity from Pittsfield and Lee.	Obtaining access to additional water supplies will enable the town to better withstand potential drought.	The Town of Lenox has established an agreement with the City of Pittsfield for emergency water supply.
Education and Awareness Programs	Continue providing information to landowners in hazard- prone areas that discuss hazard mitigation.	Better informing landowners in hazard prone areas will improve response of land owners when a disaster occurs.	This action is removed and replaced with more specific actions for the updated plan.
Preparedness and Response Actions	Conduct local disaster response drills and feature them in local news media.	Conducting response drills better prepares communities for disasters and publicizing the drills raises the public's awareness of the potential hazards.	This action is included in the updated plan.
Preparedness and Response Actions	Develop and publicize local and regional evacuation routes and shelter locations, adding an online source through the town website.	Publicizing local routes and shelters better prepares citizens for disasters.	This action is removed and replaced with stakeholder preferred actions.

Category of Action	Description of Action	Benefit	Notes
Preparedness and Response Actions	Develop formal and legally-binding Mutual Aid Agreements for emergency response teams and DPWs.	MAA will enable communities to better work together in responding to disasters.	Completed in 2012 plan.
Preparedness and Response Actions	Fill communications gaps by adding new towers where necessary, using existing towers and structure were possible.	Filling communication gaps will enable responders to be in contact with each other and allow them to respond more quickly to disasters	Noted in the 2012 plan, WRHSAC has added/retrofitted several towers to improve emergency communications.
Preparedness and Response Actions	Increase local and regional emergency response training.	Improving training will enable responders to handle disasters better.	This action is removed and replaced with stakeholder preferred actions.
Preparedness and Response Actions	Re-evaluate shelter capacity for Lenox residents and determine each shelter's structural ability to withstand natural disaster events.	Determining shelter capacity and ability to withstand disasters will ensure a community can shelter its citizens during a disaster.	The WRHSAC evaluated shelters capacity through a regional sheltering plan.
Preparedness and Response Actions	Seek the creation of additional shelters where the needs are greatest.	Creating additional shelters to increase capacity will allow more residents to be taken care of during a disaster.	This action is removed and replaced with stakeholder preferred actions.
Preparedness and Response Actions	Seek funding to support equipping current shelters, replacing oldest and unusable materials first.	Having properly equipped shelters will enable them to be more readily utilized in times of a disaster.	This action is included in the updated plan.

Category of Action	Description of Action	Benefit	Notes
Preparedness and Response Actions	Formalize remaining local agreements for use of shared mass care shelters in the event of a disaster.	Agreements to share shelters assists communities who do not have enough capacity to shelter their residents during a disaster.	This action is included in the updated plan.
Preparedness and Response Actions	Determine ability of town governmental centers to withstand a variety of natural hazard events.	Ensuring town governmental centers ability to withstand disasters helps maintain response during disasters.	This action is included in the updated plan.
Preparedness and Response Actions	Continue reviewing evacuation and emergency plans for local institutions; reach out to those institutions not being reviewed.	Ensuring local institutions have evacuation and emergency plans reduces the risk and helps ensure the safety of the employees as well as increasing the ability for an institution to survive and reopen after a disaster.	This action is removed and replaced with stakeholder preferred actions.
Preparedness and Response Actions and Education and Awareness Programs	Improve record- keeping of local natural disasters and their impacts.	Improved record keeping will enable the community to better assess its risk as well as make it more competitive for grants.	This action is included in the updated plan.
Preparedness and Response Actions	Identify historic structures, businesses and critical facilities located in hazard-prone areas, including floodplains and dam failure inundation areas.	Identifying historic structures, businesses and critical facilities in floodplain and inundation areas will enable those facilities to be better prepared for the hazards and to prevent their loss.	Complete as part of the updated plan.

Capability Assessment Worksheet

Jurisdiction: Town of Lenox

Local mitigation capabilities are existing authorities, policies, programs, and resources that reduce hazard impacts or that could be used to implement hazard mitigation activities. Please complete the tables and questions in the worksheet as completely as possible. Complete one worksheet for each jurisdiction.

Planning and Regulatory

Planning and regulatory capabilities are the plans, policies, codes, and ordinances that prevent and reduce the impacts of hazards. Please indicate which of the following your jurisdiction has in place.

Plans	Yes/No Year	Does the plan address hazards? Does the plan identify projects to include in the mitigation strategy? Can the plan be used to implement mitigation actions?
Comprehensive/Master Plan	Y 1999	
Capital Improvements Plan	Y	Updated annually for budget purposes Does not address hazards explicitly Could be used to implement mitigation actions as necessary
Economic Development Plan	Y 1999	N
Local Emergency Operations Plan		Y
Continuity of Operations Plan		
Transportation Plan	Y 2017	No, it does not.
Stormwater Management Plan	N	
Community Wildfire Protection Plan	N	
Other special plans (e.g., brownfields redevelopment, disaster recovery, coastal zone management, climate change adaptation)		We hope to incorporate climate change planning into our master plan update and capital improvement planning

