Lanesborough

Multi-Hazard Mitigation Plan

Prepared by

the Lanesborough Emergency Management Committee

with assistance from Berkshire Regional Planning Commission

March 2019

ACKNOWLEDGEMENTS

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SECTION 1. INTRODUCTION AND BACKGROUND

1.1 Purpose of the Lanesborough Multi-Hazard Mitigation Plan

A hazard is defined as "an event or physical condition that has the potential to cause fatalities, injuries, property damage, infrastructure damage, agricultural loss, damage to the environment, interruption of business, or the types of harm or loss." Hazard mitigation is defined as a "sustained action taken to reduce or eliminate the long-term risk to people and property from hazards and their effects" (FEMA, date unknown).

The Federal Disaster Mitigation Act of 2000 mandated that all localities prepare local hazard mitigation plans to be eligible for future FEMA funding from the newly established Pre-disaster Mitigation (PDM) grant program and for the existing post-disaster Hazard Mitigation Grant Program (HMGP), the latter of which is a mainstay of the FEMA grant programs.

This plan is an update of the original *Lanesborough Multi-Hazard Mitigation Plan,* which was approved by MEMA and FEMA in 2008. The geographic scope of this plan involves only the Town of Lanesborough in Berkshire County, Massachusetts, although hazard and disaster plans from the region and neighboring communities were also consulted as part of plan development. The plan is designed to serve as a tool to help town officials identify hazard risks, assess the town's vulnerability to hazardous conditions, consider measures that can be taken to minimize hazardous conditions, and develop an action plan that can be reasonably be implemented to mitigate the impacts of hazards in the region. This plan should be used in conjunction with the *Berkshire County Hazard Mitigation Plan,* the *Lanesborough Comprehensive Emergency Management Plan*, the *Lanesborough Municipal Vulnerability Preparedness (MVP) Plan* and other plans developed by the Town of Lanesborough and the Central Berkshire Regional Emergency Planning Committee.

1.2 Background

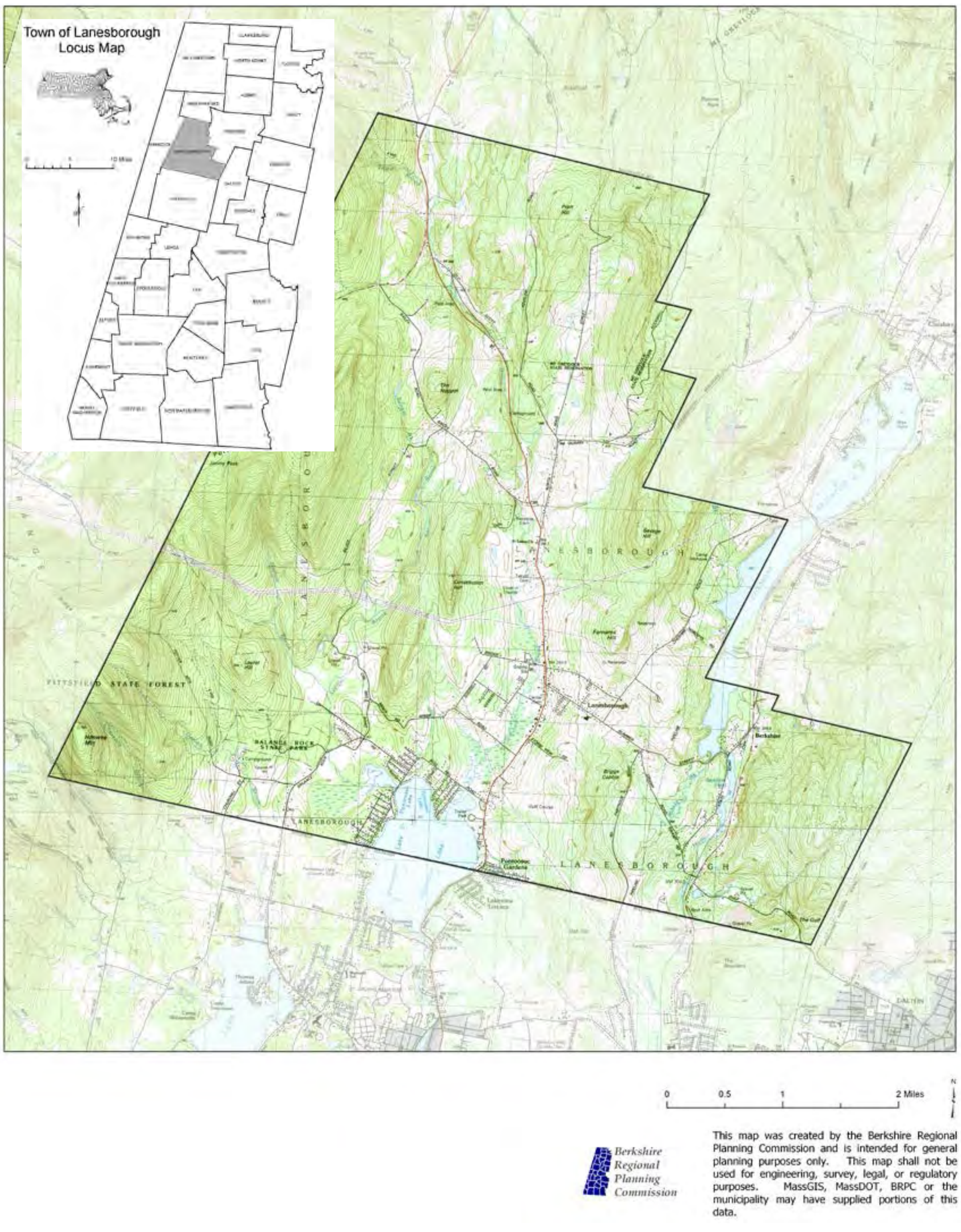
Lanesborough is located in north-central Berkshire County, Massachusetts and is bordered to north by New Ashford, to the east by Cheshire and Dalton, to the south by Pittsfield and to the west by Hancock. The town is 18,764 acres in size, which is approximately 30 square miles. The landscape of Lanesborough is that of two valleys hemmed in by mountainous terrain, some of which is steeply graded. The Taconic Mountain range dominates the western portion of the town, and features several prominent high points, including Potter Mountain, the Noppet and Constitution Hill. The Hoosac Mountain Range reaches deep into the center of the town and forms the eastern-most boundary. Savage Hill is a prominent high point extending southward from the Mount Greylock complex.

The mountains have historically limited development and road systems to the flat land of the valleys (refer to Fig. 1.1. Topographical Map). Berkshire County's two main north/south arterial roads run through Lanesborough, with Route 7 running through the center of Lanesborough along the Town Brook valley and Route 8 running along the eastern Cheshire Reservoir valley. The Berkshire Mall Connector Road connects the two routes and is the main entrance to the Berkshire Mall, one of two large shopping centers in Berkshire County.

Lanesborough is situated at the headwaters of the two major river watersheds in the county: the Housatonic River, which flows southward through Connecticut to Long Island Sound, and the Hoosic River, which flows northward into the Hudson River, which ultimately flows into the Atlantic Ocean. The majority of the town (73%) is located within the Housatonic River watershed. The relatively broad Town

Brook valley is characterized by a series of wetlands that run southward and discharge into Pontoosuc Lake. The brook is located to the west of Route 7. The northern portion of Pontoosuc Lake is located in Lanesborough, and here the land along the shore and upgradient is densely developed. The homes here were originally built as summer cottages, but have is recent decades been upgraded to serve as year-round residences. The narrower Hoosic River/Muddy Brook/Cheshire Reservoir valley flows northward east of Route 8.

Fig. 1.1. Topographical Map of Lanesborough and Its Surrounds



According to 1999 land use data, the town is largely forested (70% land use coverage), with patches of active agricultural fields and pastures (more decent data indicates that the town is 76% forested; see Sec. 3.8. for details). Residential development (8% coverage) has occurred in villages, around the lake and along major roadways. Commercial and industrial development (combined 1% coverage) has historically been located along Routes 7 and 8. Very little development has occurred in Lanesborough since 1999, and what has occurred has been dispersed small-scale residential homes or small businesses.

Lanesborough is a bedroom community, with many of its residents commuting to Pittsfield, the commercial center of Berkshire County. The largest employer in Berkshire County is Berkshire Health Systems, while the largest employer in Lanesborough is the Berkshire Mall. Other employers in the town include small businesses, restaurants, and the elementary school. According to the draft Open Space and Recreation Plan Lanesborough had the largest population in Berkshire County in 1791. Today, within the regional context, Lanesborough is a town with a small-to-medium-sized population of 2,970, ranking as the 11th largest out of the 32 municipalities in Berkshire County. According to the American Community Survey 2012-2016 the Town's population is 2,970, made up of 1,154 households.

In general the population of Lanesborough, like the vast majority of Berkshire County, is aging. In 2010 the town's population of persons age 50 or older was 40-50%, and in 2030 the population of 50+ will be 50-60%. This has several implications for natural hazard and emergency planning. In general the risk factors for the elderly during a natural hazard or disaster are higher due a variety of factors: they are more prone to chronic health disease, have more mobility and cognitive issues, and may be more socially isolated. At the recent MVP workshop residents noted that many elderly residents in the town do not have families that live close by, due to the fact that their children and grandchildren have moved away. They are more vulnerable to severe health impacts due to electricity outages, especially those who have home oxygen or dialysis systems or those who cannot withstand prolonged cold or warm temperatures. Home maintenance and repairs may not be up to date, making their homes more vulnerable to severe storm damages. Communicating with and preparing elderly residents for natural hazards and climate change was cited as the greatest single need in Lanesborough during the MVP workshop.

An aging population has additional implications for hazard and emergency planning. Having a smaller pool of adults under 50 makes it harder to recruit and retain volunteers for the fire company or the ambulance squad. It also makes it more difficult for the town to retain full membership of town boards and committees.

SECTION 2. PLANNING PROCESS

2.1 Planning Committee

The Lanesborough Emergency Management Committee (the Committee), which consists of municipal department heads and representatives from various town boards and committees from several disciplines, serves as the town's hazard mitigation planning committee. This committee meets quarterly to discuss emergency preparedness issues and is facilitated by the town manager. Outside speakers are often invited to educate committee members on a specific issue or topic, including MEMA staff, first responders from neighboring communities, representatives from gas, electric and communication companies. As a standing town committee was deemed to be the most appropriate to spearhead the update of the town's hazard mitigation plan. Committee members are listed Table 2.1.1.

Table 2.1.1. Lanesborough Emergency Management Committee

Name	Position
William Decelles	Dept. of Public Works Superintendent and member of the Lanesborough Fire Dept.
Charles Durfee	Lanesborough Fire Chief and DPW employee
Lorna Gayle	Council on Aging
Amy Lane	Town Accountant/Chief Financial Officer
Dale Newberry	Emergency Management Director and Lanesborough police officer
Stacy Parsons	Conservation Commission
Paul Sieloff, Kelli Robbins	Town Manager, liaison to Lanesborough Selectmen
Tim Sorrell	Police Chief

The Berkshire Regional Planning Commission (BRPC) provided technical assistance to the Committee, gathering data, reviewing existing relevant plans from Lanesborough and its neighboring communities, interviewing key stakeholders, and facilitating the public outreach program.

The Committee formally began the planning process for the update of the hazard mitigation plan in June 2016 and submitted its first draft plan for review to MEMA in November 2018. During those two years the Committee met several times to discuss data provided by BRPC, to gather more detailed and site-specific information, to discuss opportunities for improved preparedness and mitigation, and to begin to identify potential action strategies.

While the Committee is comprised of Town staff and local residents having extensive local knowledge and experience with natural hazards in Lanesborough and surrounding communities, it was decided that a broad and interactive public outreach program should be conducted as part of the planning process. In May 2017 the Town applied for and received a Municipal Vulnerability Preparedness (MVP) grant to support efforts to conduct an expensive public engagement program to identify the Town's strengths and weaknesses regarding natural hazard planning, preparedness and mitigation. As part of this effort the Committee and BRPC began to look more closely at natural hazards through the lens of climate change and to develop strategies to become a more resilient community.

A central element of the MVP program is the planning and hosting of a Community Resilience Building Workshop, a day-long facilitated workshop attended by key officials and residents from a variety of disciplines and backgrounds. The Committee developed a list of stakeholders who would be valuable at such a workshop: those who would provide information and input from a variety of perspectives, including elected town officials, town department heads, first responders, business owners, farmers, lakeshore residents and respected elders who had lived in Lanesborough for a long time and/or had served on town boards in the past. Invitations to participate were sent from the Town Manager's office.

On February 15, 2018 the Committee held an all-day Community Resilience-Building Workshop in the Lanesborough Senior Center, within the Town Hall. The workshop was facilitated by staff from the Berkshire Regional Planning Commission. The central goal of the workshop was to first understand the types of natural hazards and severe weather events that have occurred in the town, review climate change data and projections, collect additional local data from participants, and create a climate-related Natural Hazard Risk Matrix for the Town. As noted in the Workshop Agenda, the objectives for the day were to:

- Understand connections between ongoing issues, hazards, and local planning and actions in Lanesborough; define top hazards.
- Identify and map vulnerabilities and strengths to develop infrastructure, societal and environmental risk profiles for the town.
- Develop and prioritize actions that reduce vulnerabilities and reinforce strengths for the community - local organizations, academic institutions, businesses, private citizens, neighborhoods, and community groups.
- Identify opportunities to advance actions that further reduce the impact of hazards and increase resilience in the community.

A total of 20 people attended the Workshop, with a few key residents unexpectedly unable to attend due to illness. The Workshop opened with a presentation about natural hazards that have been identified in the region and the Town, as determined by the Committee during their initial work to update the Town's Hazard Mitigation Plan. The presentation also provided background data on the observed changes in weather patterns in the region and future projections due to climate change. This presentation was tailored to provide a foundation upon which workshop participants could build upon. Posters were created to provide additional background data and offer potential mitigation ideas for consideration, such as low-impact development techniques. The posters were created in a scientific poster format.

After the presentation the Workshop followed the Community Resilience-Building Workshop format as described in the *Community Resilience Building Workshop Guide*. Participants were broken up into three small working groups, pre-selected to provide a variety of perspectives and experiences at each table. At each table were handouts that would help to facilitate conversations, including a set of maps to help identify vulnerabilities. Participants were encouraged to write on the maps the areas of most concern. These maps edits were incorporated into a revised Critical Facilities and Areas of Concern Map. Each of the small working groups developed a Risk Matrix, identifying in their opinions the top four hazards that face the community, the Town's strengths and weaknesses in facing those hazards, and actions to lessen the impacts and build resiliency. The small groups convened at the end of the day to report its findings to the full group and, as a full group, to choose the highest priorities for action.

On February 28, 2018 the Committee held an open public forum, inviting town residents and other interested parties to learn about the Committee's work to date, hear the results of the Workshop and to solicit additional public input of the major findings. The forum opened with a viewing of informational posters developed as part of the Hazard Mitigation and MVP planning processes. A short presentation of findings followed the viewing, with the evening culminating in asking participants to rank the Actions that had been developed through the two planning processes. Participants at the forum ranked the Workshop's Top Priorities by marking a star next to the Top Three that they felt are the most pressing actions that the Town of Lanesborough should pursue. A copy of the *Lanesborough MVP Plan* is found on the Town of Lanesborough's website.

As a result of the workshop, the Emergency Management Committee was able to gather information and feedback from a more diverse set of voices, particularly residents' perspectives on natural hazards and preparedness. While many of the actions that emerged from the MVP workshop mirrored those drafted by the Committee as part of its hazard mitigation planning process, workshop attendees prioritized the actions in a different way. The actions developed by the Committee through the hazard mitigation planning process prioritized infrastructure needs while the actions developed through the MVP workshop prioritized public education and outreach.

The Lanesborough Emergency Management Committee served as the core team in the development of this natural hazard plan update, reviewing hazard data generated by BRPC, commenting and editing draft report sections, evaluating the capacity, strengths and weaknesses of Lanesborough town government, and drafting and prioritizing actions. The priority actions from both the Hazard Mitigation and MVP planning processes are reflected in the action plan offered at the end of this report.

The draft *Lanesborough Multi-Hazard Mitigation Plan* was posted on the Town of Lanesborough's website and offered for review and comment to town residents January 7-31, 2019. Paper copies of the Plan were also made available at Town Hall and the Library. The availability of the Plan for public review and comment was announced in the Town's January 7th newsletter, and was announced at a Board of Selectmen's meeting on January 8th, which was televised on local access cable. During this same period the draft plan was also offered for review/comment to the neighboring towns of Hancock, New Ashford, Cheshire and Dalton, and the City of Pittsfield through the informational channels of the Central Berkshire Emergency Planning Committee.

2.2 Coordination with Existing and Developing Planning Efforts

There are several documents and efforts that identify and address emergency and environmental concerns. The *Lanesborough Multi-Hazard Mitigation Plan*, locally adopted and FEMA-approved in 2008, served as a foundation upon which to build this updated plan. Many of the risks from natural disasters remain the same, although climate change is observed to be altering the severity and seasonal timing of some weather patterns and hazards. BRPC brought updated data, where available, to the risk assessment of the various hazards so that the Emergency Management Committee could evaluate and rank any changes identified. As part of the planning process the Committee revisited 2008 Action Plan, and the Town of Lanesborough is proud to report that many actions have been completed over the intervening years.

During the time that this hazard mitigation plan was being updated, the Town was also updating its Comprehensive Emergency Management Plan (CEMP). The CEMP outlines an emergency management program for planning and response to potential emergency or disaster situations. It assigns responsibilities and functions, which will provide for the safety and welfare of its citizens against the threat of natural, technological, and national security emergencies and disasters. The plan addresses the Mitigation, Preparedness, Response and Recovery aspects of emergency management organizations, programs, protective actions, and specific hazards. Critical infrastructure and vulnerable populations were identified and verified using the CEMP and drawing on local first responder knowledge.

Regionally, the town is an active member of the Central Berkshire Regional Emergency Planning Committee (CBREPC), which is made up of 13 towns in the central Berkshire region.
The CBREPC's priority is to minimize the risk to public safety, health and property through the development of a Regional Hazardous Materials Emergency Response Plan and a database of resources, equipment, and personnel that can be drawn on upon in an emergency.

The Town has a *Draft Capital Improvement Plan, FY 2019-FY2018*. Included in the plan is the town hall retaining wall project, a $400,000 budget item that cannot be pursued until 2023 due to the high cost. The Town is considering bonding and pursuit of grant money to fund this project. Also included in this plan are many of the road crossings that are of concerns and listed in this hazard mitigation plan update. These include the Pontoosuc Lake Streets paving and drainage improvements, which the town is directing a small amount of funding over several years, including in FY 2019 and FY 2020-2028. The Town does not have a comprehensive or master plan.

In addition to the above-mentioned plans, this Hazard Mitigation Plan also draws upon information found in the following plans:

- *Massachusetts State Hazard Mitigation Plan* (FEMA approved 2013); this plan is serving as the template for identifying hazards and risks.
- *Berkshire County Hazard Mitigation Plan* (FEMA approved 2013); the neighboring communities of Pittsfield, Hancock, and Cheshire are included in this regional plan
- *Town of Lanesborough, MA, Community Resilience Building Workshop Summary of Findings, (Lanesborough 2018)*
- *Draft Town of Dalton Multi-Hazard Mitigation Plan* (2018)
- *Central Berkshire Regional Shelter Plan* (CREPC, BRPC 2016)
- *Local Mitigation Planning Handbook* (FEMA 2013)
- *Mitigation Ideas, A Resource for Reducing Risk to Natural Hazards* (FEMA 2013)
- *Lanesborough Fire & Water District Plan*
- *Massachusetts Climate Adaptation Plan*

2.3 Plan Maintenance and Updates

The 2018 *Lanesborough Multi-hazard Mitigation Plan* is designed to be a working, living document. Although several of the mitigation measures from the Town's previous Hazard Mitigation Plan have been implemented, since that Plan was adopted there has not been an ongoing local process to guide hazard mitigation implementation. Such a process is needed over the next five years for the implementation of this Plan update and will be structured as described below.

The Lanesborough Hazard Mitigation Committee is the steward of the Plan and will meet annually to discuss the prior year's hazardous events and to revisit the Plan. At that time, the Committee will review the plan, analyze the hazards to determine if the data within the plan is still valid, and update the action plan to reflect changes or conditions that have occurred. Hazard mitigation measures that have been implemented will be analyzed for their effectiveness. This analysis may include site visits to appropriate locations where these measures have been implemented. Mitigation measures that have not been implemented will be reviewed to determine if they are still expected minimize hazards if implemented, or if they are no longer viable options. When the plan is in its third or fourth year, the Committee will begin the process of updating the plan to ensure continuity and retain the Town's eligibility to apply for and receive FEMA and other relevant funding.

Evaluation of the hazard mitigation plan in its entirety will be done on a five-year basis in accordance to the Disaster Mitigation act of 2000, or if a significant natural hazard disaster occurs. Any new problems that arise will be reviewed by the hazard mitigation committee and incorporated in to the hazard mitigation plan. The plan will be updated to meet changing conditions in the town or in the region. The Emergency Management Director will oversee the hazard mitigation committee's involvement in the review and updating process. Additional members of the public could be added to the local implementation team from businesses, non-profits, institutions and interested citizens.

As with other planning projects undertaken in Lanesborough, the public will be given the opportunity to review the plan and its proposed amendments, and to submit comments. Public comments will be invited through notices placed in the Berkshire Eagle and on the town website. The plan and its proposed amendments will be discussed at a Select Board meeting, which is publicly noticed in accordance with public meeting laws, and which is televised and distributed through local cable access, thus providing wide-spread public exposure. Comments will also be solicited from the CBREPC.

SECTION 3. NATURAL HAZARD RISK ASSESSMENT

3.1. Identifying Hazards

As defined by FEMA, a natural hazard is a source of harm or difficulty created by a meteorological, environmental or geological event. Vulnerability is defined as the characteristics of community assets that make them susceptible to damage from a given hazard. A risk assessment is a produce or process that collects information and assigns values to risks for the purpose of informing priorities, developing or comparing courses of action, and informing decision making (FEMA 2013). This section of the plan discusses the natural hazards that have been determined to impact the Town of Lanesborough. The Town chose to investigate the 14 natural hazards that are identified and discussed in the *Commonwealth of Massachusetts State Hazard Mitigation Plan* (MEMA, 2013). Two of the hazards, Coastal Hazards and Tsunami, do not occur in the Town because it is a land-locked community within Berkshire County, approximately 140 miles from the Massachusetts coast and more than 100 miles from the Long Island Sound. A third hazard, dam failure, is not discussed as there are no dams in or outside the Town that would inundate property within Lanesborough. Beaver activity is a common natural hazard in Lanesborough that can impact infrastructure and human health, and thus has been added as a hazard for discussion in the Plan. All hazards are grouped in eight categories that best fit their weather pattern and impact upon the Town (see Table 3.1.1).

To determine which natural hazards have the greatest potential to impact the town, the hazards were analyzed for their Area of Impact, Frequency of Occurrence and Severity. Refer to Table 3.1.2. for a matrix displaying the natural hazards and their ranking.

Table 3.1.1. Natural Hazards that Impact Lanesborough

Hazard	Category
Flood (Including Ice Jam, Beaver Activity)	Flood
Hurricane / Tropical Storm	Hurricane
Nor'easter	Severe Winter Weather
Snow & Blizzard	Severe Winter Weather
Ice Storm	Severe Winter Weather
Thunderstorm	Severe Weather
High Winds	Severe Weather
Tornado	Severe Weather
Drought	Drought
Extreme Temperature	Severe Weather
Wildland Fire	Fire
Major Urban Fire	Fire
Earthquake	Earthquake
Landslide	Landslide
Dam Failure	Not Included
Coastal Hazards	Not Included
Tsunami	Not Included

Table 3.1.2. Hazards that have the greatest potential to impact Lanesborough

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	
Flooding (include Ice Jam, Beaver Activity)	2	3	3	**8**
Severe Storms (High Wind, Thunderstorm, Extreme Temperature)	3	3	2	**8**
Severe Winter Event (Blizzard, Nor'easter)	3	3	2	**8**
Hurricane & Tropical Storms	3	2	2	**7**
Wildfire	2	3	2	**7**
Ice Storm	3	1	2	**6**
Tornado	2	0	4	**6**
Drought	3	1	1	**5**
Earthquake	2	0	2	**4**
Landslide	1	0	1	**2**
Urban Fire	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 (less than 0.1% per year0
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% and > 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% and > 25%
4=catastrophic	multiple deaths; complete shutdown of facilities for 30 days or more; property severely damaged> 50%

Source: Table developed by BRPC 2005; adapted & updated 2018.

3.2. Flood Hazards

3.2.1. General Background

As noted in the Massachusetts SHMP, floods are among the most frequent and costly natural disasters in terms of human hardship and economic loss—75% of federal disaster declarations are related to flooding. Property damage from flooding totals over $5 billion in the United States each year. The high costs of flood response and reparations are the reason that the National Flood Insurance Program has been established. Flooding is the result of several types of natural hazards, the impacts of which can be acerbated by development and local land-use practices, which is why it is so important that communities review and consider the effectiveness of their land use regulations and policies as part of their hazard mitigation planning process. (MEMA, 2013)

As part of this 2018 update, the Town of Lanesborough has gathered the most updated and best available data, including historical occurrences, the severity and/or recurrence interval information where available, and potential trends into the future. This gathering of information also includes that provided by local data provided by emergency responders, public works staff, local officials, business leaders and long-time residents. This update also looked at flood claims and repetitive losses in Lanesborough. HAZUS has been utilized to aid in analyzing risk, potential losses and damages. Taken together this information helps town officials and emergency management personnel gauge the scope of natural hazard events and assess their likeliness of reoccurring.