Building Code, Permitting, and Inspections	Yes/No	Are codes adequately enforced?
Building Code	Y	Version/Year: current IBC edition
Building Code Effectiveness Grading Schedule (BCEGS) Score		Score:
Fire department ISO rating		Rating:
Site plan review requirements	Y	Includes stormwater management, erosion control
Land Use Planning and Ordinances	**Yes/No**	**Is the ordinance an effective measure for reducing hazard impacts?** **Is the ordinance adequately administered and enforced?**
Zoning ordinance	Y	Section 10.1, Flood Plain Overlay District use limitations in mapped areas; requires Special Permit Section 7.4, Drainage and Erosion Control (only for larger campuses/development projects)
Subdivision ordinance	Y	Calls for protection of natural features; asks for hazard maps
Floodplain ordinance	Y	Our zoning map and zoning bylaw reference a Floodplain Overlay District but I am unable to find bylaw text
Natural hazard specific ordinance (stormwater, steep slope, wildfire)	Y	We have the Scenic Mountain Act which requires special review by Cons Comm for projects at or above 1,400 ft and in areas of steep slope.
Flood insurance rate maps		The zoning map refers to our FIRM dated July 5, 1982 and our Flood Boundary Floodway Map dated July 5, 1982
Acquisition of land for open space and public recreation uses	Y	We have a current Open Space and Rec Plan that identifies priority areas, and a set aside of CPA (Community Preservation Act) funds of $500,000 for open space acquisition
Other	Y	Scenic Mountain Act (elevation above 1400 ft and steep slope)

Administrative and Technical

Identify whether your community has the following administrative and technical capabilities. These include staff and their skills and tools that can be used for mitigation planning and to implement specific mitigation actions. For smaller jurisdictions without local staff resources, if there are public resources at the next higher level government that can provide technical assistance, indicate so in your comments.

Administration	Yes/No	Describe capability Is coordination effective?
Planning Commission	Y	Lenox has a five member, volunteer, elected Planning Board. Professional experience/training in planning or related fields is not a requirement.
Mitigation Planning Committee	Y	A committee was formed for the purpose of this plan.
Maintenance programs to reduce risk (e.g., tree trimming, clearing drainage systems)	Y	The DPW is working to digitize much of this information for improved management over time.
Mutual aid agreements	Y	
Staff	**Yes/No FT/PT[1]**	**Is staffing adequate to enforce regulations? Is staff trained on hazards and mitigation? Is coordination between agencies and staff effective?**
Chief Building Official	Y, FT	Lenox shares a (1) Building Commissioner w/ the Town of Lee.
Floodplain Administrator	Y FT	(I think it is the Chief Building Official)
Emergency Manager	Y, FT Fire Chief	
Community Planner	Y FT	
Civil Engineer	N	
GIS Coordinator	N	
Other		

Technical	Yes/No	Describe capability Has capability been used to assess/mitigate risk in the past?
Warning systems/services (Reverse 911, outdoor warning signals)	Y	Lenox has the ability to do reverse 911 calls and also Co
Hazard data and information	Y	Growing this capacity through MVP work, as well as DPW and Water projects to digitize infrastructure informa
Grant writing	Y	Department heads write grants, and work with the RPA to do so as well
Hazus analysis	N	
Other		

How can these capabilities be expanded and improved to reduce risk?
Inventorying and mapping resources, hazards and infrastructure will help to reduce risk, regular updating of this information. Distributing/sharing information with property owners and developers would also be beneficial.

Financial

Identify whether your jurisdiction has access to or is eligible to use the following funding resources for hazard mitigation.

Funding Resource	Access/ Eligibility (Yes/No)	Has the funding resource been used in past and for what type of activities? Could the resource be used to fund future mitigation actions?
Capital improvements project funding	Y	Used in past to improve municipal buildings and recreational assets; improve roads, water/sewer capacity...could be used to fund future mitigation actions.
Authority to levy taxes for specific purposes	Y	Lenox has the capacity to levy taxes for specific purposes and could do so to fund future mitigation actions.
Fees for water, sewer, gas, or electric services	Y	Lenox has fees for water and sewer services. These funds go toward the water and sewer systems and could be used to fund water- and sewer- related mitigation actions.
Impact fees for new development	N	Lenox does not levy impact fees specifically, but can negotiate with willing developers to help fund or off-set infrastructure improvement projects required by project proposals. If directly related to a project proposal, the town could use special conditions or an agreement w/ a developer to address mitigation actions.
Storm water utility fee	Y	
Incur debt through general obligation bonds and/or special tax bonds	Y	In the recent past the town has bonded the purchase of the library and land for housing; it can do so to fund mitigation projects as necessary and per approval at Town Meeting.
Incur debt through private activities	N	
Community Development Block Grant	Y	The town is seeking CDBG funds for this coming year, though for housing. It will contemplate applying in the future for infrastructure work.
Other federal funding programs	Y	Yes, funding from FEMA.
State funding programs	Y	The Town has received funds from DEP for work at the water plant and would consider seeking state funds for mitigation work
Other		

Education and Outreach

Identify education and outreach programs and methods already in place that could be used to implement mitigation activities and communicate hazard-related information.

Program/Organization	Yes/No	Describe program/organization and how relates to disaster resilience and mitigation. Could the program/organization help implement future mitigation activities?
Local citizen groups or non-profit organizations focused on environmental protection, emergency preparedness, access and functional needs populations, etc.	Y	Lenox Environmental Committee, volunteer enviro board BEAT...regional non-profit focused on environment I think both could (with additional resources) be of some assistance
Ongoing public education or information program (e.g., responsible water use, fire safety, household preparedness, environmental education)	Y	Water department has done outreach material in the past; website, subscription list, etc. can be useful in sharing information/recruiting volunteers
Natural disaster or safety related school programs	Y	The schools do safety drills
StormReady certification	N	
Firewise Communities certification	N	
Public-private partnership initiatives addressing disaster-related issues	N	
Other		

APPENDIX D: REQUEST FOR COMMENT FROM REGIONAL PARTNERS AND JURISDICTIONS

Correspondence Sent:

Correspondence Received:

Community **R**esilience **B**uilding Risk Matrix

www.CommunityResilienceBuilding.org

H-**M**-**L** priority for action over the **S**hort or **L**ong term (and **O**ngoing)
V = Vulnerability **S** = Strength

Top Priority Hazards (tornado, floods, wildfire, hurricanes, earthquake, drought, sea level rise, heat wave, etc.)

Features	Location	Ownership	V or S	Flooding; High Winds; Snow/Ice Storms; Ticks; Invasive Species; Change in Temperature; Drought	Priority H - M - L	Time Short Long Ongoing
Infrastructural						
Water Treatment Plant	Reservoir Rd.	Lenox	V/S	1) Secure funding and build a new plant. 2) Refer to the Columbia University study for efficiency recommendations. 3) Update the backup power for the plant. 4) Provide resident education before building new plant. 5) Complete analysis of legal barrier to reuse of water. 5) Assess reservoir capacity. 6) Assess increasing the pump size for bringing back up water from Pittsfield. 7) Confirm continuation of MOU with Pittsfield.	M-H	S-O
Culverts	(orange on map)	various	S	1) Assess/reassess and inventory culverts. 2) Refer to HVA-UConn flood analysis to prioritize culvert replacement. 3) Establish a town facilitated efficient toilet program. 4) water runoff Plunkett St. (marked on map), heavy rain goes over swale.	H	O
Swales	Plunkett St. and throughout Lenox	Lenox	S	1) Perform analysis of potential for and sizing of rain gardens with a catch basin assessment. 2) Assess where stormwater is collected and requirements and additional opportunities to mitigate on-site. 3) Design stormwater infrastructure to also provide habitat for native species. 4) Require curb cuts and bioswales through zoning on new development.	M	O
Roads	Town wide	Lenox	S	1) Identify erosion vulnerability. 2) Perform permeable surface analysis.	M-H	O
Basements	Throughout Lenox	Lenox and private	S	1) Perform/ educate on analysis of rain gardens to mitigate roof runoff and other stormwater. 2) Assess use of catch basins.	L	O
Electrical Lines	by white pines, pest - ash	Eversource, Lenox Dale	V/S	1) Bury more electrical lines. 2) Improve mapping to have GIS layers available after a disaster.	M	L
Wastewater Treatment including pump stations	(marked on map)	Lenox	V/S	1) Research new advanced technologies that would allow moving the plant out of the floodplain. 2) Complete tree cutting to improve access to facilities during storms. 3) Study the use of engineered wetland treatment systems for a new plant. 4) Utilize green infrastructure and allow for groundwater recharge.	H	S
Ice Dams	Town wide	private	V	1) Provide homeowner education to protect homes. 2) Work with CET - Center for EcoTechnology	L	S-O
Dams (Cleveland Reservoir)	(marked on map)	various	V/S	1) Perform drills of Code Red in case of emergency. 2) Coordinate with Pittsfield.	L-M	O
Public Safety / Critical Facilities	Fire, Police, & EMS	Lenox	S	1) Prevent building critical facilities in flood-prone areas. 2) Install an interactive digital map kiosk in Town Hall for residents to utilize. 3) Provide access to an interactive map of infrastructure, possibly through ArcGIS Online with BRPC.	M	O
Communication Networks	Town wide	Fire Tower- State, Verizon/Spectrum - fiber optic, Crown cell tower - Lenox, Mass123	S	Explore options with satellite radio	H	O
Septic Systems & Wells	Town wide	private	V/S	1) Initiate public education on household conservation and management. 2) Address illegal hookups. 3) Compete GIS mapping of infrastructure including hydrants, culverts, valves, etc.	L	O
Dirt Roads	Town wide			Maintain	M	O