Common Causes of Flooding

The hazards that produce local or regional flooding in the region include hurricanes, tropical storms, heavy rain events, winter rain-on-snow, thunderstorms and beaver activity. Storms coinciding with spring melt and with hurricane season are historically common, with winter cycles of snow followed by rain becoming more common. Flashy flood regimes are common in the region due to the hilly terrain and thin soil that supports headwater streams and rivers. Stream and riverine flooding often occurs after heavy rain events, filling steeply sloped stream channels that rapidly discharge into larger streams and the Housatonic River. Naturally occurring accelerated runoff occurs when soils are not able to absorb rainfall such as when soils are already saturated or when the ground is frozen. (MEMA, 2013)

Man-made accelerated runoff occurs where development has created impervious surface areas, most particularly where runoff has been channeled and discharged into streams and rivers that are already swollen from natural runoff. Channeling and discharging runoff bypasses the natural processes whereby vegetated cover and uncompacted soils attenuate some portion of surface runoff through infiltration and uptake. Capturing, channeling and discharging runoff results in higher volumes of water reaching streams and river in an accelerated timeframe, causing greater stream and riverbank erosion, and higher debris and sediment loads. Accelerated runoff discharged into Town Brook from Route 7 and local roads increase flood volumes, bank erosion and possible water quality impairments.

Flooding of land also occurs when stream and river channels, bridge spans, culverts or drainage channels cannot contain the volume of water flowing through their system. Flood waters overtop stream channels and back up when constricted by undersized culverts and bridges. (MEMA, 2013). There are several areas in Lanesborough that periodically flood due to the constriction that road culverts and bridges create at stream crossings. Water and sewer lines can be threatened by floodwaters and flood-borne debris when the bridges that carry them across stream and river crossings are flooded, such as the Putnam Road culvert and Summer Street culverts.

Urban flooding can occur when the amount of heavy snowmelt and/or rain events is too great to flow through storm drain systems. Fortunately, Lanesborough is not densely developed and has no urban core. The area with the greatest amount of impervious surface area is the Berkshire Mall, which has its own stormdrain system with stormwater retention ponds that have to date functioned properly. Flooding of land downgradient of Main Street / Route 7 can occur when the storm drains along the road become clogged and do not function properly. Flooding into wetlands along Route 8 has historically occurred occur when the Unistress retention pond overflows or malfunctions, but work has been done with the business through their Stormwater Pollution Prevention Plan and implementation.

Beaver activity can cause flooding in a variety of ways due to their natural instinct to create ponding and to react to flowing water. Damming streams and wetland outlets cause flooding that can expands areas of inundation upstream and outward, which can threaten the built environment. If the impoundment impacts a drinking water supply it can threaten human health. Such flooding is a concern at the well heads maintained by the Lanesborough Village Fire & Water District, particularly the well head at Bridge Street. The District has had to trap beavers out of the area to avoid flooding of well heads and the possible contamination of the supply due to bacteria. Beaver activity also causes flooding along the Town Brook floodplain.

Beavers can also cause flooding due to their propensity to block culverts, threatening not only the road crossing but possibly properties upstream. There are several areas throughout Lanesborough where the public works department monitors and addressed beaver activity at road crossings, and where needed have installed beaver deceivers. The areas most commonly impacted are Swamp Road , Silver Street, Miner Road, Putnam Road and Summer Street. These area are shown on the Critical Facilities and Areas of Concern Map, found in Appendix A.

Measuring Floods

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 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.

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 convenient 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 flood area 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). However, as noted in the FIRMs, the areas shown within the 100-year flood boundaries are for flood insurance only; they do not necessarily show area aeras in a community subject to flooding.

Table 3.2.1. Recurrence Intervals and Probabilities of Occurrences

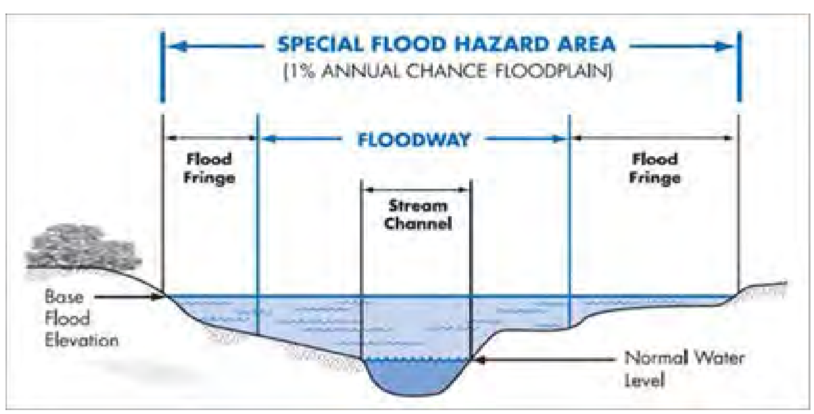
Recurrence interval,	Probability of occurrence	Percent chance of
500	1 in 500	0.2
100	1 in 100	1
50	1 in 50	2
25	1 in 25	4
10	1 in 10	10
5	1 in 5	20
2	1 in 2	50

Flood flows in Massachusetts are measured at numerous USGS stream gages, with the closest one to Lanesborough being located on the Housatonic River near the Dalton Avenue / Hubbard Avenue intersection. Typically, in the aftermath of a flood event, USGS will determine the recurrence interval of the event using data from the gage's period of historical record.

Floodplains and Wetlands

A floodplain or floodway is the area adjacent to a stream, river, or lake that becomes inundated during a flood. In the Berkshires these areas most often flood during spring melt and during high rain events, and inundation is often fairly common and expected, and are equal to a 50% or 100% (annual) chance of recurrence. In general, flooding can be defined as a rising and overflowing of a body of water onto normally dry land. In some areas it is fairly easy to identify floodway floodplains due to the terrain, soils and vegetation. Floodplain forests and wetland ecosystems may occupy these areas, serving to buffer the impacts of floods by absorbing and storing water and tempering flowing waters. Backup of floodwaters occurs when structures are built in this floodway/floodplain area that constricts or impede flows, such as when roads cross this area and bridges and culverts are undersized. Figure 3.2.1. depicts the floodway and 100-year flood hazard areas of a floodplain. (MEMA, 2013)

Figure 3.2.1. Flood-Prone Areas Associated with Streams and Rivers



Source: (MEMA, 2013)

When floodwaters recede after a flood event, they leave behind layers of rock and mud. These gradually build up to create a new floor of the floodplain. Floodplains generally contain unconsolidated sediments known as alluvium (accumulations of sand, gravel, loam, silt, and/or clay), often extending below the bed of the stream. These sediments provide a natural filtering system, with water percolating back into the ground and replenishing groundwater. These are often important aquifers, the water drawn from them being filtered compared to the water in the stream. (MEMA, 2013)

Floodplains are among the most species-rich ecosystems in the world. The biodiversity of a natural floodplain is extraordinary, due to the mix of soils, hydrologic regimes and vegetated habitats that occupy these areas. Floodplains are the habitat that connects the truly aquatic ecosystems with the truly upland ecosystems, providing the habitats needed many aquatic-based and terrestrial-based wildlife. They have historically been converted to agricultural uses due to their often fertile and deep soils and relatively level terrain. Further floodplain lands were developed as flowing waterways provided the power needed by industrial uses and the towns and cities that developed around them. (MEMA, 2013)

Human activity in floodplains frequently interferes with the natural function of floodplains. It can affect the distribution and timing of drainage, thereby increasing flood problems. Human development can create local flooding problems by altering or confining drainage channels. This increases flood potential in two ways: it reduces the stream's capacity to contain flows and it increases flow rates or velocities downstream during all stages of a flood event. Human activities can interface effectively with a floodplain as long as steps are taken to mitigate the activities' adverse impacts on floodplain functions. (MEMA, 2013). It is for these reasons that maintaining riverine floodplains in an undeveloped and natural state is so important to flood control.

Secondary Hazards

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. Fluvial erosion can also scour and downcut 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)

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)

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 wide spread outages in recent years, and where it occurs service has typically been restored within a few hours.

Landslides on steep slopes can occur when soils are saturated and give way to sloughing, often taking with it 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.

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. Although there are a few small private dams located in Lanesborough, none are large enough to be under the authority of the Office of Dam Safety. This is unusual for the county; in fact, Lanesborough is the only town in the county without a jurisdictional dam within its boundaries. Failure of the few private dams may cause flooding impacts to neighboring downstream property or tributaries, but are unlikely to cause any significant impact. Although the Pontoosuc Lake dam is not located in Lanesborough, it does control the level of the lake and affects the Lanesborough properties on the northern portion of the lake. If it were to fail property values could be diminished, and the water level of private wells could be impacted. The dam, which is categorized as a high hazard dam, is controlled by the Department of Conservation and Recreation and has undergone extensive repairs in recent years.

Flooding of homes and businesses can impact human safety health if the areas of inundation are 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 the structural damage and the mold. Vulnerable populations, such as the those whose immune systems are compromised by chronic illness or asthma, are at higher risk of illness due to mold.

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. (MEMA, 2013) However, flood damage to homes and buildings can occur even during shallow, low velocity flows that inundate the structure, its mechanical system and furnishings.

Climate Change Impacts

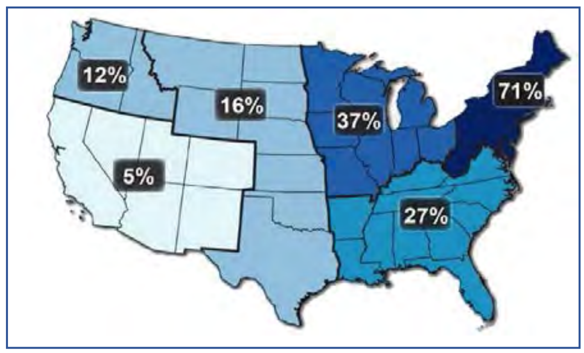
Based on data gathered from the Northeast Climate Science Center (NECSC), the yearly precipitation total for Berkshire County has been experiencing a gradual rise over the last 70 years, rising from 40.1 inches in the 1960’s to 48.6 inches in the 2000’s. According to projections from the NECSC, the county 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)

The scientific community is largely in agreement 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 across the U.S., with the greatest increase in the northern states and during the winter months. The Northeast Climate Adaptation Science Center predicts that annual increases of 3.1° to 6.7° F will occur in the Housatonic River Watershed by mid-century, with the greatest increases in the winter season. [1] 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).

Fig. 3.2.2. Increase in Precipitation Falling in Top 1% Extreme Precipitation Events 1958-2012 Engineering



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

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.[2]

The NECSC also predicts that the region will see an increase in the number of days with at least one 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) Already observed in Massachusetts, the number of extreme precipitation events, those defined as more than two inches in one day, has increased since the 1980s, with the greatest increase in the past decade (see Fig. 3.2.3)[3].

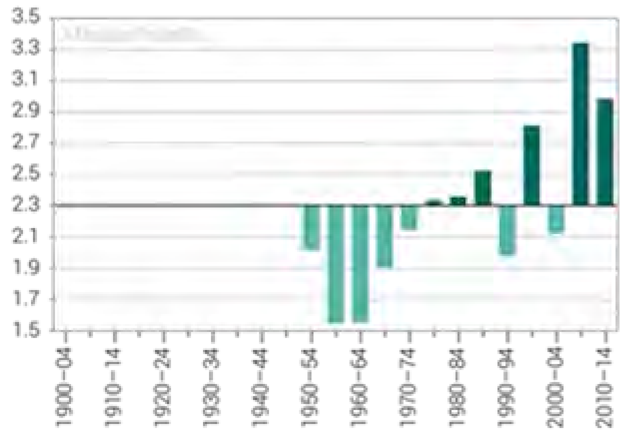
[1] Northeast Climate Adaptation Science Center, 2018. *Massachusetts Climate Change Projections*, MA EOEEA, Boston, MA.

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

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

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 is not unusual for stormwater management systems to be 50-100 years old, or older, and new infrastructure systems are being designed to have at least a 20-50-year lifespan. Thus, the vast infrastructure systems in place today will probably not accommodate the increased flows that are predicted.

Fig. 3.2.3. Number of Extreme Precipitation Events of 2" or more in 1 Day



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

Already the engineering and regulatory sectors have recognized the increase in precipitation. The long-used TP-40 method for sizing stormdrain system has been replaced by NOAA Atlas 14 and other methods. The design for a 24-hour 100-year storm event has been increased to accommodate a greater amount of water.

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.

Local public works superintendents are reporting an increase in road failures due to overwhelmed culverts, road washouts, eroding ditches, undercut road bases, and overtopped bridges. This information is not clearly documented, so it is not possible at this time to predict historic trends.

3.2.2. Hazard Profile

Location

Lanesborough sits atop the headwaters of the Housatonic River Watershed, which generally flows southward, and the Hoosic River Watershed, which generally flows northward. According to the *Flood Insurance Study, Town of Lanesborough* (1981), the lower reaches of brooks in town are susceptible to sediment and erosion damage, but are not classified as major damage areas. Stony loam soils are found in the uplands in the eastern and western parts of the town, while loams of good texture are found through the Town Brook valley, in the central portion of the town.

The town has two large lakes partially within its borders – Pontoosuc Lake that drains into the Housatonic River and Cheshire Reservoir which drains into the Hoosic River. There are also several streams in town, including Churchill Brook, Daniels Brook, Hollow Brook, Secum Brook, and Town Brook, all of which are in the Housatonic basin.

The Town of Lanesborough has relatively little floodplain areas (6.2% of town). Most of the floodplains are actually the two lakes. The floodplains of particular note are associated with Town Brook and Secum Brook.

Previous Occurrences

Between 1936 and 2017, 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 3.2.2. for a list of flood events impacting the Berkshire region. Not all these were documented to a 1% chance storm for the Town of Lanesborough, with the most recent flood event, T.S. Irene in 2011 being determined to be a 2% chance storm according to the Housatonic River stream gage in Pittsfield.

There are no USGS stream gages found in Lanesborough. The closest USGS stream gage is located on the Housatonic River in Coltsville in Pittsfield (gage #1197000). According to the data from the Coltsville gage, which provides data from 1936 to the present, and the NOAA National Weather Service, there have been 15 flood events that exceeded flood stage, which at this site is five feet. The flood event of record, with the highest water level, was the flood of 1938, with a peak level of almost 11 feet. To provide some perspective on the power and velocity of flood waters at this site, the discharge volume at the Coltsville gage was approximately 6,800 cubic feet per second (cfs) during the October 2005 flood and T.S. Irene in 2011, which had peak flood levels of slightly more than 8'. Typically this site would have a median daily discharge of 20-50 cfs during those time frames.

It may be worth noting that seven out of the 15 events exceeding flood stage at the USGS Coltsville gauge have occurred since the 1970s and five of the 15 have occurred since 2000, indicating a trend that confirm the suspicions from many local public works superintendents that flood events seem to be occurring more often in recent years. The flood stage exceedances at the Coltsville gage, which at this site is a depth of five feet, are shown in bolded text in Table 3.2.2.

Table 3.2.2. 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.[4]
1938	Large rain storm 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.
Dec. 31, 1948 – Jan. 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.

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

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.
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 and caused damage to the spillway of the dam on Plunkett Reservoir in Hinsdale.
October 2005	A stationary cold front brought over 6" of rain and caused widespread flooding throughout the region. In the Berkshires, this was approximately a 50-year flood.
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.
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. In the county, this was approximately a 2-5 year flood.
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, and in the neighboring town of Dalton it was approximately a 2% chance flood.
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. The thunderstorms also caused a EF1 tornado in Dalton causing damage to trees and homes.
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 among the top 15 events that caused the Housatonic River to flow above flood stage at the Coltsville USGS gage (5')*

Flood waters and the debris that is moved or carried can damage or destroy bridges and the infrastructure attached to them. For instance, critical water, sewer, communication and gas lines can be attached to bridges. This risk can be accentuated with the creation of and dislodging of ice dams during the winter months. According to the Ice Jam Database, maintained by the Ice Engineering Group at the U.S. Army Corps of Engineers Cold Regions Research and Engineering Laboratory, there have been no ice jams in Lanesborough. No buildings are threatened in this area. The most recent such occurrence was in January 2018, when two inches of rain and an unusually warm weather of 50+ degrees Fahrenheit, which followed a period of prolonged and unusually cold weather, caused flooding from snow and ice melt across Berkshire County. This same weather pattern caused an ice jam in Kitchen Brook in the neighboring town of Cheshire, which subsequently flooded and deposited large chunks of ice on Route 8, a major north-south arterial road in the county. The same event caused the Town of Stockbridge to declare a local disaster due to concerns that a massive buildup of ice and rising flood water could damage the Route 7 bridge over the Housatonic River and/or the natural gas main pipeline that serves as the only gas supply to the neighboring town of Great Barrington (pop. ~7,000) (Zollshan, 2018).

Fig. 3.2.4. Ice Jam on Housatonic River, Rt. 7 Stockbridge Jan. 2018

Source: Berkshire Eagle, 1-18-18.

Probability of Future Occurrences

Using the past as a guide, Lanesborough will continue to be impacted by floods. With six to eight flood events that approached or exceeded a 50-100-year interval in the region in the last 100 years, it can be assumed that a major flood event will impact the region every 12-15 years, if not more frequently, and receive minor flooding at least once a year. In addition to this, the upward trend for increased precipitation, combined with existing development in or near floodplain areas, indicated that flooding will persist in some areas. Efforts to flood proof or relocate high-risk properties within the floodplain, along with efforts to prohibit or limit new development, will decrease the potential for expanded damage and losses. The Town's effort to control new sources of stormwater runoff and upgrade stormwater drainage systems should also help to alleviate flooding in certain areas, particularly road stream crossings.

Beaver activity will continue to be a concern regarding flooding of private property and local roadways in several areas across town. It is expected that beaver activity will continue to persist throughout the region, as the factors that have allowed them to expand their range (increase in suitable habitat, an increase in wetland protection and a decrease in the hunting and trapping) are expected to remain relatively constant over the next decade.

Warning Time

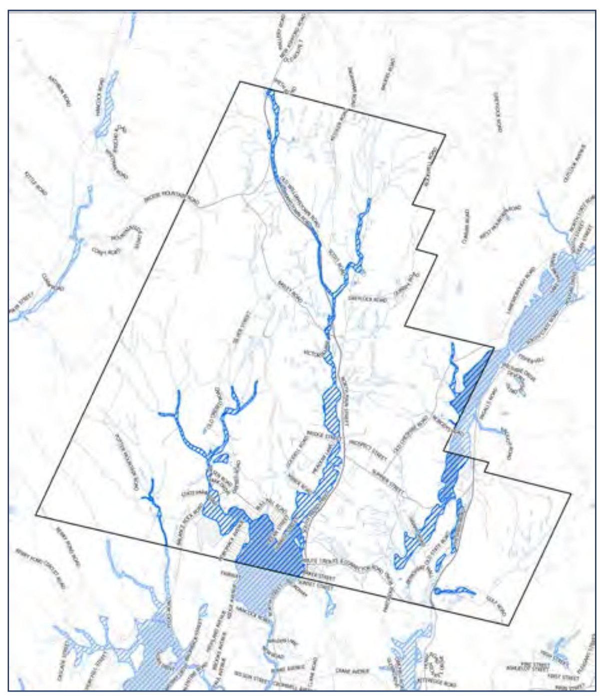
The State Hazard Mitigation Plan states that, due to the sequential pattern of meteorological conditions needed to cause serious flooding, it is unusual for a flood to occur without warning. Notice of potential flood conditions for developing storm systems is generally available five days in advance, with warning times for floods between 24 and 48 hours ahead of time. Flash flooding can be less predictable, but potential hazard areas can be warned in advanced of potential flash flooding danger. NOAA's Northeast River Forecast Center provides flood warning for Massachusetts, relying on monitoring data from the USGS stream gage network, of which the closest is the gage on the Housatonic River in Pittsfield. State agency staff monitor river, weather, and forecast conditions throughout the year. Notification of potential flooding is shared among state agency staff and the National Weather Service provides briefings to state and local emergency managers, as well as notifications to the public via the media and social networking. MEMA also distributes information regarding potential flooding to local Emergency Managers, the press, and the public. (MEMA, 2013)

The total number of injuries and casualties resulting from typical riverine flooding is generally limited based on advance weather forecasting, blockades, and warnings. Injuries and deaths generally are not anticipated if proper warning and precautions are in place. The exception is where the warning time is limited due to fast-developing events such as flash flooding from unpredicted severe thunderstorms or dam failures, or where earthquakes or landslides cause instantaneous earth movement. Populations without adequate warning of the event are highly vulnerable to this hazard. The historical record from 1993 to 2011 indicates there have only been two fatalities associated with a flood event in the state (occurring in May 2006) and five injuries associated with two flood events (occurring within two weeks of each other in March 2010). (MEMA, 2013).

Exposure

Due to historic development patterns that occurred before the town's zoning and floodplain management regulations, there are several homes and businesses that are located within the floodplain. In addition, there are more properties that located along the FIRM delineated boundaries. Development impacts, most particularly the removal of natural vegetation and addition of impervious surface area within a watershed or drainage area, increases the risk of accelerated high peak flows in waterways, which can lead to flooding, bank erosion and ban subsidence. The same development impacts within the floodplain affects the floodplains' ability to absorb, detain and store water during flood events.

Fig. 3.2.5. 100-yr Floodplain Areas



An analysis of the FIRM flood hazard area maps indicates that there is a total of 1,174 acres of 100-year floodplain within the town. This amounts to 6.2% of the total town. Most floodplain areas in the town are associated with Pontoosuc Lake and Cheshire Reservoir and their tributaries as they flow into their respective rivers (refer to blue-hatching areas in Fig. 3.2.5. and to the Critical Facilities and Areas of Concern Map in Appendix A for floodplain areas). Based on additional analysis, 51.4 acres (4.4%) of the floodplain are developed. This leaves 1,122.5 acres that are potentially developable under current zoning, however 483.6 acres of that are the lakes, so there actually is only 639.9 acres that are developable. (BRPC, 2017). The town does have a floodplain bylaw, protecting zones A and A1-30 as shown on the FIRM.

As part of this Plan update, the Town undertook an analysis to identify the number of buildings in the floodplain, using FIRM delineations, GIS capabilities and assessor information. This analysis found that there are currently 76 buildings (not including accessory structures) in the floodplain areas of Lanesborough: one commercial building (1.6% of commercial stock), one industrial (3.8% of industrial stock) and 74 residential buildings (5.5% of residential stock). (BRPC, 2017). This current number of buildings is substantially less than the 146 buildings that were identified in the former Hazard Mitigation Plan of 2009. The current number of 76 buildings is believed to be a much more accurate figure due to the improvement and increased accuracy of GIS technology and the ability to identify buildings. Table 3.2.3. lists the building stock in the floodplain.

Table 3.2.3. Number of Buildings in Floodplain

Buildings in the 100-year Floodplain							
Residential		**Commercial**		**Industrial**		**Total**	
No. Bldgs.	Percent Res. Bldgs.	No. Bldgs.	Percent Com. Bldgs.	No. Bldgs.	Percent Ind. Bldgs.	No. Bldgs.	Percent Total Bldgs.
74	5.5%	1	1.6%	1	3.8%	76	5.3%

Source: Berkshire Regional Planning Commission, 2017

3.2.3. Vulnerability

People, property and infrastructure located in or near floodplains, near waterways where floodwaters are known to overflow their banks, or those located in areas of high groundwater tables are vulnerable to the impacts of flooding. The town has had three flood insurance claims since 1978 for a total of $86,048 (MEMA, 2017). This figure is substantially higher than the $6,554 for one claim as reported in the Town's Hazard Mitigation Plan of 2008. There have been no repetitive losses in town. Of the 76 properties in the flood plain, there are only six active flood insurance policies in Lanesborough covering $947,200 (MEMA, 2017).

Infrastructure and critical facilities that have been built in, over or under floodways are vulnerable to damage due to the power of high volumes of water and from the debris that those flows can carry or dislodge. Infrastructure damages from flood waters that are of most concern to the Town of Lanesborough include washouts on steeply sloped roads around Pontoosuc Lake, and on North Main Street. Road stream crossings that continue to be of concern are found throughout the Town, due to undersized culvert/bridges, beaver activity, and deterioration due to old age. Flooding of the corridor along Town Brook continues to be of concern, due largely to beaver activity.