Ensuring that developers abide by building contracts and stormwater best management practices.	241 Walker Street - new housing project	Lenox	V	Amend zoning bylaws/enhance storm water management requirements that are enforceable - include in Master Plan updates. Town should consider providing incentives to developers to incorporate green infrastructure designs and should make the stretch code more robust. Town could create an impervious surface tax on developers of projects that have large footprints with lost of impermeable surfaces.				H	L
Pump Station in Floodplain	Located on North Lenox Road.	Lenox	V	Assess upgrades to pump station and other flooding mitigation solutions.				L	L
Culvert replacement project	Edgewood	Lenox	S	Complete construction.				H	S
Culvert replacement needed	East Street by Housatonic River	Lenox	V	Structure is undersized and needs assessment and ultimate repair/replacement.				H	S
Town's water supply is insufficient at periods throughout the year.	Town wide	Lenox	V	Town should consider studying water availability projections for Lenox. The town should work to identify potential alternative drinking water source to supplement during periods of inadequacy. Consider educating residents on water-use reduction practices and products such as low-flow shower/faucet heads (education/outreach).				H	O
Improved Stormwater drainage	Housatonic Street	Lenox	V	Explore options to better manage stormwater along Housatonic Street.				H	L
Cell towers/cell service is lacking in Town	Lenoxdale, Hous	Lenox/Private	V	Lenox needs cell service improvements. Need to boost town wide coverage - Town should look into acquiring a cell reception boosters and strategically locating them to provide maximum coverage				H	O
Sewer and major issues with septic - major failures over past 10 years - challenging soils, maintenance, more water.	Plunkett, Dugway, East Street, Martha, Birchwood, Sullivan	Lenox/Private	V	In addition to there being septic/sewer issues - these streets have road-stream crossings that the Town would like to replace up to the updated MA River and Stream Crossing Standards. Storm and wastewater sewer systems need to be updated by the Town.				H	O
Old municipal buildings lack accessibility physically disabled, elderly population	Town wide	Lenox	V	The Town should think of creating a municipal position that has the responsibility of inventorying all the municipal buildings, documenting their accessibility issues and prioritizing repairs to make more accessible. This position would also include the responsibility of developing a prioritization plan to phase accessibility remedies and would be proactive rather than just reacting to problems that arise.				H	S
Sewer plant outdated		Lenox	V/S	Updated/Upgraded				H	S
Explore Testing/issues with pharmaceuticals in Town r	Town wide	Lenox	V	Explore how pharmaceuticals might end up in Town waterways and supply.				H	O
Cybersecurity	Town wide	Lenox	V	Explore hacking prevention tactics/plan to ensure protection of sensitive Town information and to prevent disruption of normal town wide functions.				H	O
Town Solar Panel Initiative	Town wide	Lenox	S	Enhance capability to store solar power/energy. Explore ownership models, incentives, group purchasing potential to expand Lenox's solar capabilities.				H	O
Power Loss -- Lines downed	All Over; esp Yokun & West Streets	National Grid	V	Ongoing trimming and removal of downed timber/excess brush year-round		Selectively bury lines underground		H	O
Roofs, High School and Private Property Damage	Townwide	Lenox/Private	V	Develop roof replacement plan for High School	Encourage the purchase of Flood Insurance for H.O. in at-risk areas	Incentivize roof replacement or maintenance with ice guards-- make a deal with a roofer for better rates		L	O
Roads & Culverts washouts/damage	Townwide; esp. So.East & Walker Sts	Lenox	S	Culvert monitoring list - ongoing maintenance	Consider "green" solutions whenever possible	Increase culvert size in order of priority		M	O

Flooding of basements	Townwide	Lenox/Private	V	Workshops to Homeowners on flood hazard controls, planting, drainage, pumps and other equipmen				M	O
Sheltering-in-place; unknown location warming/cooling shelters; no "full" shelter capability in town	Townwide	Lenox	V	Develop a List of buildings with back-up generators	Map of short and long term shelters, guidance on How to create an Emergency Kit	Where are the Cooling & Warming Shelters? Regional Shelters? Public awareness campaign needed for Emergency preparedness town wide		H	S
Aging buildings, pipes, other critical infrastructure	Townwide	Lenox	V	Update Capital Improvement Plan				H	O
Historic buildings/Important Cultural Institutions	Townwide	Lenox/Private	S/V	Are these institutions properly protected, up-to-code? Are they engaged in Preparedness with the To				L	S
Hotels & Lodging places	Townwide	Lenox/Private	V	Coordinate all Hotels/lodging places plans for evacuation and sheltering in place with the Town-wide preparedness plans; Emergency Kits per room?				M	O
School buildings	Townwide	Lenox	V	Develop roof replacement plan for High School	Assess for Long-term Shelter capability	Encourage greater energy efficiency in long-term capital plans		H	S
Power infrastructure - Energy efficiency & independence long-term is "safer" and desirable	Townwide	Lenox/Private		Investigate solar and microgrids	Consider additional back-up generators	What are Homeowner's options? Group buying/discounts?			
Societal									
Aging Population	Town wide		V	1) Establish better sheltering, heating, and cooling stations. 2) Explore and implement transportation alternatives for those who can no longer drive. 3) Promote communications and use of CodeRed				M	O
Single-Person Households	Town wide		V	Communication planning				L	O
Nursing Homes	Town wide	various	S	1) Enhance communication with nursing home managers. 2) Coordinate emergency plans with Town.				L	O
Tourists / Second Homeowners	Town wide		V/S	1) Identify how to best share emergency and preparedness information with visitors				L	O
Shelters	Schools	Lenox	S	1) Recruit personnel needed to staff facilities. 2) Support REPC 3) Promote volunteering with the Medical Reserve Corps or other organization to train volunteers for emergency situations.				H	O
Mutual Aid			S	Maintain agreements.				H	O
Code Red (Phone Calls)	Town wide	contracted service	S	Promote Code Red sign-up through PSA's				H	O
Fewer Volunteers (Fire Dept.)	Town wide		V	Encourage volunteering such as through Citizen Corps				H	O
Faith-Based Organizations	Town wide		S	Utilize for communication				L	O
Shelter Support Staff	Town wide		V	1) Build volunteer capacity	2) Provide training for volunteers/staff			H	O
Cultural & Historic Institutions and Properties	Town wide	various	S	1) Engage in conversation to make them more storm-ready 2) Coordinate with federal programming 3) Secure funding and implement retrofitting				H	O
Community Networks (neighbor to neighbor and social media)	Town wide			1) Bolster social resilience 2) Explore citizen reserve corps. 3) Purchase a digital sign on major roads for message communication				H	S
Community hubs (community center, bars, clubs, etc.)	Town wide			Identify community hubs (community center, bars, social clubs, etc.) and target communication.				H	S

There needs to be more community knowledge about emergency plans, emergency sheltering, locations, etc. If they don't already, Tanglewood and other large cultural events that draw tourists need evacuation plans for emergency situations.	Town wide	Lenox/Private	V	Town should consider disseminating information relevant to emergency education in as many mediums as possible including by mail, newspaper, and information on the Town website to inform residents of procedures during emergency situations. Increase emergency wayfinding signage in recreational areas.	H	O
The Town needs public transportation options that pass through the center of Town (downtown), community center, and provide information for tourists "checking-in" to Town for recreational visit.	Center of Town	Lenox/Private	V	Town should look for ways to increase transportation services - potential collaboration and coordination with major employers focused on devising solutions for low-income workers needing transportation to employment. Resorts should think about creating transportation services for employees/residents through a potential rideshare program. The Town should also engage in conversations with BRTA to advocate for establishing new routes through Lenox along with expanding services in the evenings and weekends. Maybe the Town could purchase a vehicle for shuttling folks to destinations. How can Lenox increase transportation services among cultural events such as Tanglewood?	H	S
The Town needs more diverse public outreach to reach vulnerable populations that are falling through the cracks.	Town wide	P	V	Conduct outreach through newspapers, website, social media, etc. The Town should think of developing a system of check-up calls to vulnerable populations (seniors - make signing up for this service optional to respect people's willingness to accept assistance). Lenox should think about creating a 'neighbor to neighbor' program as an informal check-up system - and strengthens community bonds. Coordinate outreach among various organizations. Work to expand partnerships with VNA's, Meals on Wheels, hospitals, faith organizations, etc.	H	O
Meals on Wheels	Town wide	Lenox/Private	S	Look to expand services.	H	O
Power outage - well pumps don't work, shelter in place (max. 2 days only)	Townwide	Private	V	Plan for power outage		
Preparedness - who to call, where to go, Code Red signups	Townwide	Lenox/Private	V/S	Create Emergency Kit containing #'s to call, list of Hospitals or other medical facilities; shelter locations, etc.		
Weather leading to personal injury (falls, all other)	Townwide	Lenox/Private	V	Sidewalk maintenance		
"Catastrophic" Event planning	Townwide	Lenox/Private	S	Establish procedures and long-term preparation		
Private care homes, Schools	Townwide	Lenox/Private	V	Coordinate Emergency Plans for each private entity with Town's Emergency Management Plan		
2nd Homeowners; Seasonal Visitors	Townwide	Lenox/Private	V	Targeted outreach - Emergency Kits for travelers, Who to call, where to go for help; Hospital locations		
"Extra" Support for "Vulnerable" - singles, elders, infirm	Townwide	Lenox/Private	S	Support "Villages of the Berkshires" formation to provide service and supports to those living at home		
Environmental						
Cold Water Fisheries	(fisheries marked on floodplain map)		S	1) Zoning or other methods to protect and restore riparian buffers. 2) Implement a temperature monitoring program 3) Replace culverts to meet stream crossing standards. 4) Monitor runoff into streams (nonpoint source pollution), 5) Public education 6) Look at daylighting buried streams	M	O
Solar Panels	(yellow on map)		S	1) Property analysis, identify resources for homeowners 2) Incentivize installation	M	S
Forests	Town wide	Lenox, State, private	V/S	1) Look to California Carbon market (used by Audubon) 2) Address hardy kiwi 3) mapping of forest composition	M-H	S-O

Lake Laurel	(map)	water - State dam - private	V/S	assess septic share responsibility	bat box building	connectivity with residential owners, replace invasive species		H	O
Native Wildlife & Habitat	Town wide		V/S	change zoning to allow for chickens - tick control	resident education	protect and restore connectivity (zoning)	remove Japanese Barberry	M	O
Beavers / Wetlands (flood capacity)	(brown, on floodplain map)	N/A	V	1) Utilize beaver deceivers. 2) Consider beaver activity when making trails to prevent bad investments. 3) Create models of inundation when dams break. 4) Prevent development on areas such as Yokun Brook where there is heavy beaver activity (ie. Through zoning).				H	O
Woods Pond (high PCB)	(southeast on map)		V	1) Ensure that developers are aware of PCBs. 2) Provide education on PCB contamination for residents and visitors.				M-H	O
Housatonic River	(floodplain map)	N/A	V/S	1) Continue remediation of the floodplain. 2) Develop trails 3) Use zoning to protect the floodplain and prevent development unless it is a compatible use. 4) Identify oil and wastewater pipelines on				H	S-L
Household Solar Panels			V/S	Provide a town program to identify feasibility and areas with the greatest solar potential.				H	S
Geothermal	critical facilities		S	Provide a town program to identify feasibility and encourage adoption.				M	L
Kennedy Park		Lenox	S	1) Clean up garbage. 2) Evaluate/protect for carbon sequestration. 3) Apply to invasive removal grants after assessment and identifying a prioritized and targeted approach.				H	O
Invasive Species - potential impacts to drinking water supply (algae blooms)	Town wide	Lenox/Private	V	Town should look to better manage natural areas/natural watershed(s) to preserve quality drinking water. Continue to manage Hardy Kiwi (removal). Developing management practices for private landowners/getting private landowners onboard with invasive species management (explore grant programs). Inquire if any hotels/resorts/cultural venues are currently managing their natural areas and specifically, invasive species. Look for ways to get these venues onboard with forest management techniques and invasive species management. Expand Lenox forest management plan.				H	O
Ticks/mosquitoes - increased prevalence of in Lyme disease and other diseases. Decline of bat species. Invasive European Fire Ants increase.	Town wide	Lenox	V	The Town should look to allocate money to educate residents on disease prevention tactics/mitigating the spread of disease. Education materials will include how to avoid tick bites, importance of staying on marked trails, etc. Control spread of barberry - include in forest management plan. Install bat boxes in Town. Promote planting on native plant species. Plant meadows and other natural plant species the encourage the health of important pollinator species - utilization of solar fields for such a use?				H	O
Ash Trees need to be managed in forests and on public/private lands	Town wide	Lenox	V	Incorporate ash tree removal and other invasive species removal into update Town wide forest management plan. Town should consider engaging in some sort of group purchasing program with other towns to reduce the overall costs of private company conducting ash tree removal services				H	O
Hazardous trees on roads - falling limbs, downing powerlines, etc.	Town wide	Lenox	V	Lenox should consider engaging in an asset mapping exercise. Map street trees - better understand strengths and vulnerabilities of existing tree inventory.				H	L
Need more general forest management and diversity by the Town	Town wide	Lenox	V	Lenox should consider engaging in an asset mapping exercise. Map street trees - better understand strengths and vulnerabilities of existing tree inventory.				H	L