Population

Based on the population of 2,970 people in the Town and the estimate that 5.5% of the housing stock is located in the floodplain, it is expected that upwards of 163 residents may be impacted in a 1% flood event. (Berkshire Regional Planning Commission, 2017) Calculated a different way, using the number of

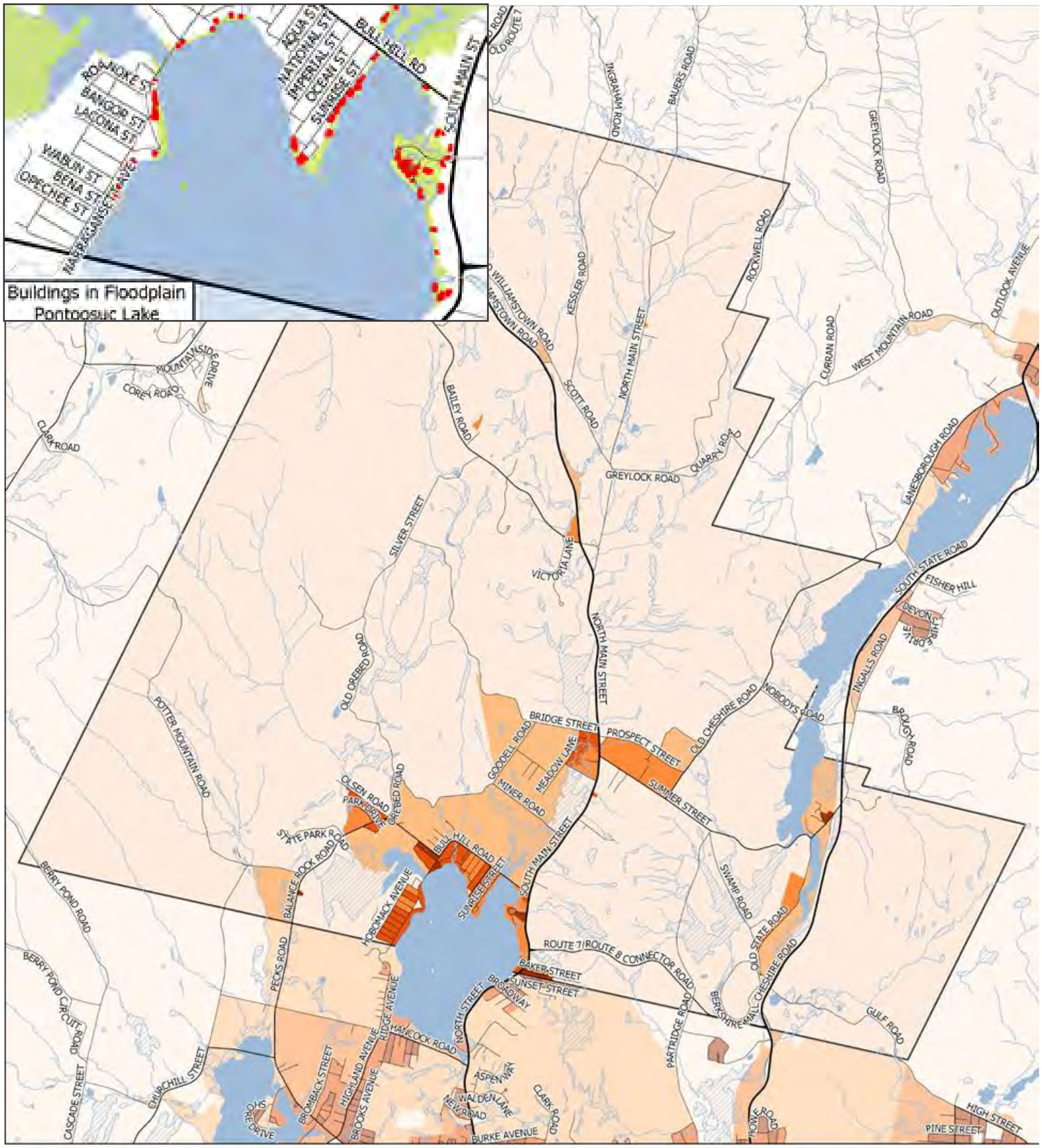
74 residential homes in the floodplain, with the average of 2.2 persons per household for Berkshire County[5], the number of people impacted would be 163 residents.

The greatest number of homes in the floodplain are clustered along the northern shoreline of Pontoosuc Lake, which is also one of the most densely populated areas in Lanesborough. As shown in the inset in Figure 3.2.6., there are several homes (each red dot represents a house) within the 100-year floodplain around the lake (floodplain shown in green). Many of these houses are seasonal cottages that have been turned into year-round homes in recent decades. Town officials are not aware of reports of serious flooding of homes or properties along the lake, even though the region has survived several severe storms, including those of 100-year flood levels. Town officials believe that this may be because the lake level is strictly controlled by the dam, which is owned and maintained by the Department of Conservation and Recreation. The lake is routinely drawn down in the fall to provide snow and snowmelt storage capacity, and it is drawn down when heavy precipitation is predicted. While local officials are unaware of damages to homes from flooding, many of these properties are prone to other hazards, such as freezing water and sewer pipes, road damages and erosion.

The risk of flooding, freezing pipes and other hazards in the Pontoosuc Lake neighborhood area was a repeated topic of discussion at the workshop held on February 15, 2018 as part of the Municipal Vulnerability Preparedness planning process. While flooding damages to the road system across Lanesborough was listed as a top concern, the risk of flooding of properties in the Pontoosuc neighborhood was particularly called out.

[5] *ACS 2012-2016*

Fig. 3.2.6. Population Density and Location of Homes in Floodplain on Pontoosuc Lake



<0.5 people/acre

0.5-0.9 people/acre

1.0 - 1.9 people/acre

2.0 - 4.9 people acre

> 5.0 people/acre

Source: US Census 2010

0 0.5 1 2 Miles

Berkshire Regional Planning Commission

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.

Severe Repetitive Loss Data

A severe repetitive loss is any insurable building for which two or more claims of more than $1,000 were paid by the National Flood Insurance Program within any rolling ten-year period, since 1978 (FEMA, 2018). The town of Lanesborough has no repetitive loss buildings.

Critical Facilities

The Town of Lanesborough does not currently have any critical facilities located within the floodplain except for road crossings. However, there are several public facilities that are located along the edge of the 100-year floodplain boundary, including the fire station and the DPW garage. Approximately four miles of road (4% of total mileage) travel through floodplain areas. Bull Hill, Miner and Putnam Roads and Bridge Street cross Town Brook and its floodplain, and are important in that they connect Main Street to the residences on Pontoosuc Lake and the western portion of the town. Summer Street and Swamp Road cross Muddy Brook and its floodplain, and are important in that they connect the Berkshire Mall and Berkshire Village to the town center.

There are key stream and wetland crossings where the bridges and culverts are deteriorating due to a combination of age and stress from increased flooding and freeze/thaw cycles. The Bridge Street bridge over Town Brook is severely deteriorated due to increased freeze/thaw events. Although the Town has patched the bridge deck, it is believed that the structure needs a full replacement. The Town has requested that the MassDOT inspect the bridge to determine if use of the bridge should be restricted. At the time of the drafting of this Plan, the Town was awaiting MassDOT's inspection and report.

According to data from MassDOT, Lanesborough has 10 bridges that cross water bodies. There are four bridges that are considered at risk to flooding due to having high scour scores in the MassDOT bridge database. These bridges all cross Town Brook, with two being on Williamstown Road, one on Bridge Street and one on Scott Road. (MassDOT, 2018). All three of these bridges are stable, however action is required to protect the exposed foundations from effects of additional erosion and corrosion.

Three additional stream crossing sites are of flooding concern, due largely to culverts that are deteriorating due to age and increased flood volumes. The Summer Street crossing of Muddy Brook is a set of two aged steel culverts, approximately 3.5-4 feet in diameter. Beaver control is needed to maintain flow. A larger, open bottom or box culvert would accommodate increased flow volumes and be more difficult for beavers to block flows. Old State Road, a short distance from the Summer Street crossing, is also an aged, steel pipe culvert and the site of flooding. Together these roads are main travel ways that connect residents from Route 8 and Berkshire Village to Lanesborough town center and the Lanesborough Elementary School. The culvert crossing on Balance Rock Road that leads into Balance Rock Park is prone to flooding due to debris carried along the stream during heavy storm events. The debris causes back up of flood waters. The Town has applied to the Massachusetts Small Bridge Program in 2018 for funds to mitigate the problem, and are awaiting a reply to its application. Flooding areas of most concern are shown on the Critical Facilities and Areas of Concern Map (Appendix A).

Critical facilities owned and maintained by the Lanesborough Fire & Water District, an entity separate from the Town, are located in or near floodplain areas, and further at risk due to beaver activity. The District's operating facility and pump house for the Bridge Street well is located at the edge of the 100-year floodplain boundary, and beaver activity at the site increases the risk of flooding during a 1% chance storm. The pump equipment at the Bridge Street well is below grade, and inundation of the pump house and the equipment could lead to a failure of this equipment. Due to the presence of beavers in the vicinity of the pump house and well head, bacteria contamination is a concern, particularly if the well were inundated with surface water. These concerns are similar at the Miner Street well, but the pump house at this site has been elevated. The Fire & Water District provides drinking water to approximately 80% of the town's population, as well as to many businesses.

Economy

According to the State Hazard Mitigation Plan, economic losses due to a flood include, but are not limited to damage to buildings and infrastructure, agricultural losses, business interruption, impacts on tourism, and tax base. Damage to buildings can be estimated using the exposure analysis above. Other economic components such as loss of facility use, functional downtime, and social economic factors are less measurable with a high degree of certainty. (MEMA, 2013)

Flooding can cause extensive damage to public utilities and disruptions to the delivery of services. Loss of power and communications may occur and drinking water and wastewater treatment facilities may be temporarily out of operation. Flooded streets and roadblocks make it difficult for emergency vehicles to respond to calls for service. Floodwaters can wash out sections of roadway and bridges, and the removal and disposal of debris can also be an enormous cost during the recovery phase of a flood event (MEMA, 2013).

Damage to buildings can affect a community's economy and tax base. As part of this hazard mitigation plan update, the total loss of buildings and their content within the floodplain was calculated to demonstrate the worst-case scenario of potential losses if a 1% chance flood event were to occur. This calculation took into consideration the value of all 76 buildings within the floodplain, as determined with assessor records, and multiplied an additional percentage to represent the contents of the properties, totaling a potential loss of $14.4 million. This represents complete destruction of buildings and contents within the floodplain. It should be noted that historical records indicate that total loss of buildings and content has never occurred in Lanesborough, and is very rare in the region. It is more likely that flooding would result in partial damages or loss of a building and its content, as demonstrated through past flood insurance claims in Lanesborough and the Berkshire region. To determine a more likely scenario of damages from a 1% chance flood event, the HAZUS-MH modeling program was utilized (see following section). The HAZUS-MH model took into account and calculated not only the number of buildings within the floodplain, but also potential losses to agriculture, business interruption and other economic impacts.

Table 3.2.4. Property Valuation within the 100-year Floodplain (Millions of Dollars)

Residential Property	Residential Contents (50% Property Value)	Commercial Property	Commercial Contents (100% Property Value)	Industrial Property	Industrial Contents (125% Property Value)	Total Loss Estimate*
$7.7	$3.8	$1.3	$1.3	$0.1	$0.1	$14.4

Source: (Berkshire Regional Planning Commission, 2017)
**Note: Total not exact due to rounding*

Aside from damage to buildings, flooding could effect some portion of the businesses and public institutions in Lanesborough that serve as major employers. As noted in Table 3.2.3. only one commercial property and one industrial property are located within the floodplain. None of the larger employers in Lanesborough – the Berkshire Mall, the elementary school, the Town of Lanesborough – have major facilities within the floodplain. Additionally, the commercial corridors along Routes 7 and 8 are not within the floodplain.

HAZUS-MH

To further assess the Town's vulnerability to flood hazard, HAZUS-MH was run using a 1% chance flood event. HAZUS-MH is an extension to ArcGIS that allows for the modeling of storm events and calculates the impact of the storm. HAZUS-MH delineates a floodplain differently than the current FEMA Floodplain maps by modeling where flooding may occur, rather than mapping that was conducted in the 1970's and 1980's.

HAZUS-MH estimates that 13 buildings will sustain damages during a 1% chance flood event, all of these residential buildings. Of these, about eight buildings will be at least moderately damaged, which is over 92% of the total number of buildings in the scenario. It further estimated that no buildings will be completely destroyed.

Direct building losses are the estimated costs to repair or replace the damage caused to the building. Based on the HAZUS-MH analysis, the town could potentially experience a loss of $5.9 million during a 1% chance flood event, which represents 1.95% of the total replacement value of the scenario buildings. (Table 3.2.5.). (HAZUS-MH, 2017) For more details about the impacts of a 1% chance storm event, see the full HAZUS-MH report in Appendix B.

Table 3.2.5. Damage Estimate from HAZUS-MH (Millions of Dollars)

	Residential	Commercial	Industrial	Others	Total
Building Loss	$2.04	$0.42	$0.12	$0.08	$2.66
Building Content & Inventory	$0.95	$1.51	$0.18	$0.59	$3.23
Business Interruption	$0.00	$0.01	$0.00	$0.00	$0.01
Total	$2.99	$1.93	$0.30	$0.67	$5.90

Source: HAZUS-MH, Berkshire Regional Planning Commission, 2017

According to HAZUS, based on a 1% chance flood event, 51 households are estimated to being displaced during the storm event, which includes households evacuated from within or very near to the inundated area. Of these, these 27 people may seek shelter during a flood event (HAZUS-MH, 2017).

3.2.4. Existing Protections Against Increased Risk of Flooding

The Town of Lanesborough has numerous existing protections in place to help reduce the risk of future flooding, including zoning to restrict development in floodplain areas, conducting infrastructure improvements, and maintaining a system to alert vulnerable populations. The Town replaced Putnam and Miner Road bridges, both of which suffered repetitive damages from flooding. The Putnam Road crossing of Town Brook was funded with FEMA and local funds (Fig. 3.2.7.), while Miner Road was funded with state and local funds. Both crossings were designed to handle larger flood volumes.

Because flooding is the most widespread and chronic hazard facing the Town, an existing protections matrix has been developed for this hazard. Matrices of this level were not developed for other hazards.

Fig. 3.2.7. Improved Putnam Road Bridge

Source: Town of Lanesborough, 2014

Table 3.2.6. Existing Protections Matrix

Type of Existing Protection	Description	Area Covered	Effectiveness	Improvements Needed
Floodplain/Wetlands Protection Zoning	Prohibits new buildings and structures	FIRM	Somewhat effective	None; increasing setbacks may reduce risk
Water Supply Protection District	Limits and conditions some uses in aquifer recharge area	Town Brook Recharge Area	Somewhat; many nonconforming uses already exist	Some residents have called for review of the bylaw to further restrict dense development
Capital Improvements Plan	Long-term fiscal planning	Town	Somewhat; funding constraints limit implementation	Funding
Illicit Discharge Detection & Elimination Bylaw	Limits new discharges into Town's drainage system	Town	Somewhat	Enforcement
Beaver Controls	Beaver Deceivers; trapping	Where needed	Effective	Funding
Pursuit of Grant Funds	Grants where available	Town	Effective when granted	Continued pursuit
DPW, Conservation Commission Coordination	Few emergency permits requested; Bundling Notice of Intent discussed to streamline activities	Where needed	Somewhat effective to date	Continued coordination

3.2.5. Actions

Flooding is the most prevalent natural hazard for the Town of Lanesborough, so it is not surprising that many of the actions arising from the hazard mitigation plan update revolve around this hazard.

- Continue to pursue implementation of the Actions of the 2009 Multi-Hazard Mitigation Plan that have not been completed (see Section 4 of this Plan). Many of these actions involve flood mitigation on the Town's transportation infrastructure.
- Support mitigation of flood-related issues raised by the Lanesborough Village Fire & Water District, including flooding of facilities and equipment due to beaver activity. Determine flood elevation at the Bridge Street drinking water well facility and well pump equipment; elevate and flood-proof as necessary.
- Pursue mitigation to reduce flood risk and damages at the Bridge Street bridge and the Summer Street, Old State Road and Balance Rock Park culvert crossings; resubmit request for MassDOT inspection of Bridge Street bridge and reapply for Small Bridge Program grant for Balance Rock Road if 2018 application not successful.
- Request that FEMA update FIRM maps for the Pontoosuc Lake area and notify homeowners in floodplain about the NFIP program.

3.3 Tropical Storm and Hurricane Hazards

3.3.1. General Background

A tropical storm system is characterized by a low-pressure center and numerous thunderstorms that produce strong winds and heavy rain. The term "tropical" refers both to the geographical origin of these systems, which usually form in tropical regions of the globe, and to their formation in maritime tropical air masses. Hurricanes begin as tropical storms over the warm moist waters of the Atlantic. As the moisture evaporates, it rises until enormous amounts of heated, moist air are twisted high in the atmosphere. The winds begin to circle counterclockwise north of the equator or clockwise south of the equator. Tropical depressions, tropical storms, and hurricanes) form over the warm, moist waters of the Atlantic, Caribbean, 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, it 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. (MEMA, 2013)

Tropical storms and tropical depressions, while generally less dangerous than hurricanes, can be deadly. The winds of tropical depressions/storms are usually not the greatest threat; rather, the rains, flooding, and severe weather associated with the tropical storms are what customarily cause more significant problems. Serious power outages can also be associated with these types of events. After the passing of Hurricane Irene through the region as a tropical storm in late August 2011, many areas of the Commonwealth were without power for in excess of five days. (MEMA, 2013)

The official hurricane season runs from June 1st to November 30th. However, August, September, and the first half of October are when the storms most frequently occur for New England. 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. (MEMA, 2013)

The Saffir/Simpson scale categorizes or rates hurricanes from 1 (Minimal) to 5 (Catastrophic) based on their intensity. This scale 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, as storm surge values are highly dependent on the slope of the continental shelf and the shape of the coastline, in the landfall region. All winds are using the U.S. 1-minute average, meaning the highest wind that is sustained for one minute. The Saffir/Simpson Scale described in Table 3.3.1. gives an overview of the wind speeds and range of damage caused by different hurricane categories. (MEMA, 2013)

Table 3.3.1. Saffir/Simpson Scale

Scale No. (Category)	Winds (mph)	Potential Damage
Tropical Depression	< 38	NA
Tropical Storm	39-73	NA
1	74-95	Minimal: Damage is primarily to shrubbery and trees, mobile homes, and some signs. No real damage is done to structures.
2	96-110	Moderate: Some trees topple, some roof coverings are damaged, and major damage is done to mobile homes.
3	111-130	Extensive: Large trees topple, some structural damage is done to roofs, mobile homes are destroyed, and structural damage is done to small homes and utility buildings.
4	131-155	Extreme: Extensive damage is done to roofs, windows, and doors: roof systems on small buildings completely fail; and some curtain walls fail.
5	>155	Catastrophic: Roof damage is considerable and widespread, window and door damage is severe, there are extensive glass failures, and entire buildings could fail.

3.3.2. Hazard Profile

Location

The entire Town of Lanesborough is vulnerable to hurricanes and tropical storms. The heavy rains often associated with tropical storms and hurricanes can result in flooding conditions, combined with high winds to create risks to people and property. Floodplain areas are especially at risk for flooding, as are flashy, steeply sloped stream channels that can become flooded, causing stream channel erosion.

NOAA's Historical Hurricane Tracks tool is a public interactive mapping application that displays Atlantic Basin and East-Central Pacific Basin tropical cyclone data. This interactive tool tracks tropical cyclones from 1842 to 2017. Between 1842 and 2017, the region has experienced more than 240 tropical cyclone events. These events occurred within 100 miles of Berkshire County.

Previous Occurrences

The National Oceanic and Atmospheric Administration (NOAA) has been keeping records of hurricanes since 1842. From 1842 to 2017, the community have had five Tropical Depressions, five Tropical Storms, one Category 1 Hurricane and one Category 2 Hurricane pass directly through the County. Table 3.3.2. lists these storms, and Figure 3.3.1. shows the paths of these storms. The only one of these storms is believed to have traveled directly through Lanesborough, a Category 1 Hurricane in the late 1890s.

Table 3.3.2. Tropical Cyclonic Storms that Tracked Directly through 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 effects of hurricanes and tropical storms however are often felt much farther away from the direct path. During this same period, an additional 38 Tropical Depressions, 86 Tropical Storms, 14 Category 1 Hurricanes and five Category 2 Hurricanes have passed within 100 miles of the region.

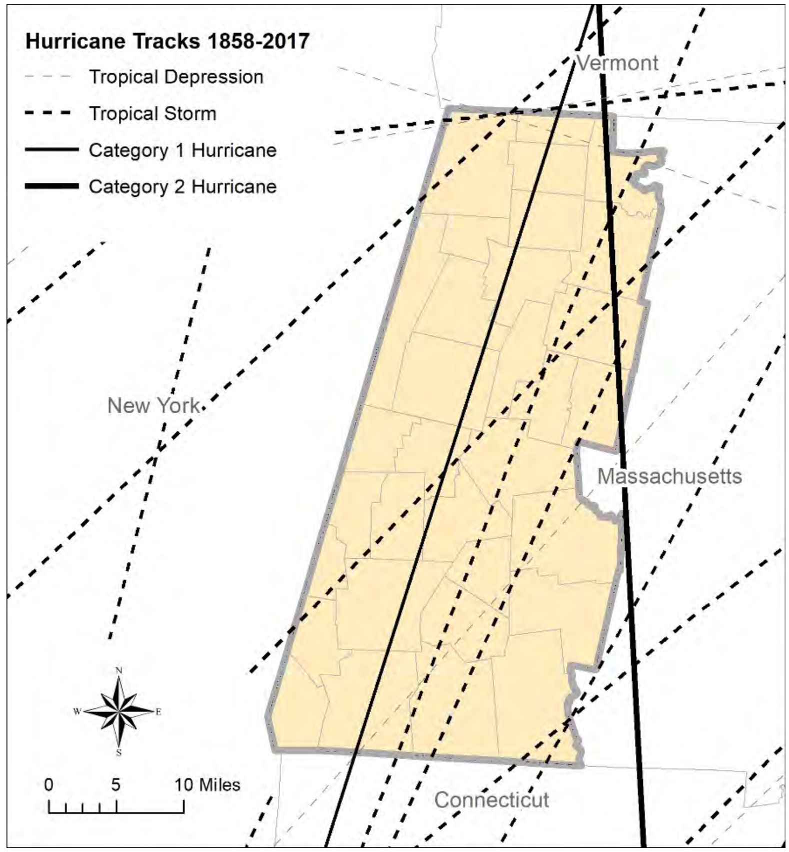
According to NOAA, tropical storm season lasts from June 1 to November 30, and an average of 10 tropical storms develop along the eastern seaboard each year. On average, five of these 10 become hurricanes. In Berkshire County, Hurricanes and Tropical Storms are generally limited to the months of August, September, and October, with a few storms arriving in May, June, July or November.

The historic storm of most note in Berkshire County is the New England Hurricane of 1938 (or Great New England Hurricane or Long Island Express or simply The Great Hurricane of 1938). The storm formed near the coast of Africa, becoming a Category 5 hurricane before making landfall as a Category 3 hurricane on Long Island on September 21. To date this storm remains the most powerful, costliest, and deadliest hurricane in New England history. The majority of the storm damage was from storm surge and wind. Damage is estimated at $6 billion (2004 USD), making it among the costliest hurricanes to strike the U.S. mainland. It is estimated that if an identical hurricane struck today it would cause $39.2 billion (2005 USD) in damage. The eye of the storm followed the Connecticut River north into Massachusetts, where the winds and flooding killed 99 people. In Springfield, the river rose to 6 to 10 feet above flood stage, causing significant damage. Up to six inches of rain fell across western Massachusetts, which combined with over four inches that had fallen a few days earlier produced widespread flooding.

Locally the Great Hurricane of 1938 remains one of the most memorable historic storms, with almost seven inches of rain falling over a three-day period. The flooding from the Hoosic River caused severe damages in the northern Berkshire communities of Adams and North Adams. According to an *iBerkshires* article highlighting the damages, two deaths occurred, many other people were injured, and

300 people were left homeless. The West Shaft Road bridge in North Adams was lost, as was the Wally Bridge in Williamstown.[1] The damages from this storm, following devastating flooding and damages from events in 1901, 1922, 1927 and 1936, and combined with that from a severe rain event in 1948, led to the construction of the flood control chutes on the Hoosic River in Adams and North Adams.

Fig. 3.3.1. Hurricanes and Tropical Storms through Berkshire County



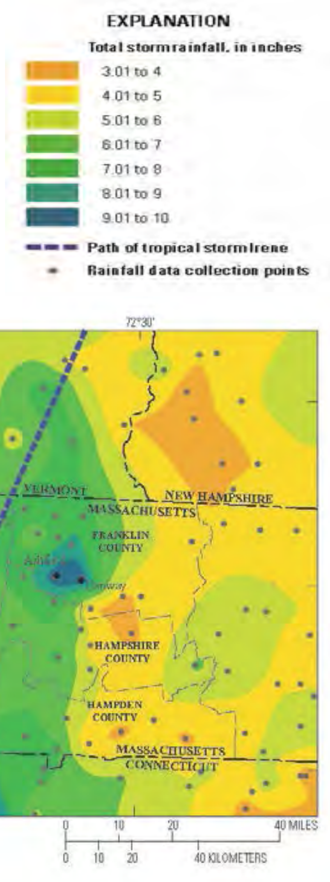
Source: NOAA, BRPC, 2017.

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. Several people had to be evacuated from their homes. 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)

[1] Ennis, Tom, 2-11-04. "Before the Chutes, Hoosic Floods Raged," *iBerkshires.com*.

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)

Fig. 3.3.2. Track of T.S. Irene 2011



Source: Gardner, et al, 2016.

Locally TS Irene is the most memorable storm event in recent history due to the flooding that occurred in northern Berkshire and Franklin Counties in Massachusetts, and in southern Vermont. In Williamstown more than 250 residents, many elderly and low income, permanently lost their homes in the Spruces Mobile Home Park due to flooding of homes and utilities. Extensive flooding in the Deerfield River watershed caused, among other damages, the closing of Route 2 in Florida/Charlemont (due to collapse of the road and a landslide) and damages to structures in Shelburne Falls.

Probability of Future Occurrences

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)

Severity

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.

Warning Time

Warning times for the majority of tropical storms and hurricanes are generally broadcast well in advance of landfall in New England. The National Weather Service issues a hurricane warning when sustained winds of 74 mph or higher are *expected* in a specified area in association with a tropical, subtropical, or post-tropical cyclone. A warning is issued 36 hours in advance of the anticipated onset of tropical-storm-force winds. A hurricane watch is announced when sustained winds of 74 mph or higher are *possible* within the specified area in association with a tropical, subtropical, or post-tropical cyclone. A watch is issued 48 hours in advance of the anticipated onset of tropical storm force winds (NWS, 2013). In general, MEMA suggests that local and regional preparations should be complete by the time the storm is at the latitude of North Carolina. (MEMA, 2013)

Secondary Hazards

Precursor events or hazards that may exacerbate hurricane damage include heavy rains, winds, tornadoes, insufficient flood preparedness, and levee or dam breach or failure. Potential cascading events include health issues (mold, mildew); increased risk of fire hazards; hazardous materials, including waste byproducts; compromise of levee or dam; isolated islands of humanity; increased risk of landslides or other types of land movement; disruption to transportation; disruption of power transmission and infrastructure; structural and property damage; debris distribution; and environmental impact. (MEMA, 2013)

Climate Change Impacts

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.