The Town has lots of protected/conservation land	Town wide	Lenox	S	Continue to look for ways to bolster natural areas and enhance their abilities to mitigate various hazards resulting from climate change.	H	O
Too many restriction on chicken ownership	Town wide	Lenox	V	The town should consider looking into its ordinance covering chicken ownership requirements - potentially loosen restrictions on property set-back requirements to make it easier to own chickens that can provide natural pest management.	H	O
Lenox has lots of protected lands, floodplains, and forest cover	Town wide	Lenox	S	Update town wide forest management plan	H	O
Trees damaged; a lot of timber on the ground	Townwide	Lenox/Private	V	Update Forest Management Plan; Promote Replanting via Town-wide tree program; Invasive insects awareness, treatment; safe burn practices/permits procedure for Homeowners		
Beaver population monitoring for flood				Assess areas prone to flooding due to beaver activity		
Public water supply - Reservoir & pvt wells; aging infrastructure; capacity?	Townwide	Lenox/Private				
Tree removal				Create incentives for removal on pvt. Lands; "Make a deal" with contractor for bulk removal by Homeowners		
Sand & Salt use on all properties to enhance safety	Townwide	Lenox/Private		Publicize DPW-provided supplies; Enforce walkway snow removal		
Invasive Species	Townwide			Continue management		
Use of Pesticides/Herbicides				Find alternatives		
Community gardens for food independence				Support		
Floodplains dysfunctional or degraded				Floodplain restoration when possible		

APPENDIX F: TOP RESULTS FROM PUBLIC VOTING ON PROPOSED MITIGATION ACTIONS

Proposed Project	Weighted Score
As PCB remediation continues, ensure that G.E. coordinates with Lenox's Hazard Mitigation Plan.	4.44
Evaluate most effective approach to boost cell phone coverage town wide, such as through cell phone reception booster acquisition and strategic locations.	4.31
Identify and implement drinking water best management practices that are appropriate for local, natural areas/natural watershed to preserve water quality.	4.13
Evaluate increased flood risk or changes in the floodplain due to planned dam removal as result of G.E. PCB settlement.	4.06
Update storm and wastewater sewer systems.	4.00
Limit the use of pesticides on agricultural and private lands.	4.00
Ensure all municipal buildings are ADA compliant.	3.97
Identify potential alternative drinking water source(s) to supplement during periods of drought.	3.91
Explore alternatives to toxic pesticides for managing invasive species.	3.88
Study water availability projections over the next 20-years, 50-years and 100-years for the Town of Lenox that accounts for climate change projections.	3.80
Create Town program to identify feasibility and encourage adoption of renewable energy sources for critical facilities.	3.76
Promote CodeRED sign-up through Public Service Announcements (PSAs).	3.69
Maintain mutual aid (sharing of resources and equipment) agreements with other towns.	3.69
Identify oil and wastewater pipelines on vulnerable bridges.	3.69

Proposed Project	Weighted Score
Explore hacking prevention tactics/plan to ensure protection of sensitive Town information and to prevent disruptions of normal town wide functions.	3.66
Develop zoning to prohibit development in the floodplain unless there is a compatible use.	3.66
Identify and apply for grant programs to pay for invasive species removal from Kennedy Park.	3.66
Continue trimming and removal of downed timber / excess brush year-round.	3.65
Prevent building critical facilities in flood-prone areas.	3.63
Develop and provide incentives to developers to incorporate green infrastructure designs.	3.58
Address illegal hook-ups to municipal stormwater/wastewater systems.	3.54
Provide education on PCB contamination for residents and visitors.	3.53
Develop and make educational resources on PCB contamination available to developers near Woods Pond.	3.53
Create programs that encourage growth of meadows and with native species to enhance health of pollinator species.	3.53
Selectively bury power lines underground.	3.53
Coordinate emergency preparedness response among cultural and historical institutions and properties with federal programming.	3.53
Engage in conversations with BRTA to advocate for establishing new routes through Lenox along with expanding services in the evenings and weekends.	3.51
Evaluate Kennedy Park for carbon storage potential and protect these natural resources.	3.50
Promote replanting via Town-wide tree program.	3.50

Proposed Project	Weighted Score
Create an impervious surface tax on developers of projects that have large footprints with large areas of impervious surfaces.	3.48
Investigate the use of solar energy and feasibility of solar micro-grid.	3.47
Provide more opportunities and encourage volunteering for the fire department.	3.47
Develop culvert monitoring list and conduct ongoing maintenance.	3.45
Perform survey through multiple mediums and outreach initiatives to determine best approaches to get information to vulnerable residents.	3.44
Formulate action plan for the wastewater facility and Clifford Oil in case of flooding	3.44
Maintain dirt roads in a "state of good repair."	3.43
Encourage greater energy efficiency in long-term capital plans.	3.41
Continue remediation of the floodplain.	3.38
Update and expand Lenox's Forest Management Plan to include more guidance on invasive species and tree debris management.	3.38
Explore and implement transportation alternatives for those who can no longer drive.	3.37
Engage with private landowners including homeowners, hotels, resorts, and cultural venues with forest management techniques and invasive species removal.	3.34
Develop a list of buildings that have back-up generators.	3.33
Assess feasibility for implementing green infrastructure solutions along/near bridges and culverts to minimize the impacts of stormwater runoff (non-point source pollution).	3.33
Continue to look for approaches to bolster natural areas and enhance their abilities to mitigate various hazards resulting from climate change.	3.31

Proposed Project	Weighted Score
Consider how to integrate pollinator species planting program into future development of solar arrays.	3.31
Assess upgrades to pump stations and flood mitigation solutions and research new technologies, with a focus on engineered wetland treatment systems, that might allow moving the wastewater treatment plant out of the floodplain.	3.29
Complete tree cutting to improve access to facilities during storms.	3.29
Complete GIS mapping of infrastructure including hydrants, culverts, valves, etc.	3.29
Disseminate information related to emergency education, including warming and cooling shelters locations and regional shelters, in available mediums including by mail, newspaper, and Town website to inform residents of procedures during emergencies.	3.28
Continue to manage Hardy Kiwi (removal).	3.28
Engage in coordinated group purchasing program with other municipalities to reduce the overall costs of a private company conducting ash tree removal services.	3.28
Create a map of short and long-term shelters.	3.28
Assess/plan ownership models, incentives, and group purchasing potential to expand Lenox's solar capabilities.	3.26
Create program to build volunteer capacity town wide.	3.26
Plant native species at municipal sites.	3.25
Utilize green infrastructure and allow for groundwater recharge through engineered wetlands.	3.23
Increase transportation services - potential collaboration and coordination with major employers focused on devising solutions for low-income workers needing transportation to employment.	3.23
Establish better sheltering, heating, and cooling stations for emergencies and weather-related extremes.	3.22
Assess school buildings for long term sheltering capacity.	3.22

Proposed Project	Weighted Score
Enhance capabilities to store solar power/energy.	3.21
Acquire additional back-up generators or solar-powered back-up generators.	3.21
Educate residents on water-use reduction practices and products such as low-flow shower/faucet heads.	3.20
Update the Capital Improvement Plan.	3.19
Implement culvert rightsizing based on order of priority.	3.18
Coordinate all Hotels'/lodging establishments' plans for evacuation and sheltering in place with the Town wide preparedness plans.	3.16
Develop zoning to require green infrastructure (curb cuts and bioswales) integration into new developments for stormwater infiltration.	3.15
Work to expand partnerships with Visiting Nurse Association's (VNA's), Meals on Wheels, hospitals and faith organizations.	3.13
Develop a system of check-up calls to vulnerable populations (seniors - make signing up for this service optional to respect people's willingness to accept assistance).	3.13
Conduct Town wide asset mapping of entire forest, including street trees, to determine composition and better understand strengths and vulnerabilities of existing tree inventory.	3.09
Design stormwater infrastructure to also provide habitat for native species.	3.09
Establish community gardens for food independence and provide training for sustainable and social resilience.	3.09
Conduct public awareness campaign on emergency preparedness town wide.	3.08
Coordinate assisted living home's emergency plans with the Town.	3.06
Promote planting of native plant species among homeowners.	3.06

Proposed Project	Weighted Score
Assess where stormwater is collected from impervious surfaces and identify opportunities to mitigate on-site.	3.06
Identify erosion vulnerability along roadways.	3.06
Perform drills of CodeRED, such as simulating dam failure, and coordinate with Pittsfield.	3.03
Create program to build volunteer capacity town wide and explore Citizen Reserve Corps and Medical Reserve Corps to encourage more volunteerism.	3.03
Enforce snow walkway removal.	3.03
Improve mapping of electrical lines to have GIS layers available after a disaster.	3.03
Secure funding and implement retrofits to cultural and historical properties and institutions to ensure effective emergency response.	3.03
Engage in conversations to ensure cultural and historical institutions and properties are storm ready.	3.03
Educate homeowners on rain gardens as green infrastructure approach to mitigate runoff.	2.97
Create town program to incentivize homeowner solar panel installation.	2.94
Enhance communication with nursing home managers.	2.94
Build on Town stretch code to be more robust and require greater energy efficiency.	2.91
Educate homeowners on safe burn practices/permit procedures for best forest management practices.	2.91
Replace road-stream crossings up to the MA River and Stream Crossing Standards on Plunkett, Dugway, East, Martha, Birchwood, Edgewood and Sullivan Streets.	2.88
Perform permeable surface analysis along Town roadways and parking lot to identify opportunities for enhances stormwater management.	2.86