Exposure

To understand risk, the assets exposed to the hazard areas are identified. For the hurricane and tropical storm hazard MEMA has determined that the entire Commonwealth of Massachusetts is exposed to extensive winds and rains. Storm surge from a hurricane/tropical storm poses one of the greatest risks to residents and property. (MEMA, 2013) Berkshire County is landlocked, so no community in the region is at risk of storm surge. Damages from a hurricane can be broken into two general categories of direct impacts: flooding and high winds. Flooding damage for the Town of Lanesborough has been assessed and discussed in the flooding section of this plan and is not discussed here. For wind-based damage, the hurricane simulation model for Lanesborough was run in HAZUS-MH, using a probabilistic 100-year (1% annual chance) storm using default HAZUS value. The 100-year storm was used to be comparable to the storm event used in the flooding model.

3.3.3. Vulnerability

Population

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 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. HAZUS-MH was run to estimate the sheltering needs of Lanesborough residents should a 100-year event occur. According to HAZUS-MH, no residents may be displaced or require temporary to long-term sheltering due to wind damages. It should be noted that HAZUS-MH utilizes 2000 Census data, and therefore, the totals will vary slightly. However, as reported in the flooding section of this plan, approximately 27 residents could be displaced and seek shelter during this 100-year flooding event.

Critical Facilities

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. There are very few areas where power lines are buried underground. HAZUS-MH predicted that no critical facilities would be impacted by wind-related damages.

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. HAZUS-MH estimates the total building-related economic loss associated with each storm scenario (direct property damages and business interruption losses). The building related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.

Damage to buildings can impact a community's economy and tax base. HAZUS-MH analysis determined that there is $140,010 of exposure due to the potential wind damage. It is notable that the statistical data model predicts that all damages will be incurred by residential building owners and none by commercial and industrial building owners. No buildings would sustain moderate or severe damages. (HAZUS-MH, 2017)

Table 3.3.3. HAZUS-MH Results for Hurricane Winds (in dollars)

		Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	100,580	-	-	-	100,580
	Content	39,410	-	-	-	39,410
	Inventory	-	-	-	-	-
	Subtotal	***$139,990***	**-**	**-**	**-**	***$139,990***
Business Interruption						
	Income	-	-	-	-	-
	Relocation	20	-	-	-	20
	Rental Income	-	-	-	-	-
	Wage	-	-	-	-	-
	Subtotal	***20***	**-**	**-**	**-**	***$20***
Total		**$140,010**	**-**	**-**	**-**	**$140,010**

Source: HAZUS-MH, 2017

HAZUS-MH also estimates the amount of debris that may be produced a result of wind events. The debris produced is estimated to be approximately 430 tons, the vast majority (89%) of which would be tree debris. (HAZUS-MH, 2017) Because the estimated debris production does not include flooding, this is likely a conservative estimate and may be higher if multiple impacts occur. The full HAZUS-MH report is found in Appendix B of this plan.

3.3.4. Existing Protections

- Massachusetts Building Code dictates building construction in Lanesborough.
- Regional School District and Town have emergency communications systems in place.

3.3.5. Actions

- Continue to encourage all town residents to enroll in Reverse 911.

3.4. Severe Weather Hazards: High Winds, Thunderstorms, Tornados, Extreme Temperatures

3.4.1. General Background

There are several severe weather events that impact the Berkshire County region and the Town of Lanesborough, some of which occur suddenly and with little warning times. The severe weather hazards being discussed in this section of the plan are atmospheric in nature.

3.4.2. Severe Weather Hazard Profiles

Wind is air in motion relative to surface of the earth. Effects from high winds can include downed trees and/or power lines and damage to roofs, windows, etc. High winds can cause scattered power outages. Massachusetts is susceptible to high wind from several types of weather events: before and after frontal systems, hurricanes and tropical storms, severe thunderstorms and tornadoes, and Nor'easters. Winds measuring less than 30 mph are not considered to be hazardous under most circumstances. Sometimes, wind gusts of only 40 to 45 mph can cause scattered power outages from trees and wires being downed. This is especially true after periods of prolonged drought or excessive rainfall, since both are situations which can weaken the root systems and make them more susceptible to the winds' effects. (MEMA, 2013)

A thunderstorm is a storm with lightning and thunder produced by a cumulonimbus cloud, usually producing gusty winds, heavy rain, and sometimes hail. Frequently during thunderstorm events, heavy rain and gusty winds are present. Less frequently, hail is present, which can become very large. Tornadoes can also be generated during these events. (MEMA, 2013)

Rising, warm moist air is the foundation for thunderstorms. If this warm air is forced to rise and is channeled upward by hills or mountains, or areas where warm/cold or wet/dry air collide, it an become unstable and charged. Sometimes strong downdrafts of cool air, known as downbursts, can cause tremendous wind damage, similar to that of a tornado. A small (< 2.5-mile path) downburst is known as a "microburst." (MEMA, 2013)

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. A tornado is a narrow, violently rotating column of air that extends from the base of a cumulonimbus cloud to the ground. The visible sign of a tornado is the dust and debris that are caught in the rotating column made up of water droplets. Tornadoes can form from individual cells within severe thunderstorm squall lines. They can form from an isolated super-cell thunderstorm. They can be spawned by tropical cyclones or even their remnants that are passing through. (MEMA, 2013) Tornadoes are the most violent of all atmospheric storms and are historically the deadliest of weather events in Berkshire County.

Massachusetts has four well-defined seasons. The seasons have several defining factors, with temperature one of the most significant. Extreme temperatures can be defined as those that are far outside the normal ranges. According to MEMA the average temperatures for Massachusetts are:

- Winter (Dec-Feb) Average = 22.5ºF
- Summer (Jun-Aug) Average = 65.8ºF

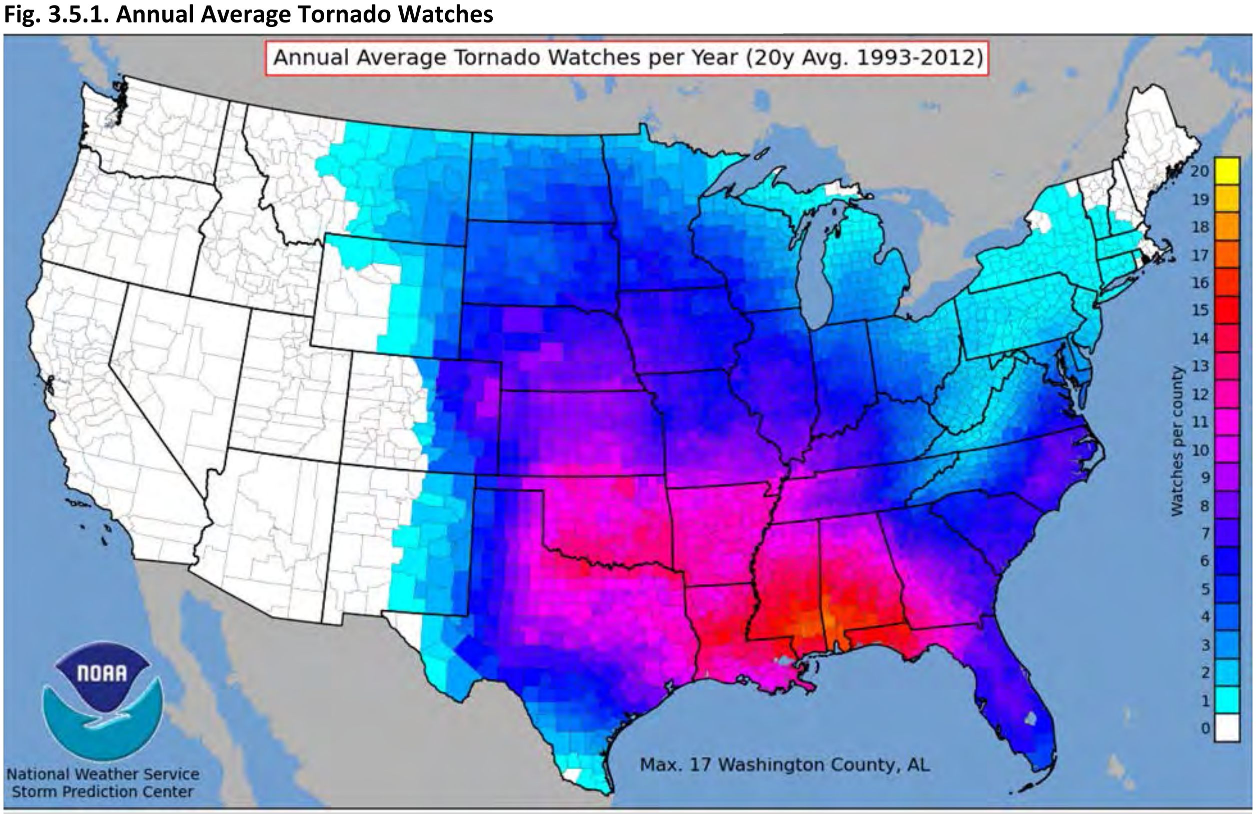
Extreme heat events impact the health of human beings, livestock and wildlife, and can impact the ability of people to function at home or work. Extreme cold is a dangerous situation that can result in health emergencies for susceptible people, such as those without shelter, who work outside or who are stranded or who live in homes that are poorly insulated or without heat.

Impacts from severe storm events can be as widespread as effecting all of the Northeast, such as a hurricane or nor'easter. Impacts can occur along narrow paths of Berkshire County where weather fronts collide and deliver high winds and rain or where tornado touchdowns have carved a path of destruction. Alternately impacts from these storms can be concentrated, such as when microbursts suddenly hit an area. In general, the high percentage of forest cover across Berkshire County, including most of Lanesborough, tends to disrupt wind flows, although conversely trees can create high hazard conditions near buildings and utility lines. Areas of impact from tornados and microbursts are unpredictable.

Severe storms can occur anywhere in the Town of Lanesborough. Thunderstorms affect relatively small areas, rather than large regions much like bands of winter storms and hurricane events.   The community is in an area that would experience between 15 and 20 thunderstorm days each year.

The location of tornado impact is totally unpredictable. However, the county is located in a lower risk area with an average of 1 tornado watch per year (see Fig. 3.4.1.).

Fig. 3.5.1. Annual Average Tornado Watches



Source: National Weather Service Storm Prediction Center 2018

Secondary Hazards

The most significant secondary hazards associated with severe local storms are falling and uprooted trees and broken branches, downed power lines, and possible flooding and landslides. Rapidly melting snow combined with heavy rain can overwhelm both natural and man-made drainage systems, causing overflow and property destruction. (MEMA, 2013) Possible long-term power outages and closed transportation systems can threaten human health and disrupt businesses.

The Berkshires are currently a moderately temperate climate, but an increase in summer temperatures will create higher peak summer electricity demands for cooling, including an increase in the number of air conditions units being installed. The current cooling degree days (CDD) with a base of 65°F for the summer season in the Housatonic River basin is 231 (for years 1971-2000). By mid-century the summer season CDD is projected to increase an additional 169-473, an increase of 73-205%, and by the 2090s the summer CDD is projected to increase an additional 239-931, an increase of 104-403%. (MA Climate Change Projects for Housatonic Watershed, 2018). It is unknown how well prepared the electric grid is for the increased peak season and daily demand.

Previous Occurrences

Based on all sources researched, known severe weather events that have affected the region and were declared a FEMA disaster are identified in Table 3.4.1, which provides detailed information concerning the FEMA declarations for the Commonwealth. (MEMA, 2013)

Table 3.4.1. FEMA Severe Weather Event Declarations Including Berkshire County 1954 to Present

Incident Period	Description	*Declaration Number*
3/30/87 – 4/13-87	Severe storms and flooding; 8" in some areas of state with already high river conditions due to spring snowmelt.	*DR-790*
10/7/05-10/16/05	Severe storms and flooding throughout Berkshire County the remnants of T.S. Tammy produced significant rain and flooding across western Massachusetts. It was reported that between 9-11" of rain fell. The state received over $13 million in individual and public assistance. The Town of Lanesborough used FEMA disaster funds to improve several gravel roads, including replacing gravel and/or improving and replacing culverts and catch basins; fund went most specifically to North Main, Kessler, Scott, Potter Mountain and Minor Roads.	*DR-1614*
4/15/07-4/25/07	Severe storms and flooding; 3-6" of wet snow, sleet, and rain to parts of western Mass. The storm was primarily a rain event due to warmer temperatures, but higher elevations experienced significant snow and ice accumulations. Mass. received $8 million in public assistance from FEMA.	*DR-1701*
1/29/2011	Severe thunderstorms produced quarter- sized hail and damaging winds, knocking numerous trees and power lines in the affected areas, causing nearly $100,000 in property damage.	*EM-3343*

10/29/11-10/30/11	Severe storm and Nor'easter; at peak 665,000 residents state-wide without power; 2,000 people in shelters statewide. Snowfall accumulations of 1-2' were common in the Monadnocks, Berkshires, Connecticut Valley, and higher elevations in central Massachusetts. Up to 31 inches of snow was reported in Plainfield, MA. The accumulation of the heavy, wet snow on trees and power lines resulted in widespread tree damage and power outages across central and western Massachusetts. Six fatalities occurred during and in the aftermath of the storm.	*DR-4051*

Source: MEMA, 2013; BRPC 2017

The Storm Prediction Center maintains a severe weather database that contains information regarding hail, tornado, and damaging events. The damaging wind reports include data from 1996 to 2017. According to the Storm Prediction Center database, over the course of the last 20 years, the region has experienced 40 damaging wind events, with an annual frequency of two per year (NOAA, 2017). The events from the past 20 years caused over $348,000 in property losses.

Southern New England typically experiences 10 to 15 days per year with severe thunderstorms. An average thunderstorm is 15 miles across and lasts 30 minutes, although severe thunderstorms can be much larger and longer. (Massachusetts Emergency Management Agency, 2013) On Sunday, June 1, 2016 an afternoon thunderstorm stalled for two hours over Lee and Stockbridge, flooding streets, basements and ground floors, including the ground floor of Stockbridge Town Hall. Stockbridge received almost 5" of rain while 4.5" fell at the Lee water treatment plant. Another inch of rain fell the next evening in another storm.[1]

Microbursts occur throughout Berkshire County, downing trees, utility lines and sometimes causing damage to property. In the Berkshires microbursts are often accompanied by heavy rainfall that can cause additional damage from flooding. According to news media reports, several recent thunderstorm/microburst events have caused damages in the communities of Williamstown, North Adams, Cheshire, Lanesborough, Pittsfield, Lee, and Stockbridge.

Fig. 3.4.2 Microburst in Cheshire 7-18-16

Source: iBerkshires 7-18-16.

According to local officials, Lanesborough has experienced high wind storms and microbursts that resulted in damages and loss of electricity. In general, power outages occur most frequently in the northern portion of the town, to residents along Route 7 north of the Bailey Road intersection and along upper Scott and Kessler roads. On average, residents estimate that they lose power approximately 4-5 times per year, with the outages lasting only a few hours. The frequency and duration of outages has decreased over the last few years

[1] *Lindsay, Dick, 6-1-16. "Weekend deluge swamps roads, homes in Stockbridge, Lee," Berkshire Eagle.*

as Eversource and its predecessor Western Mass. Electric Company continue to upgrade its distribution system and have made efforts to improve communications with first responders.

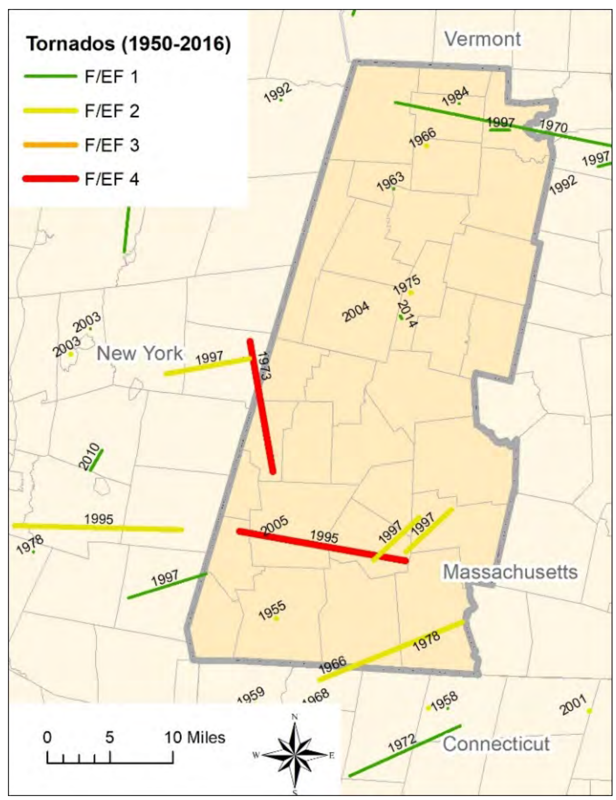
Several microburst events have occurred in Lanesborough in recent history. One microburst struck in the southeast portion of the town in 2001, knocking down trees and power lines. The route of the storm generally followed the corridor of the underground gas lines, crossing Partridge and Swamp roads and Summer Street. In December 2006, on an unseasonably warm evening, many of the trees around the perimeter of the mall property were blown down. The storm's pathway was a southwest/northeast direction, crossing Swamp, Old State and Cheshire roads. Because of this storm, electric power along Swamp Road was down for more than 24 hours. Another severe wind event downed trees and limbs along Bailey Road in August of 2008. Electricity in this area of town was out for more than seven hours

An event that struck Pittsfield and other central Berkshire communities in July 2011 caused extensive damage and was responsible for the death of a man in Hinsdale who was struck by a falling utility pole. WMECO called in 339 out-of-state work electric crews and 14 out-of-state tree crews to remove trees and repair damaged lines[2]. According to the MA State Hazard Mitigation Plan, there have been several damaging severe storms that have included Berkshire County.

Typically, there are one to three tornadoes somewhere in southern New England per year, with Massachusetts experiencing an average of one tornado event annually between 1991 and 2010. Starting in 2007, tornados are rated based on the Enhanced Fujita Tornado Scale; prior to 2007 tornados were based on the Fujita Tornado Scale. Of the 18 tornados that have occurred in Berkshire County between 1950 and 2016, only one has occurred since 2007, an EF1 in July 2014 in Dalton. 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 tornados 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 – they lie scattered on the hillside like matchsticks.

Fig. 3.4.3. Tornados in the Berkshire Region and their Severity



Source: Midwest Regional Climate Center, 2018

[2] *McKeever, Andy, 1-27-11. "Pittsfield Slammed by Surprise Microburst Storm," iBerkshires.*

In July 2014 an EF-1 tornado and microburst touched down in the Greenridge section of Dalton, causing downed trees and powerlines across the area, and temporarily closing local roads. The tornado caused structural damage on at least one home and cut a path through the woods behind Greenridge Park. A home on Norwich Drive sustained extensive damage, as the tornado lifted the roof off the house, shifted the chimney and ripped vents and siding. At this same house a large tree smashed through the back of the house and broke windows. Other local homeowners suffered minor damages.[3]

Most tornados occur in the late afternoon and evening hours, when the heating is the greatest. In Berkshire County the majority of tornados occur in the month of July and to a lesser degree in August, but tornadoes have it the county as early as March (in Adams in 1966) and as late as October (in Cheshire in 1963). (MEMA, 2013)

Probability of Future Occurrences

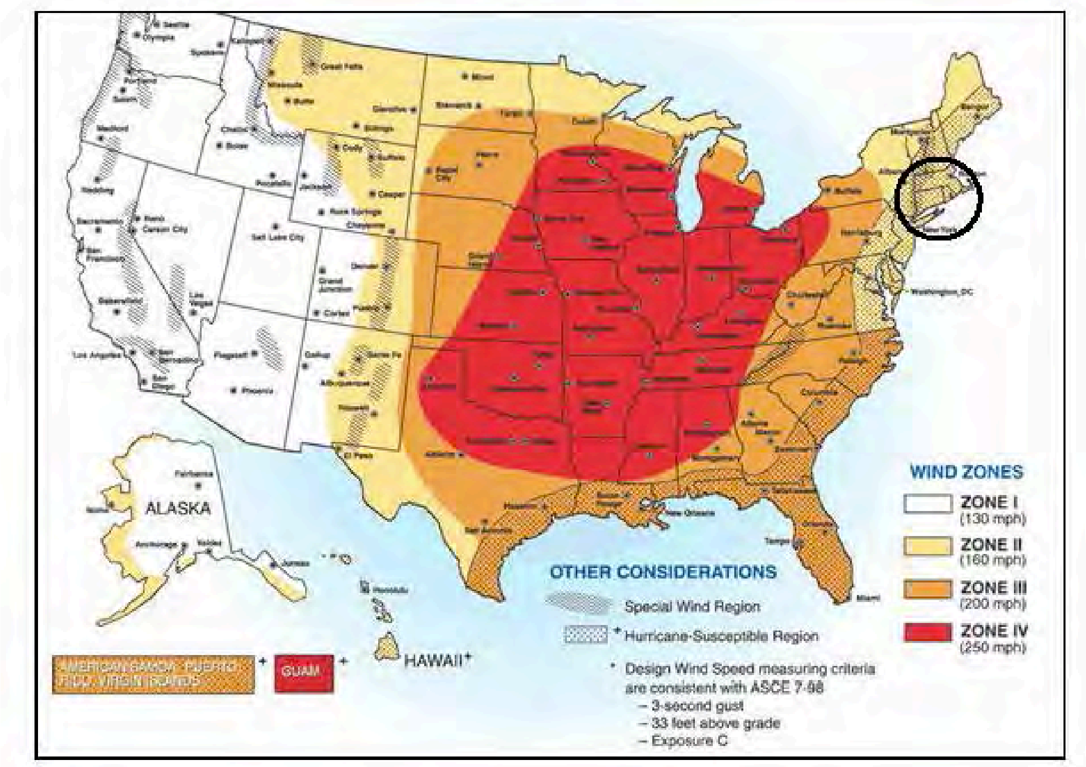
Severe storms comprising of thunderstorms, high winds, and hail will continue to affect the community. While these events may occur during any month, they most likely will occur between May and August. FEMA has developed Wind Zones for the U.S. based on 100 years of hurricane data and 40 years of tornado data, and according to the maps generated the Berkshires is listed as a Special Wind Region within the Hurricane-susceptible Region of a Wind Zone II (up to 160 mph winds). See Fig. 3.4.4. Based on this historical data the Town of Lanesborough can expect to continue to experience at least the same number and severity of wind-related weather events into the future. Some scientists project that the number and severity of events will increase as a result of climate change.

Lightning strikes primarily occur during the summer months. According to NOAA, there have been one fatality and 43 injuries as a result of lightning events from 1993 and 2012 in the Commonwealth (NCDC, 2012). Although thunderstorms with lightening may increase due to a more volatile atmosphere, the chance of death or injury is likely to remain low.

According to the National Climatic Data Center, since 1950, there have been 13 tornados that have touched down or moved in a path across Berkshire County. As shown in Fig. 3.4.3, there are several others that occurred in adjacent counties and states in the region. The most recent of these was in July 2014 when a tornado struck in Dalton. This averages to one tornado striking the county approximately every five years. Of these, only two have been of a severity of an EF4, which indicates that such a severe tornado has a statistical recurrence rate of one in every 33 years. (NOAA, 2017)

[3] *http://www.berkshireeagle.com/stories/national-weather-service-confirms-tornado-touch-down-in-dalton,365967*

Fig. 3.4.4. Wind Zones in the U.S.



Source: MEMA 2013.

Since 2000, there have been 24 cold weather events within the Commonwealth, ranging from Cold/Wind Chill to Extreme Cold/Wind Chill events. Since 2000, there have been one warm weather event, Excessive Heat. Detailed information regarding most of these extreme temperature events was not available.

Extreme temperatures will continue throughout the entire county into the future. With global warming, the county should expect more extreme temperatures, both hot and cold. It is projected that the region will experience 11 less days below 0°F. (Northeast Climate Science Center, 2018). According to the Massachusetts Climate Change Projections for the Housatonic River Watershed, a high temperature of above 90°F currently only occurs once per year. By mid-century the number of days it will go above 90°F will range from 4 to 20, and by the 2090s the number will increase to 7 to 57 days per year. The number of days going above 95°F will increase from the current zero days per year to almost 6 days by mid-century and up to 27 days by the 2090s. (MA Climate Change Projections for the Housatonic Watershed, 2018)

Severity

For non-tropical high wind events that occur over land, the National Weather Service (NWS) issues a Wind Advisory (sustained winds of 31 - 39 mph for at least one hour, or any gusts 46 - 57 mph) or a High Wind Warning (sustained winds 40+ mph or any gusts 58+ mph). For tropical systems, the NWS issues a tropical storm warning for any areas that are expecting sustained winds 39 - 73 mph. A hurricane warning is issued for any areas that are expecting sustained winds of 74+ mph. Effective 2010 the NWS modified the hail size criterion to classify a thunderstorm as 'severe' when it produces damaging wind gusts in excess of 58 mph, hail that is 1 inch in diameter or larger (quarter size), or a tornado (NWS, 2013).

Tornado damage severity is measured by the Enhanced Fujita Tornado Scale and it allows surveyors to create more precise assessments of tornado severity. Table 3.4.5 illustrates the EF-scale.