Proposed Project	Weighted Score
Develop system to monitor runoff loads into important fresh water supplies.	2.85
Purchase a digital sign on major roads for emergency message communication.	2.84
Capitalize on community networks to improve community resilience.	2.84
Equip emergency kits with information such as phone numbers to call in case of emergency, list of hospitals or other medical facilities, shelter locations and all essential facilities.	2.81
Assess and implement (if viable) ordinance that reduces restrictions on chicken ownership and potentially loosens restrictions on property set-back requirements as natural pest management approach.	2.81
Consider beaver activity when constructing trails.	2.81
Create a 'neighbor to neighbor' program as an informal check-up system to strengthen community bonds.	2.78
Perform analysis of use of rain gardens to mitigate roof and other stormwater runoff.	2.76
Implement bat-box education/building program and install bat boxes throughout the Town.	2.75
Explore ways to expand meals on wheels services.	2.74
Amend zoning bylaws/enhance storm water management requirements that are enforceable and incorporate into Master Plan updates.	2.73
Undergo communications planning for single person households.	2.72
Increase emergency wayfinding signage in recreational areas.	2.69
Support “Villages of the Berkshires” formation to provide service and support to those living at home.	2.69
Target and remove Japanese Barberry.	2.69

Proposed Project	Weighted Score
Initiate public education on household conservation and management of septic systems and wells.	2.69
Recruit and provide training to staff and volunteers for shelter management practices.	2.65
Identify community hubs (community center, bars, social clubs, etc.) and target emergency preparedness communication.	2.63
Prevent development on Yokun Brook where there is heavy beaver activity.	2.63
Allow upscaling of beaver dams for flood control in undeveloped areas.	2.63
Assist homeowners and business owners with winter walkway maintenance through better advertising of sand and salt supplies available at DPW station.	2.62
Coordinate with BRPC on providing guidance on how to create an emergency kit.	2.61
Provide at-home access to interactive map of infrastructure, possibly through ArcGIS Online with BRPC.	2.59
Explore various models for responding to beaver dam failures and/or breaks	2.59
Conduct property analysis and inform homeowners on suitability of solar panel installation.	2.59
Develop roof replacement plan for High School.	2.56
Analyze requirements for mowing operations and its impact on native species.	2.56
Reduce strain on septic systems and wastewater treatment plant by creating an efficient toilet purchase program through the Town.	2.52
Hold workshops for homeowners on flood hazards controls, planting, drainage, pumps and other equipment to prevent stormwater from flooding basements.	2.51
Incentivize employee and resident rideshare program.	2.49

Proposed Project	Weighted Score
Perform analysis of potential siting for and sizing of rain gardens with a catch basin assessment.	**2.48**
Assess septic share responsibility around Lake Laurel area.	**2.46**
Develop zoning to protect riparian buffers.	**2.45**
Assess options to better manage stormwater along Housatonic Street.	**2.45**
Identify how to best share emergency and preparedness information with visitors.	**2.41**
Implement beaver deceivers in areas deemed appropriate.	**2.41**
Incentivize roof replacement or maintenance with ice guards – and bundle properties for improved rates.	**2.40**
Consider viability of Town purchasing a vehicle for shuttling folks to destinations and cultural events such as Tanglewood.	**2.40**
Look to California Carbon Market (Audubon) as model for conserving forests.	**2.39**
Provide homeowners with education to protect homes from ice dams with potential partnership through CET (Center for Eco-Technology).	**2.37**
Study feasibility of equipping all hotel/lodging rooms with emergency kits.	**2.31**
Implement water temperature monitoring program of freshwater resources important to fish species.	**2.30**
Encourage the purchase of flood insurance for homeowners in at-risk areas.	**2.29**
Explore alternative emergency communication options such as satellite radio.	**2.28**
Conduct emergency preparedness outreach among second homeowners and seasonal visitors and include emergency phone numbers, hospital locations, and identity assistance centers.	**2.28**

Proposed Project	Weighted Score
Engage in activities to restore riparian buffers.	2.27
Create Laurel Lake neighbor program to remove invasive species and replace with native species.	2.26
Provide financial assistance for tree management on private property.	2.22
Develop educational resources outlining fisheries management practices.	2.21
Educate residents on use of chickens for controlling tick population to mitigate spread of disease.	2.13
Study the feasibility of creating a municipal position that has the responsibility of inventorying all the municipal buildings, documenting their accessibility issues and prioritizing repairs to make more accessible.	2.06
Utilize faith-based organizations for communication and outreach.	1.97
Increase the size of and improve swale along Plunkett Street.	1.61
Install an interactive digital map kiosk in Town Hall for residents to utilize.	1.50
Study feasibility of providing emergency kits to second homeowners and seasonal travelers.	1.38
Explore additional ways to support REPC.	1.35