Table 3.4.5. Enhanced EF-Scale

EF Number	3-second gusts (mph)
0	65-85
1	86-110
2	111-135
3	136-165
4	166-200
5	Over 200

In the Berkshires, extreme cold temperatures are those that are well below zero for a sustained period of time, causing distress for vulnerable populations that are exposed to the temperatures when outside and straining home heating systems. The severity of extreme cold temperatures are generally measured through the Wind Chill Temperature Index. Wind Chill Temperature is the temperature that people and animals feel when 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 is cooled at a faster rate causing the skin's temperature to drop. (MEMA, 2013)

The NWS issues a Wind Chill Advisory if the Wind Chill Index is forecast to dip to –15ºF to –24ºF for at least three hours, using only the sustained winds (not gusts). The NWS issues a Wind Chill Warning if the Wind Chill Index is forecast to fall to –25ºF or colder for at least three hours using only the sustained wind. In 2001 the NWS implemented a Wind Chill Temperature Index to more accurately calculate how cold air feels on human skin and to predict the threat of frostbite. According to the calculations, people can get frostbite in as little as 10 minutes when the temperature is -10 degrees and winds are 15 miles per hour. (MEMA, 2013)

The following are some of the lowest temperatures recorded in the Berkshire region for the period from 1895 to present. (National Climatic Data Center, 2017)

- Lanesborough, MA –28°F
- Great Barrington, MA –27°F
-
- Stockbridge, MA –24°F
- Pittsfield, MA --19°F

Extreme heat temperatures are those that are 10°F or more above the average high temperature for the region and last for several hours. The following are some of the highest temperatures recorded for the period from 1895 to present, showing Boston and three Berkshire County locations. (National Climatic Data Center, 2017)

- Boston, MA 102°F
- Great Barrington, MA 99°F
- Adams, MA 95°F
- Pittsfield, MA 95°F

It should be noted that 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°-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.

Warning Times

Meteorologists can often predict the likelihood of a severe thunderstorm outbreaks with several days of lead time. However, they can only pin this down to portions of states and cannot predict the exact time of onset or severity of individual events. Other storms, such as a well-organized squall line, can yield lead times of up to an hour from the time a Severe Thunderstorm Warning is issued to the time that severe criteria are observed. Some severe thunderstorm events may develop quickly, with only a few minutes of advance warning times. Doppler radar and a dense network of spotters and amateur radio operators across the region have helped increase warning lead time across southern New England. (MEMA, 2013) In Berkshire County the hilly and sometimes steeply sloped terrain facilitates cumulonimbus cloud development, creating very localized thunderstorms. These can develop quickly and dissipate quickly, with damages caused by wind, rain and sometimes hail.

Tornado watches and warnings are issued by the local NWS office. A tornado watch is released when tornadoes are possible in an area. A tornado warning means a tornado has been sighted or indicated by weather radar. The current average lead-time for tornado warnings is 13 minutes. Occasionally, tornadoes develop so rapidly, that little, if any, advance warning is possible. (MEMA, 2013) According to the Dalton Emergency Management Director, who monitors weather advisories, there was no tornado warning for the Town prior to the tornado striking the Greenridge area in 2014. The only warning issued was a severe weather warning, with possible high winds.

Meteorologists can accurately forecast extreme temperature event development and the severity of the associated conditions with several days lead time. Excessive heat watches are issued when conditions are favorable for an excessive heat event in the next 24 to 72 hours. Excessive heat warning/advisories are issued when an excessive heat event is expected in the next 36 hours. (MEMA, 2013)

The severe weather warnings issued for Berkshire County are generated out of the National Weather Service out of Albany NY, not from that in Boston. Also, residents in most of Berkshire County rely on weather reports from Albany NY television stations rather than from stations within the Commonwealth. This is because the county is listed as being in the Albany designated marketing area for cable and satellite companies. Also, given that the prevailing winds are from the west, Albany is often a good barometer for Berkshire weather. Fortunately, Albany TV stations include Berkshire County when they issue storm watches and warnings, and storm systems are easily tracked live online via the radar displays of all three major Albany television stations. Albany and local radio stations also issue warnings.

Climate Change

Climate change presents a significant challenge for risk management associated with severe weather. The frequency of severe weather events has increased steadily over the last century. The number of weather-related disasters during the 1990s was four times that of the 1950s, and cost 14 times as much in economic losses. Historical data show that the probability for severe weather events increases in a warmer climate. (MEMA, 2013) Warming ocean temperatures are a source of increased evaporation and resulting precipitation, and warmer air masses can create more volatile atmospheric conditions, particularly if they interact or collide with cooler air masses. Any severe storm event could have significant economic consequences.

Extreme temperatures are among the most dangerous impacts associated with climate change. Extreme heat is among the most harmful to public health and safety, particularly for populations made more vulnerable due to existing chronic medical conditions or lower economic status. Additional impacts pose serious threats to public health and safety of urban areas, rising sea levels, and decreases in natural biodiversity.

Exposure

Whereas risk from some hazards can be somewhat dependent on locating development and infrastructure in higher risk areas (i.e. floodplain areas, dam inundation areas or proximity to forest and grasslands), the hazards described in this section are less dependent on location. In some localized areas wind speeds can increase across wide expanses of open, unforested areas, such as pasture or crop lands.

Temperature extremes can occur throughout the entire region and the Town of Lanesborough. Colder temperatures are more common in the higher elevations of the community, such as the higher elevations of Grange Hall Road at Barrett Hill, but the entire community is susceptible. Areas that are more prone to heat include the lower elevations in the downtown area and developments that are surrounded by parking lots. To understand risk, the assets exposed to the hazard areas are identified, and for the purposes of this plan the entire Town of Lanesborough is considered to be at risk for all the severe weather hazards discussed in this section.

3.4.3. Vulnerability

Population

The following populations are more vulnerable to a severe wind storm or tornado (MEMA, 2013):

- communities without or having ineffective early warning systems;
- Elderly and functional needs populations are considered most vulnerable because they require extra time or outside assistance to seek shelter;
- those with a language barrier unable to following warning messages;
- those in mobile homes;
- people in automobiles at the time of a tornado.

Severe storm events such as wind and rain storm events can impact people across Berkshire County and the Town of Lanesborough. Overall the greatest concern to human health from the hazards discussed in this section arise out of the potential for wide spread, long-term electricity outages, particularly during extreme temperature events that would make expose people susceptible to severe cold due to lack of heat and severe heat due to lack of fans or air conditioning. People with pre-existing illnesses who need electricity for oxygen, dialysis or other equipment, and those who need moderate temperatures and humidity to reduce stress on pulmonary or cardiac systems are more vulnerable to electricity outages. The elderly are typically more vulnerable due to chronic illness, and given the trend of an increasing elderly population, mitigation and preparing for electricity outages should be a high priority. The additional trend of helping seniors age in place, including the more rural areas of Lanesborough, could mean that elderly residents become isolated during severe weather events.

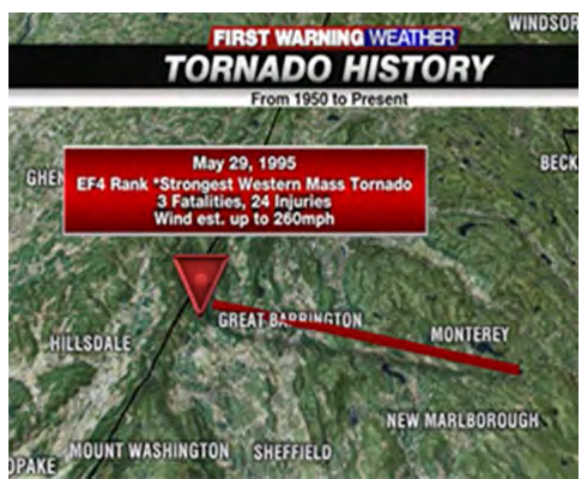
While residents in Lanesborough have not experienced a prolonged power outage in recent memory, some residents in neighboring towns in the region were without electricity for days or weeks during the Ice Storm of 2008. Participants at the Municipal Vulnerability Workshop noted that the elderly population is increasing in Lanesborough while the young adult population is dwindling. The children of many of the Town's senior have moved away, leaving seniors with a smaller circle of support. The increasing senior population will demand more services during a hazard event, while the number of volunteer first responders will decrease, which could lead to a reduction in response and aid to those who may need it most. There is only one senior housing complex in the town and it has relatively few units, so most seniors are scattered throughout the Town in homes or apartments. Although the Lanesborough Council on Aging (COA) and first responders are aware of some seniors who will need specific aid during a power outage, they do not have a list that is in any way complete. The resistance of many seniors to proactively self-report their needs to fire or police is an ongoing issue

A long-term power outage could also limit or halt delivery of drinking water due to loss of power at the drinking water storage tank or loss of the Bridge Street well which does not have a backup generator.

Massachusetts ranks 35th among states for frequency of tornadoes, 14th for the frequency of tornadoes per square mile, 21st for injuries, and 12th for cost of damage. (MEMA, 2013) On June 1, 2011, seven tornadoes traveled through the Connecticut River Valley. destroying large sections of Springfield and other towns in the region, killing three people, injuring 300 in Springfield alone, and leaving at least 500 people homeless. The F3 tornado traveled a 39-mile path from Westfield to Brimfield and Monson, the latter small towns of which suffered the greatest damages. With winds of up to 160 mph, it destroyed 1,400 homes and 78 businesses.[4]

According to available data tornados are the single deadliest natural hazard in Berkshire County in recent decades (other deadly hazards have historically been floods and dam failures). So far deaths have been relatively low because none of the stronger tornados were struck an area within one of the county's more densely populated areas such as a town center, village or subdivision. If a tornado where to strike a densely populated area it is likely that local and regional sheltering would be required.

Fig. 3.4.6. Path of the Great Barrington Tornado



[4] *http://boston.cbslocal.com/2016/06/01/springfield-tornado-5-year-anniversary-3-killed-millions-damage/*

All residents in the Town of Lanesborough are vulnerable to the health effects of extreme temperatures, with those who work outside directly at a greater risk. Others at greater risk are those individuals who have pre-existing medical conditions that impair their ability to regulate their body temperatures, or whose homes or work places are inadequately heated or cooled.

Fig. 3.4.7. Wind Chill Temperature Index and Frostbite Risk

Wind (mph) \ Temperature (°F): Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes, 10 minutes, 5 minutes

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (°F) V= Wind Speed (mph)

Effective 11/01/01

The NWS Wind Chill Temperature Index calculates how cold air feels on human skin, showing where temperature, wind speed and exposure time will cause frostbite to exposed human skin. Fig. 3.4.7. illustrates the relationship.

Vulnerable populations are the elderly and those with pre-existing health conditions such as cardiovascular disease, Type II diabetes and other chronic ailments are at higher risk of extreme heat events. Hot humid conditions have been found to make breathing more difficult for those suffering from impaired respiratory and pulmonary systems. Societal factors most associated with heat related health risks were a lack of air-conditioning, lower social economic status, socially isolated individuals and a higher percentage of elderly (DPH, 2014)

Based on the criteria for heat stress forecasts developed by the National Weather Service (NWS), watches or warnings are issued when thresholds of daytime high and nighttime low heat index (Hi) values are exceeded for at least two consecutive days (Fig. 3.4.8). That number provides a temperature that the body feels. 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. In Boston more than 50 people die each year due to heat-related illnesses. (MEMA, 2013) When interviewed in 2016 about projected climate change impacts, local ambulance crews reported no increase in heat-related calls in recent years, but Pittsfield Fire Chief Czerwinski did note that his department and Berkshire Medical Center staff are coordinating more closely about when to open cooling centers in Pittsfield for vulnerable populations (BRPC & BCBOHA, 2016) .

Fig. 3.4.8. Heat Index Chart and Human Health Impacts

HEAT INDEX CHART

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

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

Source: MEMA 2013

Nationally more than half of heat-related deaths occurred in homes where there was little or no air conditioning. Although the temperatures in the Berkshires do not equate to those in the southern portion of the country, the proportion of residents here without air conditioning is likely much higher than down south, indicating increased risk if the region were to experience a severe and prolonged heat wave. Air quality, which tends to be more degraded in urban areas, adds additional stress. Populations living in urban heat cores are more vulnerable to heat stress, particularly those without access to air conditioning and those with existing health conditions more susceptible. There are no urban core areas in Lanesborough.

What may be more concerning is the trend for higher nighttime temperatures. Warm nights are those where the minimum temperature stays above 70°F. Since 1950 the number of warm nights in Massachusetts has steadily increased since the mid-1990s with the highest number since 1950 occurring between 2010 and 2014. Refer to Fig.3.4.9., where the dark horizontal line represents the long-term average.

Fig. 3.4.9. Observed Number of Warm Nights in MA 1950-2014

Historically the cooler evening temperatures in the Berkshires has allowed residents to cool their body temperatures in the night air and to cool their homes by opening windows and using fans to bring in the cooler air. Warmer nighttime temperatures will make it increasingly difficult to cool homes that are not equipped with air conditioning.

Extreme heat temperatures and heat waves have historically been rare in Berkshire County, with temperatures that are cooler than the Hudson and Connecticut river valleys, ranging from 5°F cooler in the valley communities and 10°F cooler in the hilltowns. This is due largely to the slightly higher elevations of the Berkshires when compared to other regions in southern New England. Due to the rarity, this is a natural hazard for which communities and individuals are largely unprepared for. While most work places and increasingly more houses are being equipped with air conditioning, many residents across the county still rely on fans or inefficient window air conditioning units to cool their homes.

According to the *Berkshire Communities for Climate Change* report, the Massachusetts Department of Public Health survey taken by local boards of health across the state, in which less than 20% of local boards reported dealing with heat waves. Thirteen of the 17 Berkshire towns that answered the survey reported not having taken any steps to plan for cooling centers. Local schools are often designated as an emergency shelters and in the western region only 38% of respondents reported having at least partially available air conditioning in their schools. (BCBOHA, 2016).

Critical Facilities

All critical facilities in the Town of Lanesborough are exposed to severe weather events such as high winds and thunderstorms and tornados. The most common problem associated with severe weather is loss of electricity and possibly communications systems. Downed power lines can cause blackouts, leaving large areas isolated. Phone, water, and sewer systems may not function. Roads may become impassable due to flash or urban flooding. (MEMA, 2013)

The electric power line infrastructure along the Route 7 corridor could pose a public safety risk in the event that the power lines come down during a severe wind or other event. In addition to the three-phase power the lines already carried, the power lines here carry electricity generated by the Berkshire

Wind Cooperative wind turbine project, a 15-megawatt facility atop Brodie Mountain. The project owners are planning on adding two additional turbines for an additional 4.6 megawatts. This is an unusually high and dangerous amount of electricity, possibly able to melt asphalt if lines are broken. Several commercial solar projects have been proposed along the Route 7 corridor, and thus additional voltage may be added to the power lines along this portion of road if these are approved.

Route 7 is a major transportation artery in the region, serving as a main commercial route and a main link to the county's hospital, and loss of this road could delay emergency response and severely impact commercial and commuter movement. If a line went down anywhere on Route 7 between Bailey Road (South) to Prospect Street, there would be no way to divert traffic around it, short of sending them all over Summer Street or Old Cheshire Road, and then the all the way up Route 8 into North Adams and across Route 2 to Williamstown. Likewise, South bound traffic on Rt. 7 would have to go over Brodie Mountain Road into Hancock and out Routes 43, 22, and 20 in New Lebanon. Silver Street onto Ore Bed Road would have to be used for only emergency egress due to the fact that both are narrow dirt roads. These detours could be accentuated in the event of a region-wide disaster.

All critical facilities are exposed to the extreme temperatures hazards. Extreme cold temperature events can damage buildings and infrastructure through freezing/bursting pipes and freeze/thaw cycles. The water lines in the Pontoosuc Lake neighborhoods are prone to freezing and bursting during severe winter temperatures, as they were not laid as deeply in the ground as they should have been when constructed decades ago. The Lanesborough Village Fire & Water District and the Town of Lanesborough have been working to repair and replace these lines, but the extent of the infrastructure repairs is beyond current financial resources.

Extreme heat that occurs in the Berkshires generally does not impact buildings or other structures, but damages can be associated with overworking of HVAC systems, particularly those that are older or undersized. There is some concern that increased temperatures can reduce the transmission capacity of electric power lines during summer heat waves, which is exactly the time when peak demand for electricity will be highest due to air conditioning. In general the demand for electricity continues to rise, and the electric grid may have increasing difficulty meeting demand during the highest peak periods, leading to potential brown out or failures. Backup power sources will be all the more important for critical facilities such as key public buildings (for continuity of operations) and cooling centers.

Economic Vulnerability

Wind storms, thunderstorms, and tornado events may impact the economy, including loss of business function, water supply system damage, damage to inventory, relocation costs, wage loss, and rental loss due to the repair/replacement of buildings. Loss of key transportation routes may also occur. Agricultural losses can be devastating due to lightning and resulting fires. Because of differences in building construction, residential structures are generally more susceptible to wind damage than commercial and industrial structures. Wood and masonry buildings in general, regardless of their occupancy class, tend to experience more damage than concrete or steel buildings. (Massachusetts Emergency Management Agency, 2013) Mobile homes are the most vulnerable to damage, even if tied down, and offer little protection to people inside. The total structural replacement cost value for residential buildings in Lanesborough is greater than $190 Million or approximately 77-percent of all occupancy classes. (BRPC, 2018)

Many small businesses suffer disproportionately than larger industries – if small businesses cannot open the business than they may struggle to make payroll and other expenses – and the longer the closure the deeper the impacts.

3.4.4. Existing Protections

- The Town of Lanesborough adheres to the Massachusetts state building code, which as of 2018 was the Ninth Edition of the State Building Code. Part of that code requires buildings to withstand specific wind loads and adhere to energy efficiency standards. The Town of Lanesborough is also a Green Community, which requires that new construction adhere to the state's Stretch Energy Code, requiring new buildings to more energy efficient and the building envelopes tighter than the state's underlying code. The more heavily insulated building envelope will add in maintaining temperate interior temperatures against extreme exterior cold and heat. The MassSave Program offers free energy audits to residential and business customers who request the and, based on the results of the audits, offers financial incentives for building owners to become more energy efficient and better insulated.
- Regarding electricity outages, town officials across Berkshire County have reported an improvement in response from the electric companies since the ice storm in 2008. Additionally, the electric utility companies have created special community liaison staff who work more directly with municipal first responders during emergency incidents. The Lanesborough Emergency Management Committee periodically requests that Eversource send its municipal liaison to its meetings periodically to maintain good communications between the Town and the utility.
- The Town of Lanesborough has sheltering plans for local and regional sheltering if needed. A MOU is in place to use the Lanesborough Elementary School if needed. Regionally, as a member of the Central Berkshire Regional Emergency Planning Committee, the Reid Middle School is also available for larger events.
- Reverse 911 is utilized by emergency personnel when severe weather events are predicted; it is also utilized during and post-storm to inform residents of resulting road closures, power outages and other safety instructions.

3.4.5. Actions

- Continue strict adherence to MA building code and the Stretch Energy Code
- Continue the partnership between the Town of Lanesborough and the Lanesborough Water and Fire District to cost effectively upgrade aged and deteriorating buried infrastructure during road and other capital improvement projects
- Encourage cell phone users to enlist in the town's Reverse 911 system

3.5. Severe Winter Weather Hazards: Snow, Blizzards and Nor'easters, Ice Storms

3.5.1. General Background

Winter storms are the most common and most familiar of Massachusetts hazards which affect large geographical areas. 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. However, periodically, a storm will occur which is a true disaster, and necessitates intense, large-scale emergency response.

Snow formation requires temperatures to be below freezing in all or most of the atmosphere from the surface up to cloud level. Generally, ten inches of snow will melt into one inch of water. Sometimes the snow-liquid ratio may be much higher – up to 20:1 or 30:1. This commonly happens when snow falls into a very cold air mass, with temperatures of 20 degrees or less at ground level. (MEMA, 2013)

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 moister 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) The main impacts of Nor'easters in the Berkshires are 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.

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)

3.5.2. Hazard Profile

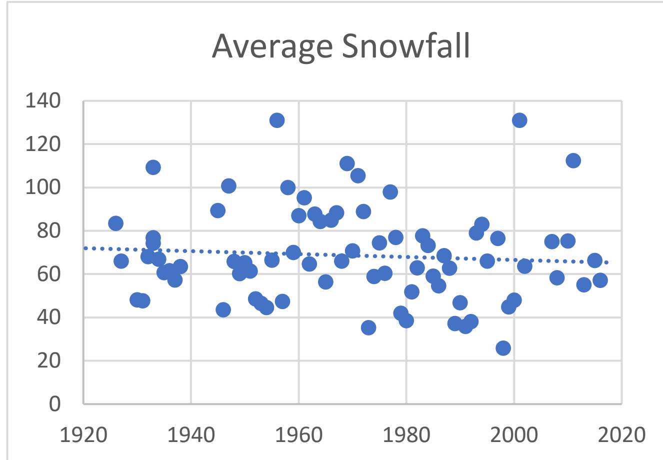
Location

Severe winter storm events generally occur across the entire area of Lanesborough, although higher elevations, particularly those in the northern section of Lanesborough, have slightly higher snow depths.

Previous Occurrences

Figure 3.5.1. illustrates historic snowfall totals the region has received, as recorded by the National Climatic Data Center (NCDC), a division of NOAA. 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. (NCDC, 2017)

Fig. 3.5.1. Average Snowfall in Berkshire County



The NCDC 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 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 3.5.1. 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 sever 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.

One unusual storm was October snowstorm of 1987, which dropped several inches of wet snow on the county. The trees, which still had their autumn leaves, were overwhelmed with the weight of the snow. As a result, trees, limbs and downed power lines were scattered across the region. Lanesborough rescue crews drove the town loader and other equipment up Rockwell Road to open the road and allow the rescue of campers staying in the Sperry Campground in the Mt. Greylock State Reservation.

Table 3.5.2. Severe Winter Weather – Declared Disasters that included Berkshire County 1992-2017

Incident Period	Description	Declaration Number
12/11/92-1213/92	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
3/13/93-3/17/93	High winds & heavy snow; generally 20-30" in Berkshires; blizzard conditions lasting 3-6 hrs afternoon of March 13.	EM-3103
1/7/96-1/8/96	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
3/5/01-3/6/01	Heavy snow across eastern Berkshires to Worcester County; several roof collapses reported; $21 million from FEMA	EM-3165
2/17/03-2/18/03	Winter storm with snow of 12-24", with higher totals in eastern Berkshires to northern Worcester County; $28+ million from FEMA	EM-3175
12/6/03-12/7/03	Winter Storm with 1'-2' across state, with 36" in Peabody; $35 from FEMA	EM-3191
1/22/05-1/23/05	Blizzard with heavy snow, winds and coastal flooding; highest snow falls in eastern Mass.; $49 million from FEMA	EM-3201
4/15/07-4/16/07	Severe Storm and Flooding; wet snow, sleet and rain add 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
1/11/11-1/12/11	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
2/8/13-2/9/13	Severe Winter Snowstorm and Flooding; $56+ million from FEMA	RE-4110

Source: FEMA 2017.

Probability of Future Occurrences

Severe winter weather is a common occurrence each season in Massachusetts. 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). The Town of Lanesborough'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.

Severity

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, which is similar to the Fujita scale for tornadoes or the Saffir-Simpson scale for hurricanes. 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 3.5.3. RSI 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 (as listed in Table 2), 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. Impacts to Lanesborough from this storm was limited by power outages.

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.

Fig. 3.5.2. Opening Mohawk Trail in Florida MA with Shovels 1926

Source: Stan Brown, Florida, MA

Warning Time

Meteorologists can often predict the likelihood of a severe winter storm. This can give several days of warning time. Schools and businesses usually have at least a 24-hour warning to monitor weather reports and start to plan closings. However, meteorologists cannot predict the exact time of onset or severity of the storm so decisions on closing schools, businesses or events are often made hours earlier. Some storms may come on more quickly and have only a few hours of warning time. (MEMA, 2013)

Secondary Hazards

Secondary impacts for winter events are similar to those experienced in other severe storm events such as high winds or flooding, but with the additional structural risk of damage from snow load, more widespread hazardous driving conditions and greater risk of hypothermia from power outages or shoveling.

Climate Change Impacts

The climate of the region is changing and will continue to change over the course of this century. Since 1900, ambient air temperatures have increased by 0.5°F. This warming trend have been associated with other changes, more frequent days with temperatures above 90°F, reduced snowpack, and earlier snow melt and spring peak flows. By the end of the century, under the high emissions scenario of the Intergovernmental Panel on Climate Change, Massachusetts is expected to experience a 5°F to 10°F increase in average ambient temperature with several more days of extreme heat during the summer. Sea surface temperatures are also expected to incase by 8°F. (MEMA, 2013)

Along with rising temperatures, it is expected that annual precipitation will increase by 14%, with a slight decrease in summer totals and a 30% increase in winter totals. Winter precipitation is predicted to be in the form of rain rather than snow. This change in precipitation will have significant effects on the amount of snow cover, winter recreation, spring snowmelt and peak stream flows, water supply, aquifer recharge, and water quality. The Commonwealth is located in an area where thresholds between snow and rain are sensitive and reductions in snow would be the largest. Snow is also predicted to fall later in the winter and cease falling earlier in the spring. (MEMA, 2013)

Exposure

For the purposes of this plan, the entire Town of Lanesborough is considered to be exposed to severe winter weather.

3.5.3. Vulnerability

Population

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 fatalities may occur due to traffic accidents on icy roads, heart attacks while shoveling snow, or of hypothermia from prolonged exposure to cold. (MEMA, 2013)

Heavy snow can immobilize a region and paralyze a city, shutting down air and rail transportation, stopping the flow of supplies, and disrupting medical and emergency services. Accumulations of snow can collapse buildings and knock down trees and power lines. In rural areas, homes and farms may be isolated for days, and unprotected livestock may be lost. (MEMA, 2013)

The entire population of the community is exposed to the severe winter weather hazard, particularly those that work outside or whose job requires that they respond to the weather, such as shoveling, plowing or clearing snow from building roofs. The elderly are considered most susceptible due to their increased risk of injury and death from falls and overexertion and/or hypothermia from attempts to clear snow and ice, or related to power failures. 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). In addition, severe winter weather events can reduce the ability of these populations to access emergency services. Power outages can result in complete loss of heat for those who have electric heat or where electricity is required to run boilers or pellet stoves. Frozen water pipes could burst and threaten the home and the health of the residents who reside there. The ice storm of 2008 was the incident that created the longest power outages in the region in recent memory, but this storm did not severely impact residents in the Town of Lanesborough.

Deep and heavy snow depths can weaken building roofs and threaten the structural integrity below them, injuring or killing people inside the building or those standing close to collapsing buildings. The weight of one foot of light fresh snow ranges from three pounds per square foot to 21 pounds per square foot for wet heavy snow.[1] Heavy snow loads in February/March 2015 caused the collapses of at least 210 buildings across the state.[2] Snow loads on buildings and homes with poorly insulated or vented attics are prone to melting and refreezing, causing the snow load to be heavier and making the roof more prone to ice dam damage. Educating building owners about improvements that could be done to protect roofs from snow load and ice dam damage would help to reduce risk from building collapse.

Critical Facilities

All critical facilities and infrastructure in the community are exposed to severe winter weather hazards. Full functionality of critical facilities such as police, fire and medical facilities is essential for response during and after a winter storm event, but these facilities may not be fully operational due to workers unable to travel to ensure continuity of operations pre- and post-event. Fortunately, many town critical workers live within a short driving distance and public works and first responder staff levels seldom suffer. Because power interruption can occur, backup power is recommended for critical facilities and infrastructure. Long-term infrastructure at risk for this hazard includes roadways that could be damaged due to the application of salt and intermittent freezing and warming conditions that can damage roads over time. (MEMA, 2013)

Economy

The entire general building stock inventory in the community is exposed and vulnerable to the severe winter weather hazard. In general, structural impacts include damage to roofs and building frames, rather than building content. Heavy accumulations of ice can bring down trees, electrical wires, telephone poles and lines, and communication towers. Communications and power can be disrupted for days while utility companies work to repair the extensive damage. Even small accumulations of ice may cause extreme hazards to motorists and pedestrians. Bridges and overpasses are particularly dangerous because they freeze before other surfaces. (MEMA, 2013)

Current modeling tools are not available to estimate specific losses for this hazard. As an alternate approach, this plan considers a one percent damage of structures that could result from winter storm conditions. This one percent was used by the state in their 2013 State Hazard Mitigation Plan. Table 3.5.4. summarizes percent damage that could result from winter storm conditions on the community's total general building stock (structure only). These figures do not include financial losses suffered by businesses due reduced business hours or closures.

[1] *FEMA, 2013. Risk Management Series, Snow Load Safety Guide, FEMA P-957. Washington, DC.*

[2] *https://www.bostonglobe.com/metro/2015/03/04/partial-roof-collapse-bayside-expo-center-dorchester-fire-officials-say/T3gLvWMMB7Jd7YszVABPDL/story.html*

Table 3.5.4. Estimated Potential Loss Due to a Severe Winter Storm Event

Number of Buildings	Replacement Cost Value (Structure Only)	1% Loss
2,051	$245,252,600	$2,452,526

A specific area that is vulnerable to the winter storm hazard is the floodplain. Snow and ice melt can cause both riverine and urban flooding. At-risk general building stock and infrastructure in floodplains are presented in the flood hazard profile (Section 10). These risks can expect to increase as warmer winter temperatures results in more rain events.

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.

3.5.4. Existing Protections

- Experiencing snow storms and severe winter weather are considered part of living in Berkshire County. Municipalities budget money for snow plowing, sanding and overtime, and public works road crews plan equipment and materials purchases in preparation for the winter season. Capital improvements often consider new truck or plow equipment. Most snow and severe winter weather events are considered expensive nuisances, with only the most severe blizzard or Nor'easters that threaten human health due to closed transportation routes or services, or those that cause power outages a cause for concern.
- The Town of Lanesborough and the Mount Greylock Regional School Districts have good public communication systems that alert residents to school closings and other emergency conditions.
- The Town of Lanesborough follows the Massachusetts Building Code. In this building code, most of Berkshire County is in a zone that requires new construction to withstand 50 pounds per square foot (psf) of snow load, with a few south county towns having a rating of 40 psf. These are the strongest requirements in the state, with other parts of the state requiring strengths of 25-40 psf, depending on the location of the municipality. The snow load is an important consideration when building owners are considering installing solar panel on homes and businesses.
- Properly insulated and sealed homes can maintain warm interior temperatures longer during a winter power outage than those with little or no insulation, reducing health risks to inhabitants sheltering in place and the risk of frozen pipes. Properly insulating and venting attics can help to reduce ice dam damage. The MassSave energy program offers free home audits and provide financial incentives for owners to seal and insulate the building envelopes. Berkshire Community Action Council provides further assistance by aiding low income residents access fuel assistance and home improvement programs, including weatherization and energy-efficient

furnaces and appliances. Being able to retrofit homes with little or no insulation is important as 40% of the building stock was constructed before 1940, and 60% is pre-1960.[3]

3.5.5. Actions

- Increase emergency preparedness outreach to residents, particularly the vulnerable populations such as the elderly and those with disabilities.
- Continue to access disaster funding when available.
- Encourage homeowners to get energy audits and improve attic insulation.
- Increase enrollment in Reverse 911.

[3] *BRPC, 2014. Sustainable Berkshires, a Long-Range Plan for Berkshire Count, Housing and Neighborhoods. Pittsfield, MA*

3.6. Drought Hazard

3.6.1. General Background

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 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.

3.6.2. Hazard Profile

Location

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 Lanesborough is at risk of drought.

The Lanesborough Fire & Water District provides public drinking water to approximately 2,400 residents, which is roughly 80% of the Town's population. It also provides water to approximately 40 businesses. The Miner Road well, within the Town Brook subwatershed, is the primary source for the District and has a capacity of 610 gallons per minute. A second well on Bridge Street is a back-up source, as it does not quite have the capacity to meet summer demand of the District. July is the peak usage month, and is 12% higher than the average month. The District is searching for another groundwater source to ensure service.

The Berkshire Village Cooperative provides water to approximately 50 residents in Berkshire Village.

In general, it is believed that residents with private wells are at greater risk of drought, especially if their wells have been dug relatively shallow.

Previous Occurrences

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 1). (MEMA, 2013) The most severe drought occurred during the 1960s, due to both severity and extended duration.

Table 3.6.1. 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 post-2013 information gathered show 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.[1] 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 (see Table 3.6.1. and Fig. 3.6.1. and for the progression of the 2016-17 drought).

The Lanesborough Fire & Water District reported that their water supply did not appear to be at risk during the 2016-17 drought. The Miner Road well, within the Town Brook subwatershed, is the primary source for the District and has a capacity of 610 gallons per minute. This well taps a deep underground aquifer, which helps to buffer it from drought. A second well on Bridge Street is a shallower well and is a back-up source, as it does not quite have the capacity to meet summer demand of the District. July is the peak usage month, and is 12% higher than the average month. The District did report that it received calls from a few residents in the northern portion of the town whose private wells had run dry. Greylock Estates, a small residential development off Bailey Road had to re-dig its wells.

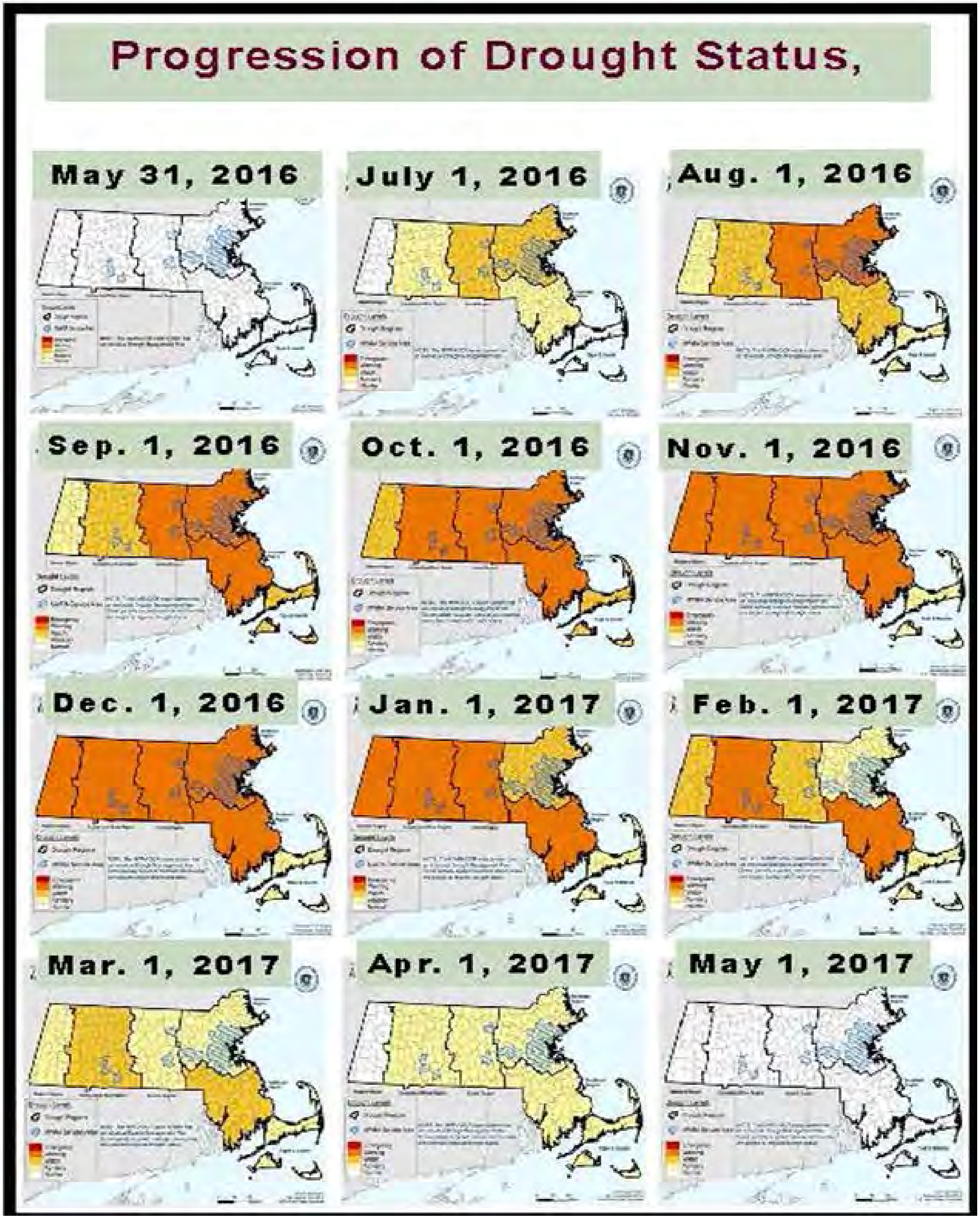
[1] MA Water Resources Commission, 2017. *Annual Report, Fiscal Year 2017*. Boston, MA.

Table 3.6.2. Drought Events and Levels 2001-2017

					Drought Level by Regions				
Year	**Begin Date**	**End Date**	**Comment**	**Western**	**CT River**	**Central**	**Northeast**	**Southeast**	**Cape & Islands**
	12/28/2001	**1/31/2003**							
2001	**12/28/2001**			Advisory	Advisory	Advisory	Advisory	Advisory	Advisory
2002			February 2002	Advisory	Watch	Watch	Watch	Advisory	Advisory
2002			March 2002	Watch	Watch	Watch	Watch	Watch	Watch
2002			April 2002	Watch	Watch	Watch	Watch	Watch	Watch
2002			May 2002	Watch	Watch	Watch	Watch	Watch	Watch
2002			June 2002	Advisory	Advisory	Advisory	Advisory	Advisory	Advisory
2002			July 2002	Advisory	Advisory	Advisory	Advisory	Advisory	Advisory
2002			August 2002	Advisory	Advisory	Advisory	Advisory	Watch	Watch
2002			September 2002	Advisory	Advisory	Advisory	Advisory	Watch	Watch
2002			October 2002	Advisory	Advisory	Advisory	Advisory	Advisory	Advisory
2002			December 2002	Normal	Normal	Normal	Normal	Normal	Advisory
2003		**1/31/2003**	As of January 31, 2003	Normal	Normal	Normal	Normal	Normal	Normal
	10/1/2007	**3/18/2008**							
2007	**10/1/2007**			Normal	Advisory	Advisory	Advisory	Advisory	Normal
2008		**3/18/2008**	As of March 18, 2008	Normal	Normal	Normal	Normal	Normal	Normal
	8/1/2010	**11/19/2010**							
2010	**8/1/2010**			Normal	Normal	Advisory	Advisory	Normal	Normal
2010			October 2010	Normal	Advisory	Advisory	Advisory	Normal	Normal
2010		**11/19/2010**	As of November 19, 2010	Normal	Normal	Normal	Normal	Normal	Normal
	10/1/2014	**11/30/2014**							
2014	**10/1/2014**			Normal	Normal	Normal	Normal	Advisory	Advisory
2014		**11/30/2014**	As of December 1, 2014	Normal	Normal	Normal	Normal	Normal	Normal
	7/1/2016	**4/30/2017**							
2016	**7/1/2016**		June 2016	Normal	Advisory	Watch	Watch	Advisory	Normal
2016			July 2016	Advisory	Watch	Warning	Warning	Watch	Advisory
2016			August 2016	Advisory	Watch	Warning	Warning	Warning	Watch
2016			September 2016	Watch	Warning	Warning	Warning	Warning	Watch
2016			October 2016	Warning	Warning	Warning	Warning	Warning	Advisory
2016			November 2016	Warning	Warning	Warning	Warning	Warning	Advisory
2016			December 2016	Warning	Warning	Warning	Watch	Warning	Advisory
2017			January 2017	Watch	Warning	Watch	Advisory	Warning	Advisory
2017			February 2017	Advisory	Watch	Advisory	Advisory	Watch	Advisory
2017			March 2017	Normal	Advisory	Advisory	Advisory	Advisory	Advisory

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

Fig. 3.6.1. Progression of the 2016-17 Drought



Source: MA Water Resources Commission, 2017.

Probability of Future Occurrences

An analysis of historical rainfall data indicated that, based on this index alone, between 1850 and 2012, the Commonwealth experienced drought emergency conditions in 1883, 1911, 1941, 1957, and 1965-1966. The 1965-1966 drought period is viewed as the most severe and longest duration drought to have occurred in Massachusetts. On a monthly basis, there is a 1% chance of the Commonwealth being in a drought Emergency. Drought Warning conditions not associated with drought Emergencies occurred in 1894, 1915, 1930, and 1985. On a monthly basis, there is a 2% chance of the state being in a drought Warning level. Drought Watch conditions not associated with higher levels of drought would have typically occurred in three to four years per decade between 1850 and 1950. The overall frequency of the Commonwealth being in a drought Watch is 8% each month (MEMA, 2013). The drought levels, recurrence interval and state estimated drought level nomenclature is found in Table 3.

Berkshire County was determined to be in Warning drought conditions October 2016 through January 2017. Using the U.S. Drought Monitoring system, this type of drought event could be estimated to reoccur once per 10 to 50 years. Given that the duration was short and that the greatest severity was during the winter months, when water demand is less, water managers in Berkshire County did not suffer a severe threat to their supplies. The relatively low impact of this drought and of others in recent memory may lead water managers in the region towards a false sense of security.

Table 3.6.3. U.S. Drought Monitor Level and Comparable State Level Indices

Names	Recurrence	Percentiles	MA Drought Levels
D0: Abnormally Dry	once per 3 to 5 years	21 to 30	Advisory
D1: Moderate	once per 5 to 10 years	11 to 20	Watch
D2: Severe Drought	once per 10 to 20 years	6 to 10	Warning
D3: Extreme Drought	once per 20 to 50 years	3 to 5	Warning
D4: Exceptional Drought	once per 50 to 100 years	0 to 2	Emergency

Source: U.S. Drought Monitor; MA Drought Management Plan 2013.

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 (EEA, 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 MassDEP 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.

Warning Time

Droughts are climatic patterns that occur over long periods of time. Drought levels advisories are issued at gradual levels to alert the public to conditions that, if continued, could result in more serious degrees of drought. Initial drought levels include Advisory and Watch levels. Voluntary water conservation efforts are advised during early stages of drought conditions and increasing conservation requirements are expected when Drought Warning and Emergency conditions develop. These higher levels of drought require months of dry conditions to be reached. (MEMA, 2013) Therefore, according to state agencies, there is a lot of lead time as drought conditions progress.

Despite the long lead time to drought conditions, efforts to conserve water on the municipal, private and individual level should be conducted in an ongoing basis. Efforts by water managers to identify and remedy leaks in the piping system that deliver water supplies should be given ongoing attention, and efforts to encourage customers to conserve water in the home and in commercial and industrial uses should be given additional attention. Water conservation efforts will reduce the demand on reservoir and groundwater supplies in the event that a multi-year Emergency Drought event like that of the 1960s recurs.

Secondary Hazards

The secondary hazard most associated with drought is wildfire. For drought conditions to occur it is likely that soil moisture is limited or lacking, forest duff is dried out and standing vegetation is dry and possibly dead, providing the fuel needed for a wildfire. Given that the Town of Lanesborough is 69% forested, the risk of wildfire during drought conditions is a concern.

Climate Change Impacts

Changes in winter temperatures will lead to less snow pack 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.[2]

Exposure

For the purposes of this plan, the entire Town of Lanesborough is at risk of exposure to drought. It is generally believed that residents that are on private wells may be more susceptible to drought, particularly those with shallow wells, but there is not definitive data to verify this belief.

3.6.3. Vulnerability

To understand risk, this plan considers the impact to population, critical facilities and the economy.

Population

For the purposes of this plan update, the entire population of Lanesborough is exposed and vulnerable to drought. Those residents who are served by the Lanesborough Water District are believed to be less vulnerable to drought due to the productivity of the Town Brook aquifer. However, the Berkshire region has not suffered a severe, Emergency level drought since the 1960s and it is unclear how well the aquifer could serve the demands of its customers. The District believes that the greater risk to its water supply is contamination from a chemical spill along Route 7, a major transportation artery that accommodates heavy commercial truck traffic.

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 or urban fires. A more detailed discussion of wildlife and the Town's vulnerability is found in that section of the report.

Critical Facilities

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. Facilities and structures located outside the town center and that are in areas surrounded by forest or dry vegetation, such as water tanks, water pumps, sewer pumps and other infrastructure, could be more vulnerable to wildfire.

If a severe drought of long duration were to occur, the Town and the Fire and Water District may need to provide some assistance to provide water to residents whose wells have gone dry. An emergency dispensing center may need to be created to serve this population.

[2] EEA, Adaptation Advisory Committee, 2011. *MA Climate Change Adaptation Report, Boston*, MA.

Economy

Drought would also impact local farmers, causing crop and livestock losses. The Town did not receive any reports that farmers in Lanesborough have suffered damages due to drought in recent memory. Dry standing vegetation in fields could increase risk of wildfires.

3.6.4. Existing Protections

- The Lanesborough Fire & Water District has conducted several activities in the past several years to add storage capacity to the water system. It has replaced an old 300,000 gallon storage tank with new 750,000 tank in 2011 with USDA grant and long term loan. The District has also upgraded its monitoring system to ensure supply during short-term power outages, adding a battery system at the storage tank that can provide power for a couple of hours. Longer power outages lasting more than a couple of hours remain a concern. It also tests its generator at the Miner Road well once a week to ensure proper function if needed.
- The Massachusetts Department of Environmental Protection has broad jurisdiction to protect water supply and water quality. During a state of water emergency, MassDEP may issue orders to: (1) establish priorities for the distribution of any water or quantity of water use; (2) permit any person engaged in the operation of a water supply system to reduce or increase by a specified amount or to cease the distribution of that water; to distribute a specified amount of water to certain users as specified by the department; or to share any water with other water supply systems; (3) direct any person to reduce, by a specified volume, the withdrawal or use of any water; or to cease the withdrawal or use of any water; (4) require the implementation of specific water conservation measures; and, (5) mandate the denial, for the duration of the state of water emergency, of all applications for withdrawal permits within the areas of the Commonwealth to which the state of water emergency applies (EEA, MEMA, 2013)

3.6.5. Actions

- Pursue funding to secure a second drinking water source against both drought and potential contamination of the Town Brook aquifer; Bull Hill Road site is promising if funding can be found.
- The Bridge Street well pump is below grade and sumps are used to keep pump machinery dry during flood conditions; the site does not have a generator. Raising the machinery above flood elevation will remove the need for sumps and ensure function of the equipment during power outages.
- Continue to take opportunities to improve the condition of infrastructure where feasible, including the Water District continuing to work with the Town of Lanesborough to bundle road and other infrastructure improvement projects where possible for cost effectiveness.

3.7. Fire Hazards

3.7.1. General Background

There are three basic fire hazard regions that are discussed as part of this risk assessment: Urban Fire, Wildland-urban, and Wildfire. A major urban fire or conflagration is a large destructive, often uncontrollable, fire that spreads substantial destruction. Over the past several years, structure fires in Massachusetts account for the majority of fire deaths, injuries, and property loss within the Commonwealth. In Massachusetts, 83% of building fires and 69% of fire deaths in 2010 took place in residential occupancies, with more fire deaths occurring in one-and two-family homes than in all other residential occupancies combined. People under the age of 5 and over the age of 55 have a much higher death rate than the average population, accounting for more than one-third of all deaths nationally.

A wildland-urban interface area defines the conditions where flammable vegetation is adjacent to developed areas. The wildland-urban interface is the line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels. In these areas, homes are built among densely wooded areas, so humans are more likely to start a fire that will easily spread to the surrounding forested areas with plentiful vegetative fuels. The wildland-urban interface is at risk for wildfires due to human caused fire ignitions, which are more common than natural causes such as lightning. (MEMA, 2013)

A wildfire can be defined as any non-structure fire that occurs in the vegetative wildland, including grass, shrub, leaf litter, and forested tree fuels. In general, wildfires in Massachusetts occurrence can be caused by human activity (prescribed burns or accidents) or natural events. Wildfires often begin unnoticed, but can spread quickly, igniting brush, trees, and homes. Because 95% of wildfires are started by negligent human behavior, such as smoking in forested areas or improperly extinguishing campfires, most are considered preventable. In 2011, approximately 8% of the outside and other fires were considered intentionally set, indicating that the vast majority are started by accident. Wildfires can result in the destruction of forests, brush, field crops, grasslands, and personal property. (MEMA, 2013)

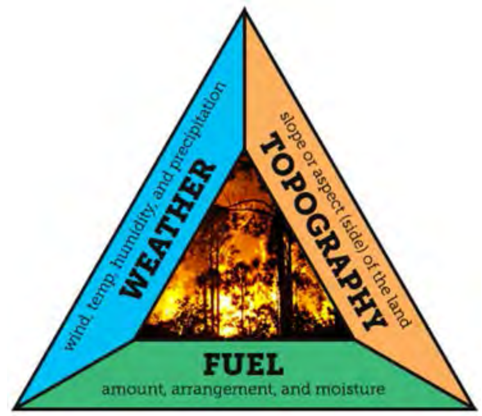
The "wildfire behavior triangle" of weather, topography and fuel are the three primary factors that influence wildfire behavior (Fig. 3.7.1.). Of the three, weather is the most variable and least predictable[1]. Climate change may influence future wildfire behavior due to changing weather and resulting forest fuel changes.

- 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, dying, or become receptive to ignition when influenced by environmental factors, such as drought, low humidity, and warm temperatures.

[1] https://learn.weatherstem.com/modules/learn/lessons/121/12.html. *Source also of the triangle graphic.*

- Weather:
  - Strong winds can exacerbate extreme fire conditions, especially wind events that persist for long periods, or ones with significant sustained wind speeds that quickly promote fire spread through the movement of embers or exposure within tree crowns.
  - Spring and summer drying months, many of which maintain drought-like conditions extending beyond normal season also can increase the normal fire season. Likewise, the passage of a dry, cold front through the region can result in sudden wind speed increases and change in wind direction affecting fire spread.
  - 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.

Figure 3.7.1. Fire Behavior Triangle



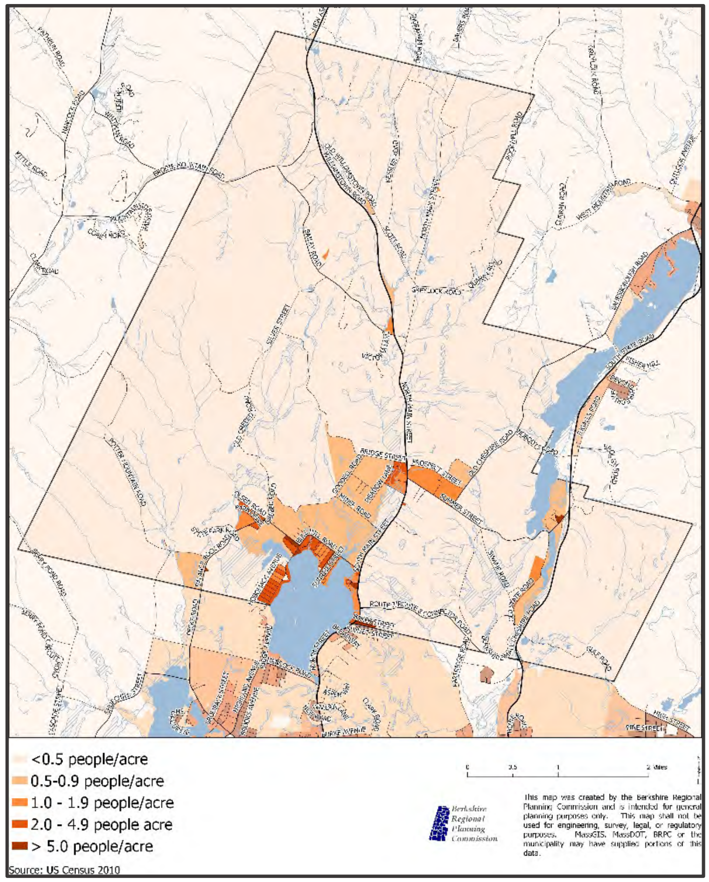
- Topography
  - Topography of a region or a local area influences the amount and moisture of fuel.
  - Barriers such as highways and lakes can affect spread of fire.
  - Elevation and slope of landforms—fire spreads more easily uphill compared to downhill.
- Climate Change
  - Without an increase in 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. In addition, 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)

3.7.2. Hazard Profile

Location

The risk of urban fire exists in few areas of Lanesborough, which is largely a bedroom community with single family homes scattered along a few key roadways. The areas where development is denser than usual (greater than five people per acre) are around the shore of Pontoosuc Lake and in Berkshire Village. Outside of these areas the population density is typically four people or less per acre. The map of Figure 3.7.2. illustrates population density using 2010 Census Blocks. While this is a good indication of where dense neighborhoods may be found, it should be noted that census block can encompass a large are, some of which may be very densely developed, while other portions of the block may be sparsely developed. The map in Figure 3.7.4, shown later in this plan section, illustrates development patterns using land use data.

Fig. 3.7.2. Population Density (2010 Census Blocks)



Source: BRPC 2018.

The majority of land in the town is vulnerable to wildfire. Sixty-nine percent of Lanesborough is forested, with vast unfragmented forest blocks that lie east and west of the centrally developed areas of the town. There are increased risks of fire due to campfires in the two campgrounds in town and human traffic in the state forests. The campground in Pittsfield State Forest is located south of Lanesborough, in the Pittsfield portion of the property, and if a wildfire were to occur in the campground the Town would likely respond to assist the Pittsfield Fire Department.

Previous Occurrences

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 (Massachusetts Emergency Management Agency, 2013). According to the Massachusetts Fire Incident Reporting System, fire 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: 272 acres in Clarksburg near the Williamstown border in 2015 and 168 acres in Lanesborough in 2008 (not the 600 acres listed in the MA Fire Incident Reporting System). 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

Table 3.7.1. Wildfires 2007-2016 in Lanesborough

Year	Number of Wildfires	Acres
2016	6	1
2015	2	4
2014	0	0
2013	2	4
2012	1	0
2011	0	0
2010	3	4
2009	0	0
2008	8	168
2007	1	5
Total	**23**	**186**

Source: MA Fire Incident Reporting System 2016 wildland acres burned would be 19. Berkshire County fire officials respond rapidly through mutual aid and through a coordinated effort with the DCR.

The Widow White's Peak fire of 2008, was the second largest fire in the county within the past few decades, is one of note the Town. The fire burned 168 acres (not the 600 acres listed in the MA Fire Incident Reporting System), largely forest lands. The Lanesborough Fire Department received an enormous amount of support from DCR and from 10 neighboring fire companies through mutual aid. The first day of the fire approximately 120 fire fighters worked to contain the fire, and through the second day 65 fire fighters from eight companies ensured containment. Hotspots continued to be put out for the next week.

In total, 23 wildfire incidents burned approximately 186 acres during 2007-2016 in Lanesborough. If the Widow White's Peak fire of 168 acres is removed as an outlier, the remaining 18 acres burned is averaged over the 10-year period, it would average slightly less than 2 acres per year. (Massachusetts Fire Incident Reporting System, 2017)

Probability of Future Occurrences

For the purpose of this plan, the probability of future occurrences is defined by the number of events over a specified period. The historical record 2007-2016 indicates that Lanesborough has on average slightly more than two wildfires a year, with an average of less than 2 acres burned per incident. Major urban fires are a low concern due to the lack of large urbanized areas where buildings are adjacent to one another. Many commercial buildings have their own fire detection and suppression systems. Risks continue to be mostly limited to structures, particularly homes, which as discussed earlier in this section pose the greater risks of injury and death.

Frequency

It is difficult to predict the likelihood of urban fires and wildfires in a probabilistic manner, such as, "there will be a catastrophic wildfire once every X number of years." This is because a number of variable factors affect the potential for a fire to occur and because some conditions (for example, ongoing land use development patterns, location, fuel sources, construction, etc.) exert increasing pressure on the wildfire and urban interface zone. Based on available data, urban fires and wildfires will continue to present a risk. (MEMA, 2013)

Differences in climate and building stock could play a factor in urban fires. It is likely that home fires related to heating occur more frequently in the northern areas of the U.S. Electrical distribution fires are likely to be more common in the northeast and south, where the building stocks are older, on average, than in the Midwest and west. (MEMA, 2013)

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. However, wildfires can occur every month of the year. Drought, snow pack, and local weather conditions can expand the length of the fire season. The early and late shoulders of the fire season usually are associated with human-caused fires. (MEMA, 2013)

Severity

Lanesborough is not developed to a density that would provide fuel for a major urban fire. The likeliest chance of urban-type fire would be in the Pontoosuc Lake neighborhoods where houses can be as close as 16-18 feet apart from each other.

Warning Time

Early warning for urban fires is none or minimal at best. Smoke detectors provide early warning of a fire; however, they do not guarantee an escape. Federal studies have shown in a typical fire, one has only about three minutes to evacuate safely before unsustainable conditions are encountered. (MEMA, 2013)

Dry seasons and droughts are factors that greatly increase fire likelihood, and posting forest fire risk, issuing warnings and burn bans can reduce the risk of urban and urban-forest areas. If a fire breaks out and spreads rapidly, residents may need to evacuate within days or hours. A fire's peak burning period generally is between 1 p.m. and 6 p.m. Once a fire has started, fire alerting is reasonably rapid in most cases. The rapid spread of cellular and two-way radio communications in recent years has further contributed to a significant improvement in warning time. (MEMA, 2013) In Berkshire County, mutual aid response from neighboring towns is common, further reducing risks.

Secondary Hazards

Smoke and air pollution from wildfires can be a health hazard, especially for sensitive populations including children, the elderly, and those with respiratory and cardiovascular diseases. Wildfire may also threaten the health and safety of those fighting the fires. First responders are exposed to the dangers from the initial incident and after-effects from smoke inhalation and heat stroke. (MEMA, 2013)

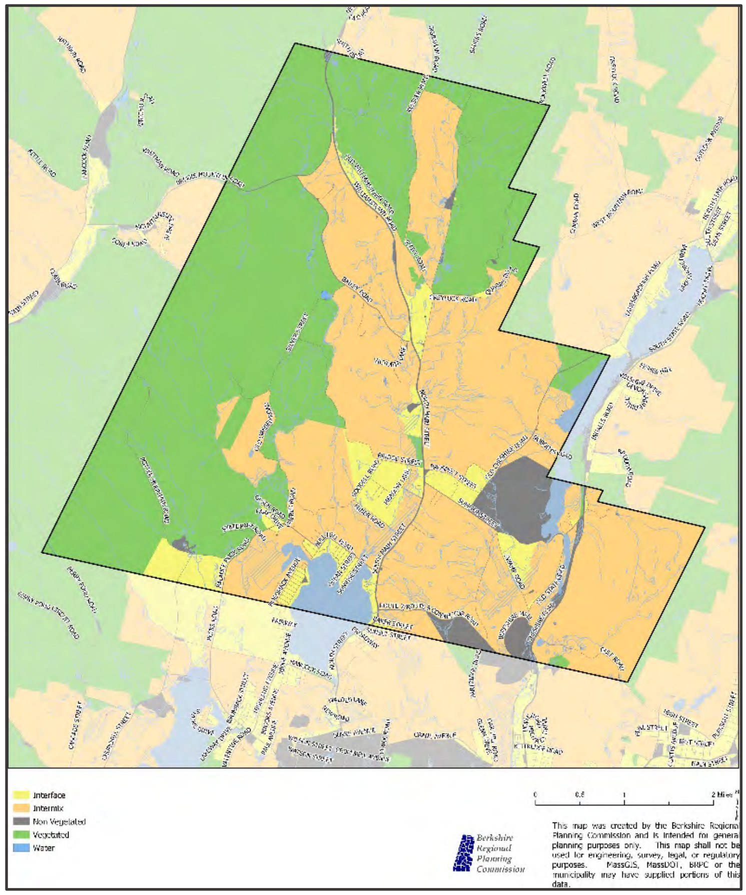
Wildfires can generate a range of secondary environmental effects, which in some cases may cause more widespread and prolonged damage than the fire itself. Fires can cause direct economic losses in the reduction of harvestable timber and indirect economic losses in reduced tourism. Wildfires cause the contamination of reservoirs, destroy transmission lines, and contribute to flooding. They can strip slopes of vegetation, exposing them to greater amounts of runoff, which can in turn can weaken soils and cause failures on slopes. Major landslides can occur several years after a wildfire. (MEMA, 2013) There are no areas in Lanesborough that have been affected by secondary environmental impacts in recent memory.

Climate Change Impacts

While climate change is unlikely to change topography, it can alter the weather and fuel factors of wildfires. Climate scenarios project summer temperature increases between 3ºF and 9ºF 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)

Exposure

Fig. 3.7.3. SILVIS Wildland-Urban Interface

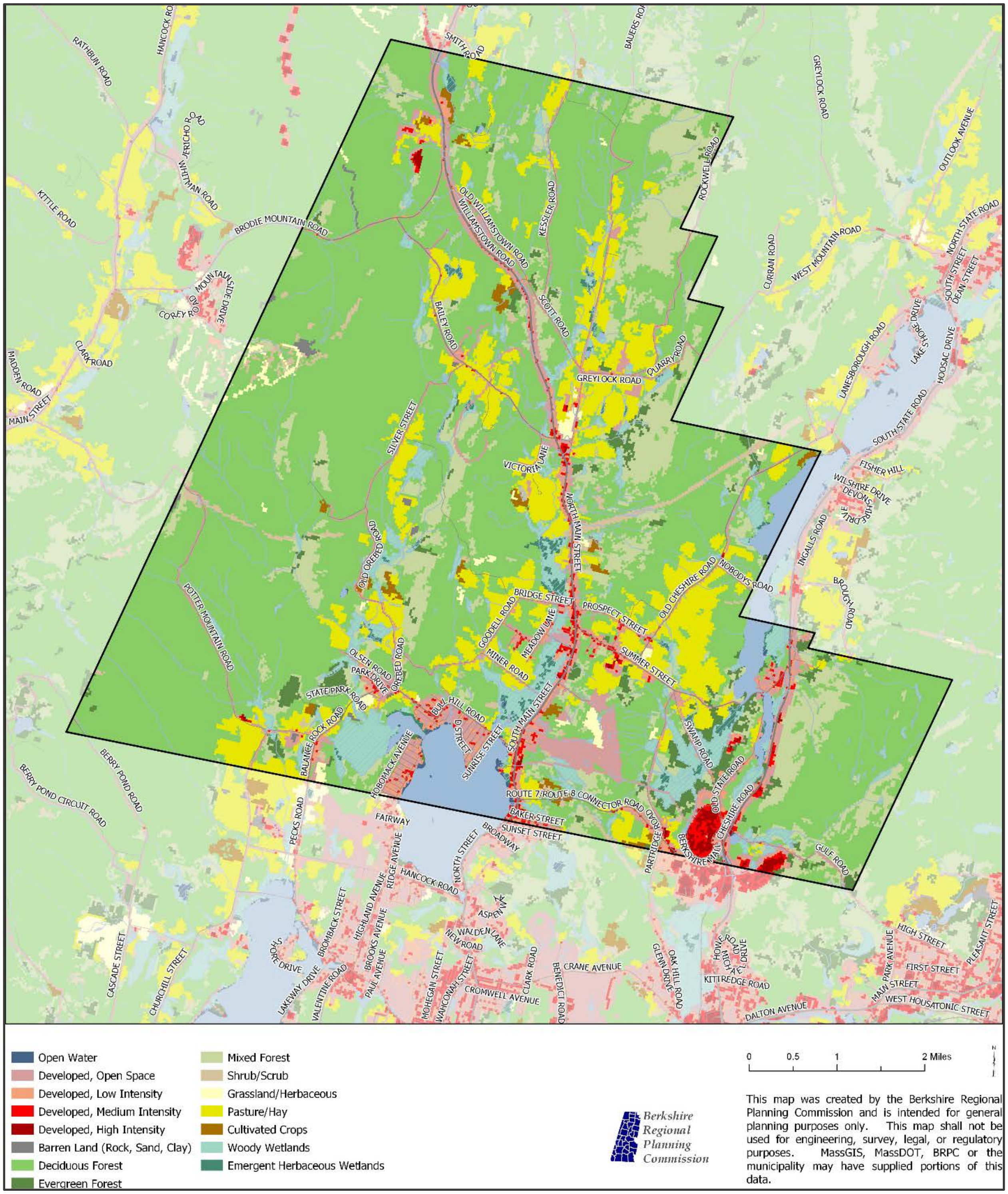


The ecosystems in Massachusetts that are most susceptible to wildfire hazard are pitch pine, scrub oak, and oak forests. These are the most flammable vegetative fuels. (MEMA, 2013) Lanesborough does not have any significant land coverage that include these ecosystems. However, the state forests are more vulnerable to wildfire due to increased human activity, particularly Mount Greylock and Potter Mountain. Land use and forest cover are shown Figure 3.7.3.

To understand risk, the assets exposed to the hazard areas are identified. For the wildfire hazard, areas identified as hazard areas include the wildland-urban areas. In its statewide hazard mitigation plan the Commonwealth utilized the SILVIS Lab, Department of Forest Ecology and Management at the University of Wisconsin to determine this risk. This method utilized census track data, the national land cover database and the protected areas database to determine risk. This same method was utilized as part of the fire risk assessment analyses for the Town of Lanesborough for this hazard mitigation plan. However, upon examination of this data and the map, Town officials do not believe that they reflect actual risk. While the Interface areas (yellow) around the Pontoosuc Lake area, it does not reflect risk to development in most other areas of the town because census blocks in most areas of the town include large blocks of undeveloped land and do not necessarily reflect the areas where homes are located within those blocks. This is particularly true for the Intermix areas (tan). Also, the model assumes protected land has a lower risk of wildfire than non-protected lands, which local officials question the merits off, because most of the protected lands across Berkshire County, including Lanesborough, open to the public and used by hikers and overnight campers. As a result, they are equally at risk of fire due to human activity on those lands.

Therefore, the Town of Lanesborough chose not to use the SILVIS data and is instead using the National Land Cover Data to more accurately show the locations and interface of development and forest lands. This data and map shows not only the interface between existing development and forest, it also demonstrates that the vast majority of Lanesborough is covered in deciduous forest, with some pockets of evergreen and mixed forest lands.

Fig. 3.7.4. National Land Cover Data Showing Forest and Development Patterns



3.7.3. Vulnerability

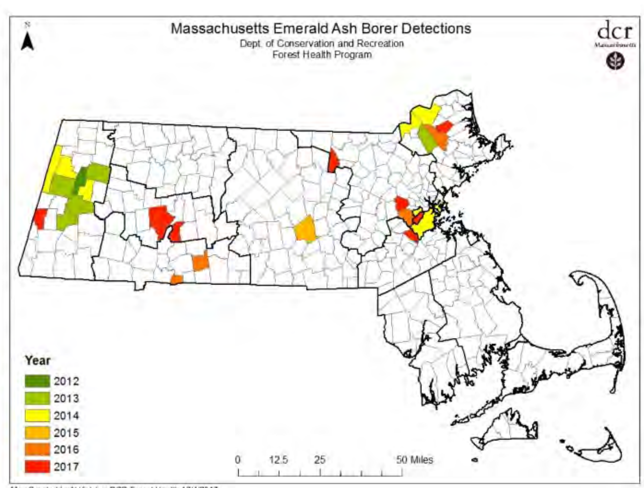
Population

Smoke and air pollution from wildfires can be a severe health hazard, especially for sensitive populations, including children, the elderly, and those with respiratory and cardiovascular diseases. Smoke generated by wildfire consists of visible and invisible emissions that contain particulate matter (soot, tar, water vapor, and minerals), gases (carbon monoxide, carbon dioxide, nitrogen oxides), and toxics (formaldehyde, 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. Public health impacts associated with wildfire include difficulty in breathing, odor, and reduction in visibility. Wildfire may also threaten the health and safety of those fighting the fires. First responders are exposed to the dangers from the initial incident and after-effects from smoke inhalation and heat stroke. (MEMA, 2013) Residents in all areas of the town are vulnerable to these secondary hazards due to the amount of forest lands within the town, and first responders throughout the region who respond to fires within their town or through mutual aid are vulnerable to direct and indirect dangers fighting fires.

All Berkshire County communities are considered by the state, based on historic occurrences, to be at low risk of fire due to the number of fires that have occurred. This is most likely due to the low population density along the urban/woodland. The county's exception is the City of Pittsfield, which is considered to be at medium risk. To better understand the urban/wildland interface and the general forest types in the town, land cover was mapped using the Multi-Resolution National Land Cover Database. According to this data and illustrated in Figure 3.7.4., Lanesborough is about 69% forested, with northern hardwoods comprising 81% of the forest and mixed forest comprising 16% of the forest. Conifer dominant forest, which poses a greater risk of wildlife, comprises only about 3% of the forest. (Multi-Resolution Land Characteristics Consortium, 2011)

Fires within the town's forests are highly dependent on soil and vegetation moisture and amount of underbrush. Much of the forest in Berkshire County is lightly being harvested, which can lead to a buildup of dry brush fuel. The ice storm of 2008, which impacted the higher elevations along the Berkshire and Hoosac Ranges, damaged much of the timber stock by knocking down limbs and damaging crowns, which exposed areas of the trees and main trunks to the elements. As a result, this storm created a large amount of fallen debris in the forest, is leaving dead and dying snags, and in the long run is increasing fuel for wildfire. Although Lanesborough was largely unaffected by the ice storm, higher elevations such as the areas off North Main Street did ice over.

Fig. 3.7.5. Emerald Ash Borer Dispersal 2017



The presence of the Emerald Ash Borer, first found in Massachusetts in the neighboring town of Dalton in 2012 (shown in dark green on Fig. 3.7.5.), has quickly spread throughout central Berkshire County. It was subsequently documented in Lanesborough in 2014. This rapidly-spreading invasive insect quickly kills its host trees within a few years of settling in an area, leading to massive die-offs of all ash trees within an area. This will increase the amount of dead limbs, brush and standing dead trees throughout forests in the county. UMass Extension states that, as a component of Massachusetts forests, the highest percentages of ash are located in Berkshire County[2]. Other invasive insects such as the Hemlock Wooly Adelgid threaten healthy hemlock stands and the Asian Longhorn Beetle threatens ash, maples, elms, poplar and willow. The fire risk impacts of the ice storm and invasive insects are not well documented at this time. At this time Town officials are not aware of any die offs at this time.

Critical Facilities

The vast majority of the critical facilities in Lanesborough are located in developed areas of the town and would be vulnerable to urban fires. In the event of wildfire, there would likely be little damage to the infrastructure and facilities located in the path of the fire. Most road and railroads would be without damage except in the worst scenarios. Fires can create conditions that block or prevent access and can isolate residents and emergency service providers. Power lines are the most at risk to wildfire because most poles are made of wood and susceptible to burning. In the event of a wildfire, pipelines could provide a source of fuel and lead to a catastrophic explosion. (MEMA, 2013)

Economy

Wildfire events can have major economic impacts on a community from the initial loss of structures and the subsequent loss of revenue from destroyed business and decrease in tourism. Wildfires can cost thousands of taxpayer dollars to suppress and control and involve hundreds of operating hours on fire apparatus and thousands of volunteer man-hours from the volunteer firefighters. There are also many direct and indirect costs to local businesses that excuse volunteers from work to fight these fires. In Lanesborough the facilities of most risk are those owned by Jiminy Peak Ski Resort, along the Lanesborough/Hancock border.

To estimate potential residential losses, a risk exposure analysis was conducted. Quantifying the number of homes at risk involved utilizing 2010 census and breaking it into the intermix and interface areas delineated from SILVUS. The SILVUS model was determined to be a good model for this analysis because it fairly accurately could estimate the number of residential units within those areas. Using this method it was determined that the Urban Wildland Interface hazard areas (yellow in Fig. 3.7.4) contains 687 housing units, and the Intermix hazard area (tan) contains 663 housing units. (Berkshire Regional Planning Commission, 2010)

To estimate the total potential loss of buildings in the community, the wildfire hazard areas were overlaid upon the assessor's parcel data. It was determined that $132,863,215 work of property is at risk of wildfire in the Interface area and $185,556,117 is at risk in the Intermix area. (Berkshire Regional Planning Commission, 2010) It should be noted that these figures are assessor estimates and does not include market cost or replacement costs, nor do they include estimate of loss of building contents. These figures also do not include the major economic impacts on a community from the initial loss of structures and the subsequent loss of revenue from destroyed businesses or farms or loss of employment.

[2] *https://ag.umass.edu/landscape/fact-sheets/emerald-ash-borer*

3.7.4. Existing Protections

The Lanesborough Fire Department has 34 members, 22 of whom are certified EMTs. The department has three fire engines, two tankers, one ATV and one UTV. Protections include:

- Mutual Aid with other fire departments through the Berkshire County Fire Chiefs Association.
- Strictly enforces burn permit system.
- Hydrants near developed areas.
- All members of the Fire Department have had wildland fire training.
- The Town utilizes the Reverse 911 emergency communications system.

3.7.5. Actions

- Continue to recruit and train new fire department members, particularly those who work in Lanesborough and can respond quickly to fire calls.
- Continue the strong bonds developed through mutual aid.

3.8. Landslide Hazards

3.8.1. General Background

The term landslide includes a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows. Although gravity acting on an over steepened slope is the primary reason for a landslide, there are other contributing factors. According to the state hazard mitigation plan, slope saturation by water is a primary cause of landslides in the Commonwealth. This effect can be in the form of intense rainfall, snowmelt, changes in groundwater level, and water level changes along earth dams, and the banks of lakes, rivers, and reservoirs. Water added to a slope can not only add weight to the slope, which increases the driving force, but can increase the pore pressure in fractures and soil pores, which decreases the internal strength of the earth materials needed to resist the driving forces. (MEMA 2013)

Landslides in Massachusetts can be divided into four general groups, construction related, over steepened slopes caused by undercutting due to flooding or wave action, adverse geologic conditions, and slope saturation. Construction related failures occur predominantly in road cuts excavated into glacial till where topsoil has been placed on top of the till. This juxtaposition of materials with different permeability often causes a failure plane to develop along the interface between the two materials resulting in sliding following heavy rains. (MEMA 2013)

Undercutting of slopes during flooding events is a major cause of property damage. Streams erode the base of the slopes causing them to over steepen and eventually collapse. This is particularly problematic in unconsolidated glacial deposits, which covers the majority of the community. Adverse geologic conditions exist anywhere there are lacustrine or marine clay soils. Clays have relatively low strength, and when over steepened or exposed in excavations these areas often produce classic rotational landslides. (MEMA 2013)

Another occurrence of landslides in Massachusetts results from slope saturation. This occurs following heavy rains and dominantly in areas with steep slopes underlain by glacial till or bedrock. Bedrock and glacial till soils are relatively impermeable relative to the unconsolidated material that overlies them. Water accumulates on these less permeable layers, increasing the pore pressure at the interface. This interface becomes a plane of weakness, and if conditions are favorable failure can occur. (MEMA 2013)Saturation was a leading cause of the landslide that occurred in Savoy at Route 2 during T.S. Irene in 2011.

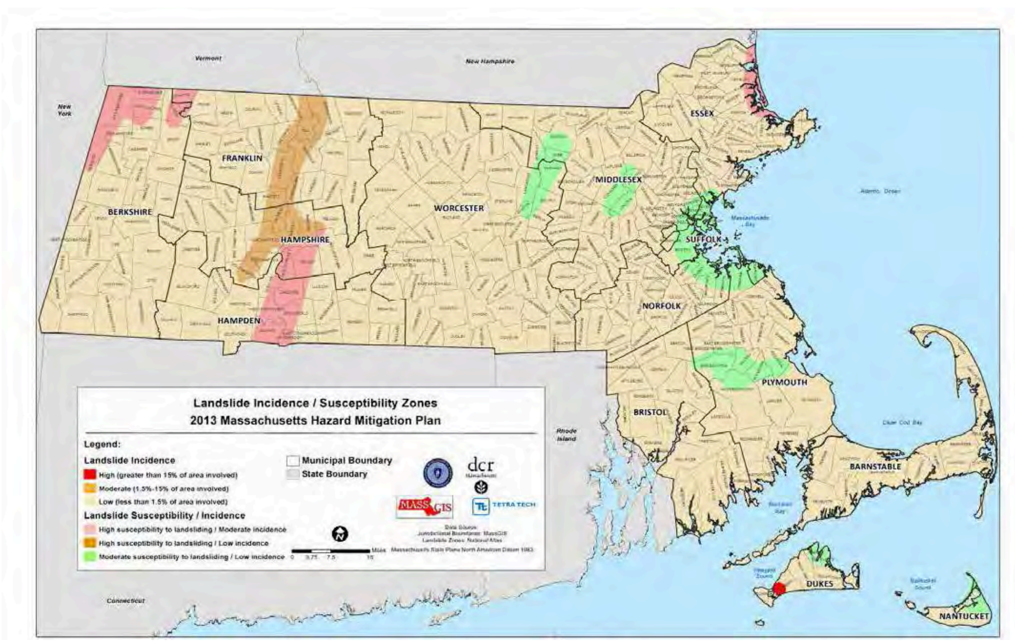
3.8.2. Hazard Profile

Location

Thirty-six of the 50 U.S. states have moderate to highly severe landslide hazard areas. Within Massachusetts, there are a few areas that have a high susceptibility / moderate incidence occurrence to landslides, including areas within the Taconic and Hoosac Mountain Ranges of northern Berkshire County (see Fig. 3.8.1 for locations). The Town of Lanesborough lies just outside of the area along the Taconics, which encompasses the northern half of the neighboring town of Hancock. When referring to Fig. 3.8.1, the definition of incidence and susceptibility are defined as such:

- Landslide incidence is the number of landslides that have occurred in a given geographic area. High incidence means greater than 15% of a given area has been involved in landsliding, medium incidence means that 1.5-15% of an area has been involved, and low incidence means that less than 1.5% of an area has been involved.
- Landslide susceptibility is defined as the probable degree of response of geologic formations to natural or artificial cutting, to loading of slopes, or to unusually high precipitation. It can be assumed that unusually high precipitation or changes in existing conditions can initiate landslide movement in areas where rocks and soils have experienced numerous landslides in the past. Landslide susceptibility depends on slope angle and the geologic material underlying the slope. Landslide susceptibility only identifies areas potentially affected and does not imply a time frame when a landslide might occur. High, medium, and low susceptibility are delimited by the same percentages used for classifying the incidence of landsliding. (MEMA, 2013)

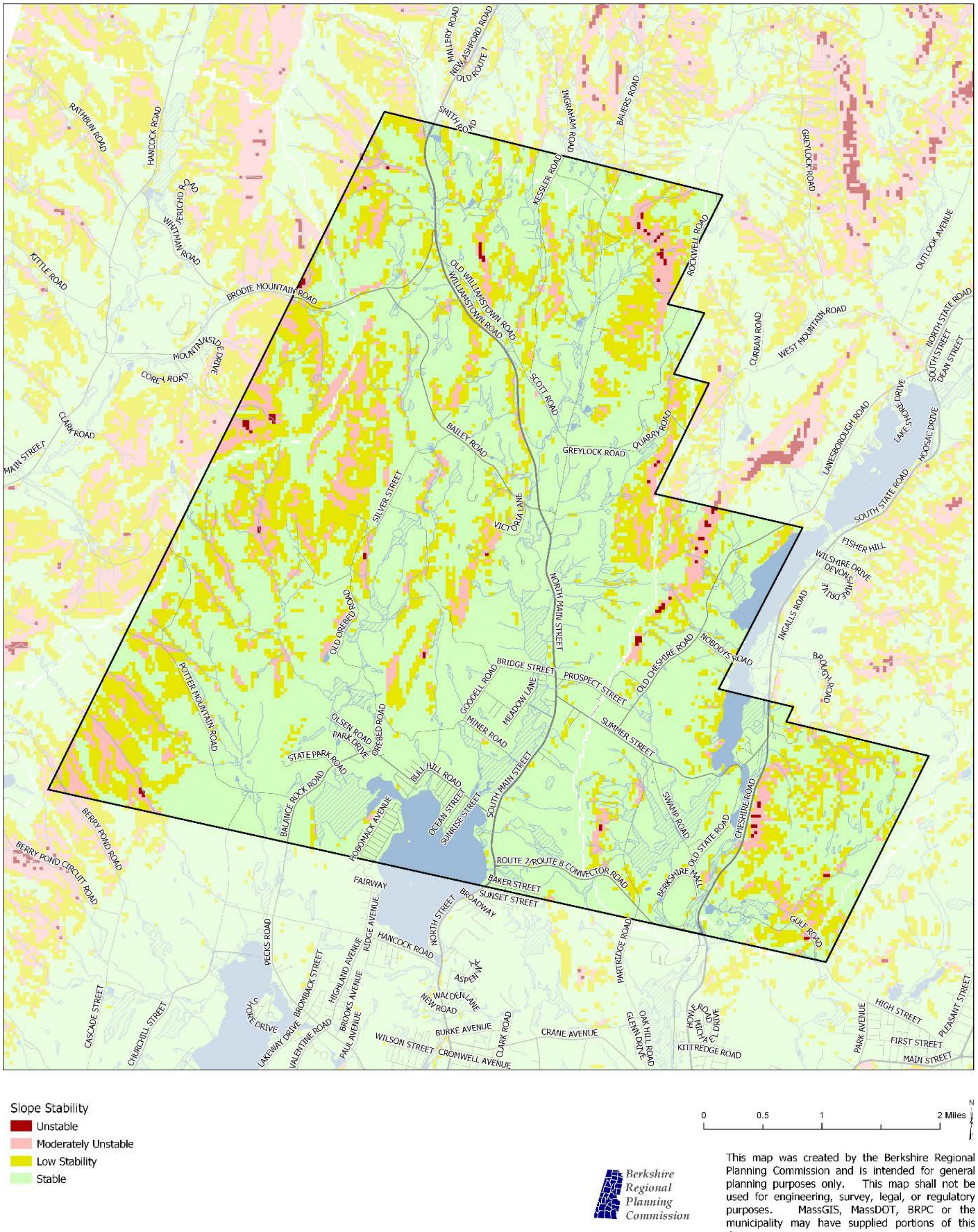
Fig. 3.8.1 Landslide Incidence / Susceptibility Zones



Source: MEMA 2013

To investigate landslide risk more closely, data from the Slope Stability Map produced by the Massachusetts Geologic Survey was gathered. According to this source, Lanesborough has 45 acres of Unstable land (red on the map) and 1,327 acres of Moderately Unstable land (pink on the map). Unstable lands account for less than 1% of total land in the Town and Moderately Unstable lands account for 7% of total land. As seen in the map in Fig. 3.8.2, these locations tend to be located on steeply sloped mountain sides and along steeply sloped stream ravines. There is a string of Unstable lands along the mountain sides of Farnham and Savage Hills on the eastern port of the Town, and a string on the steep slopes on the eastern side of Cheshire Road (Rt. 8), a major north-south regional transportation artery that connects the northern communities of North Adams, Adams and Cheshire to the commercial hubs of central Berkshire County.

Fig. 3.8.2 Slope Stability (using the Massachusetts Geologic Survey)

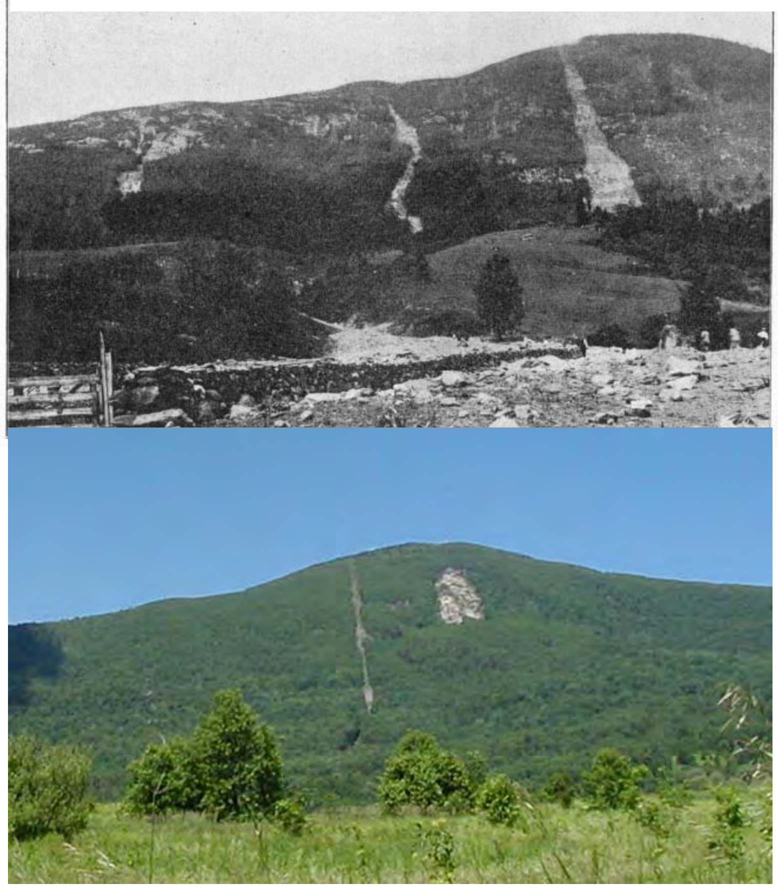


Previous Occurrences

Landslides commonly occur with other major natural disasters such as earthquakes and floods that exacerbate relief and reconstruction efforts. Rock slides occur along roadsides throughout the county where bedrock was blasted to make way for the road and there is little room between the road bed and the rock. Common examples are found on Route 2 near the Hairpin Turn in Clarksburg and Route 7 in New Ashford.

Many landslide events may have occurred in remote areas causing their existence or impact to go unnoticed. Therefore, this hazard profile likely does not identify all ground failure events that have impacted the Berkshires. While the region has had a few landslides of note, the data on them is very limited and there is nothing specific to Lanesborough that can be presented in this report. Data taken from the state's hazard mitigation plan of 2013 notes these events that occurred in the Berkshire region.

Fig. 3.8.3. Landslide scars on Mt. Greylock 1901



Mass., MA Geological Survey. Bottom – BRPC 1999.

- 1901: 11 landslides occurred along the east face of Mount Greylock after heavy rains (Fig. 3.8.3 top photo). The mountain was designated in 1898 as the first Massachusetts State Reservation for conservation purposes, due largely to deforestation that occurred during private land ownership. The deforestation may have contributed to these landslide events.
- 1936: North Adams - 1 home was destroyed and 6 others evacuated during a slide in North Adams.
- 1990 – following two days of heavy rain, a landslide estimated to be at least 1,000 feet long and 300 feet wide occurred in August on the eastern slope of Mt. Greylock, the state's highest peak. The landslide scar is still widely visible today (see Fig. 3.8.3. bottom).
- Early 2000s: Notable rock fall on Route 7 in New Ashford which closed a portion of the road for over a year. This is an example of the type of event that occurs throughout the region.
- August 2011: Hurricane Irene caused damage throughout portions of the Commonwealth, including a 5.8-mile section of Route 2 that was closed from South County Road in Florida to West Charlemont due to erosion and undercutting of the roadway, damage to retaining walls, debris flows, landslides, and bridge damage.

Probability of Future Occurrences

Landslides are often triggered by other natural hazards such as earthquakes, heavy rain, floods, or wildfires, so landslide frequency is often related to the frequency of these other hazards. In general, landslides are most likely during periods of higher than average rainfall. The ground must be saturated prior to the onset of a major storm for significant landsliding to occur. (MEMA, 2013)

For the purposes of this plan, the probability of future occurrences is defined by the number of events over a specified period of time. There have been zero federally declared landslide disasters from 1954 to 2017 in Massachusetts. This time period includes the landslide in Savoy, which was included in a disaster declaration for a flooding/tropical storm. It is noted that the historical record may underestimate the true number of events that have taken place in the community because steep slopes are generally undeveloped and unmonitored for this type of event. Massachusetts state officials estimate that approximately one to three landslide events occur each year throughout the state. (MEMA, 2013)

Severity

To determine the extent of a landslide hazard, the affected areas need to be identified and the probability of the landslide occurring within some time period needs to be assessed. 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, 2013)

The most severe landslide to occur in the Berkshire region was the one that occurred along Route 2 in Savoy during T.S. Irene in 2011. The slide was 900 feet long and involved 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.

It is unknown what the severity of a landslide in the Unstable or Moderately Unstable areas of Lanesborough would be due to the number of factors that lead to landsliding and to the low number of serious incidences that have occurred in the region.

Fig. 3.8.4. Landslide in Savoy August 2011

Source: Top: Mabee, Stephen B., Duncan, Christopher C. 2013. Slope Stability Map of Mass., MA Geological Survey. Bottom: courtesy Stan Brown of Florida, MA

Warning Time

Mass land movements can occur suddenly or slowly. The velocity of movement may range from a slow creep of inches per year to many feet per second, depending on slope angle, material, and water content. Some methods used to monitor mass land movements can provide an idea of the type of movement and the amount of time prior to failure. It is also possible to determine what areas are at risk during general time periods. Assessing the geology, vegetation, and amount of predicted precipitation for an area can help in these predictions. However, there is no practical warning system for individual landslides. The current standard operating procedure is to monitor situations on a case-by-case basis, and respond after the event has occurred. Generally accepted warning signs for landslide activity include the following:

- Springs, seeps, or saturated ground in areas that have not typically been wet before
- New cracks or unusual bulges in the ground, street pavements or sidewalks
- 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 water lines 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 though rain is still falling or just recently stopped
- Sticking doors and windows, and visible open spaces indicating jambs and frames out of plumb
- A faint rumbling sound that increases in volume as the landslide nears
- Unusual sounds, such as trees cracking or boulders knocking together. (MEMA, 2013)

Secondary Hazards

Landslides can cause several types of secondary effects, such as blocking access to roads, which can isolate residents and businesses and delay commercial, public, and private transportation. This could result in economic losses for businesses. Other potential problems resulting from landslides are power and communication failures. Landslides also have the potential of destabilizing the foundation of structures, which may result in monetary loss for property owners. (MEMA, 2013)

Landslides can severely alter the course of rivers and streams, erode banks and contribute large amounts of sediment and debris into waterways. Stream and river banks that are already prone to erosion or which are already undercut could become more unstable due to a large event. Landslide debris can block the flow of water under bridges and through culverts, threatening the structures themselves and transportation routes for miles downstream of the actual landslide event. If the landslide occurs during a flood event, debris could be widely distributed throughout the floodplain area.

Climate Change Impacts

With the latest regional models showing warmer and wetter winters for New England, climate change may impact storm patterns, increasing the probability of more frequent, intense storms with varying duration. Increase in global temperature could affect the snowpack and its ability to hold and store water. Warming temperatures also could increase the occurrence and duration of droughts, which would increase the probability of wildfire, reducing the vegetation that helps to support steep slopes. All of these factors would increase the probability for landslide occurrences. (MEMA, 2013)

In the Berkshires, the areas rated as being more prone to landslide incidence and susceptibility are undeveloped, forested steep slopes. Trees and other vegetation help to hold soil in place. Climate change is expected to impact forest species composition in a variety of ways, with cooler species such as sugar maples and hemlocks retreating northward and higher in elevation and invasive forest pests such as the emerald ash borer, wooly adelgid and Asian long-horned beetle increasing tree mortality of key species. Hemlocks are a species that tend to be found in cool, steeply sloped ravines, and the dieback of this species could result in an increase in unstable slopes.

Exposure

In general, as shown in Figures 3.8.1 and 3.8.2., most of the developed areas within Lanesborough are considered to be a low risk for landslides. However, it should be recognized that landslides can occur throughout the town during severe events, particularly earthquakes, and more commonly during high precipitation events during times of soil saturation.

3.8.3. Vulnerability

Population

In general, the population exposed to higher risk landslide areas is considered to be vulnerable, including populations located downslope. Overlaying slope stability from the Massachusetts Geological Survey, it appears that six buildings in Lanesborough are on Unstable or Moderately Unstable land, all of which are residential homes. To estimate the population vulnerable to the landslide hazard, the approximate hazard areas were overlaid with the assessor parcel data to determine the impact. Based on the six houses in the Unstable or Moderately Unstable land, and the 2.33 people/household average within Lanesborough, it can be calculated that approximately 14 people may need to be sheltered in the event that landslides destroy or severely damage homes. Expansion of urban and recreational developments up onto hillside areas could lead to more people being threatened by landslides each year.

Critical Facilities

Several types of infrastructure are exposed to landslides, including buildings, transportation routes, bridges, water, sewer, and power lines. At this time all critical facilities, infrastructure, and transportation corridors located within the high incidence and high susceptibility hazard areas are considered vulnerable until more information becomes available. (MEMA, 2013) The 2013 state hazard mitigation plan notes that the estimated cost to address landslide problems to state highways alone was $1 million during the years 1986-90, and the expense to keep highways safe from landslides was $2 million. The cost associated with remediation work and cleanup of debris from only four landslide-related events during the October 2005 rain event was $2,300,000. The repair to a 6-mile stretch of Route 2 caused by T.S. Irene (2011) which included debris flows, four landslides, and fluvial erosion and undercutting of infrastructure cost $23 million just for the temporary repairs. Accordingly, landslides have a significant cost to taxpayers, yet this hazard is not well known because most earth movements occur during extreme rainstorms and it is the rain and associated flooding that receives the majority of the publicity. (MEMA, 2013)

Based on the Slope Stability map, there are no critical municipal facility buildings within the Unstable or Moderately Unstable land areas in Lanesborough. However, Cheshire Road / Route 8 lies in close proximity to Unstable and Moderately Unstable land. Loss of this transportation route would severely impact travel between northern and central Berkshire County, including commerce. Detour times for ambulances and other first responders could result in greater risk of serious injury or death.

Some Berkshire County communities have adopted the Berkshire Scenic Mountain Act (M.G.L. Chapter 131 Section 39A), which allows Berkshire County communities to "adopt reasonable rules and regulations relative to the mountain regions … to protect watershed resources and preserve the natural scenic qualities of the environment." The preamble to the Act notes that destruction of the natural ground cover can result in severe erosion and alteration of mountainsides increases the likelihood of uncontrolled runoff. The Act allows Berkshire County municipalities in the Housatonic River Watershed to adopt regulations to govern development projects or alterations on land with elevations higher than 1,500 feet and those in the Hoosic River Watershed on land with elevations higher than 1,800 feet. While adopting the Act may allow the Town of Lanesborough more discretion in permitting development on higher elevations in the Town, many of the Unstable or Moderately Unstable sites identified in the Massachusetts Geologic Survey are slopes below the 1,500- and 1,800-foot thresholds of the Act. For example the Unstable slopes along Cheshire Road / Route 8 is approximately 1,100-1,200 feet in elevation, well below the 1,800-foot threshold for the Hoosic River Watershed.

Economy

In general, the built environment located in the high susceptibility zones (Unstable and Moderately Unstable) and the population, structures, and infrastructure located downslope are vulnerable to this hazard. In an attempt to estimate the general building stock vulnerable to this hazard, the associated building replacement values (buildings and contents) were determined by using the assessor's data. These values estimate the costs to repair or replace the damage caused to the building. These dollar value losses to the community's total building inventory replacement value would impact the local tax base and economy. The buildings in the Unstable and Moderately Stable areas of Lanesborough have an assessed value of $5,532,800.

3.8.4. Existing Protections

- The Town of Lanesborough does not have any current protections in place to specifically address landsliding.

3.8.5. Actions

- Provide this section of the plan to the Lanesborough Building Inspector for reference.

3.9. Earthquake Hazards

3.9.1. General Background

An earthquake is the vibration, sometimes violent, of the earth's surface that follows a release of energy in the earth's crust due to fault fracture and movement. A fault is a fracture in the earth's crust along which two blocks of the crust have slipped with respect to each other. The cause of earthquakes in eastern North America is the forces moving the tectonic plates over the surface of the Earth. New England is located in the middle of the North American Plate. One edge of the North American plate is along the west coast where the plate is pushing against the Pacific Ocean plate. The eastern edge of the North American plate is at the middle of the Atlantic Ocean, where the plate is spreading away from the European and African plates. New England's earthquakes appear to be the result of the cracking of the crustal rocks due to compression as the North American plate is being very slowly squeezed by the global plate movements. (MEMA, 2013)

Seismic waves are the vibrations from earthquakes that travel through the Earth. The magnitude or extent of an earthquake is a seismograph-measured value of the amplitude of the seismic waves. Table 1 summarizes Richter scale magnitudes and corresponding earthquake effects. Effects listed are more applicable at lower levels to California than to Massachusetts. For example, earthquakes in the 2 to 2.5 range are typically felt in Massachusetts and throughout the eastern United States. Generally, earthquakes in the eastern U.S. are felt over a larger area than those in the western U.S. (MEMA, 2013)

Table 3.9.1. Richter scale

Richter Magnitude	Earthquake Effects
2.5 or less	Not felt or felt mildly near the epicenter, but can be recorded by seismographs
2.5 to 5.4	Often felt, but only causes minor damage
5.5 to 6.0	Slight damage to buildings and other structures
6.1 to 6.9	May cause a lot of damage in very populated areas
7.0 to 7.9	Major earthquake; serious damage
8.0 or greater	Great earthquake; can totally destroy communities near the epicenter

The intensity of an earthquake is based on the observed effects of ground shaking on people, buildings, and natural features, and varies with location. Intensity is expressed by the Modified Mercalli Scale; a subjective measure that describes how strongly an earthquake was felt at a particular location. Table 3.9.2. summarizes earthquake intensity as expressed by the Modified Mercalli Scale. (MEMA 2013)

Table 3.9.2. Modified Mercalli Scale

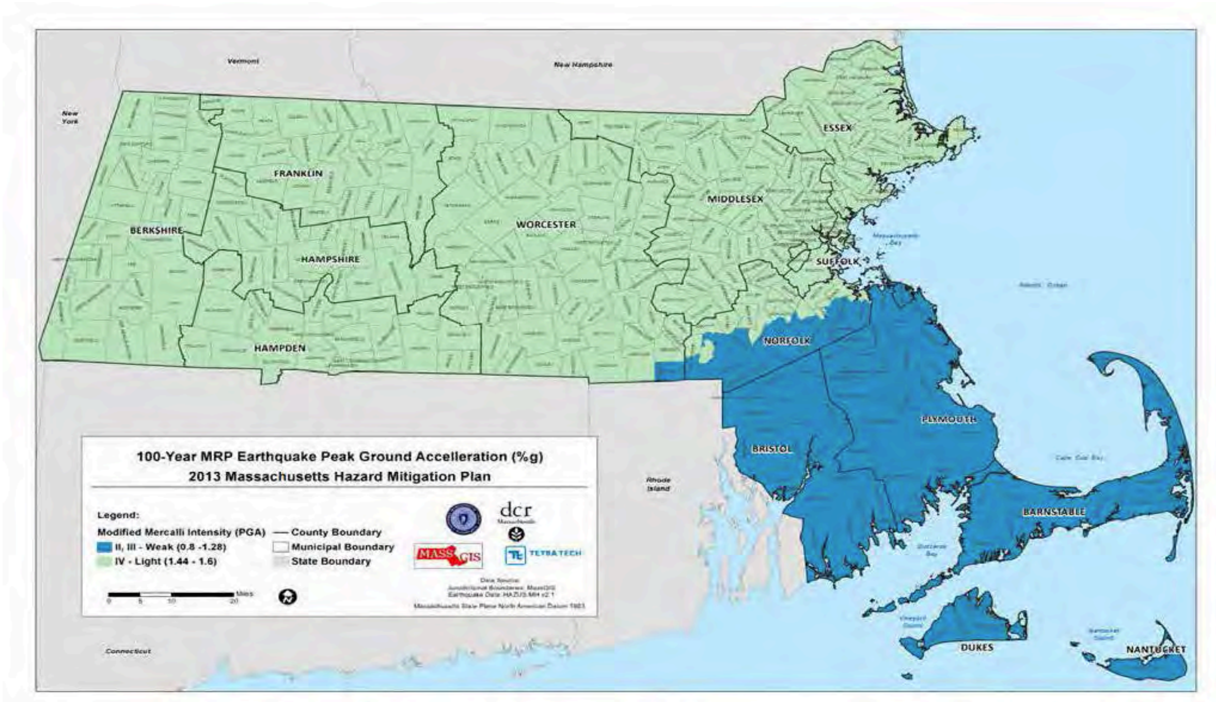
Mercalli Intensity	Description
I	Felt by very few people; barely noticeable.
II	Felt by few people, especially on upper floors.
III	Noticeable indoors, especially on upper floors, but may not be recognized as an earthquake.
IV	Felt by many indoors, few outdoors. May feel like passing truck.
V	Felt by almost everyone, some people awakened. Small objects move, trees and poles may shake.

VI	Felt by everyone; people have trouble standing. Heavy furniture can move; plaster can fall off walls. Chimneys may be slightly damaged.
VII	People have difficulty standing. Drivers feel cars shaking. Some furniture breaks. Loose bricks fall from buildings. Damage is slight to moderate in well-built buildings; considerable in poorly built ones.
VIII	Buildings suffer slight damage if well-built, severe damage if poorly built. Some walls collapse.
IX	Considerable damage to structures; buildings shift off their foundations. The ground cracks. Landslides may occur.
X	Most buildings and their foundations are destroyed. Some bridges are destroyed. Dams are seriously damaged. Large landslides occur. Water is thrown on the banks of canals, rivers, lakes. The ground cracks in large areas.
XI	Most buildings collapse. Some bridges are destroyed. Large cracks appear in the ground. Underground pipelines are destroyed.
XII	Almost everything is destroyed. Objects are thrown into the air. The ground moves in waves or ripples. Large amounts of rock may move.

Seismic hazards are often expressed in terms of Peak Ground Acceleration (PGA) and Spectral Acceleration (SA). USGS defines PGA and SA as the following: 'PGA is what is experienced by a particle on the ground. Spectral Acceleration (SA) is approximately what is experienced by a building, as modeled by a particle mass on a massless vertical rod having the same natural period of vibration as the building'. Both PGA and SA can be measured in *g* (the acceleration due to gravity) or expressed as a percent acceleration force of gravity (%g). PGA and SA hazard maps provide insight into location specific vulnerabilities. More specifically, a PGA earthquake measurement shows three things: the geographic area affected, the probability of an earthquake of each given level of severity, and the strength of ground movement (severity) expressed in terms of percent of acceleration force of gravity (%g). (MEMA, 2013). As shown in Figure 3.9.1. Berkshire County has a Mercalli Intensity of IV for a 100-year event, which is described as being light and as described in Table 3.9.2. as "felt my many indoors, few outdoors; may feel like passing truck."

According to MEMA's State Hazard Mitigation Plan, New England has not experienced a damaging earthquake since 1755, but numerous, less powerful earthquakes have been centered in Massachusetts and neighboring states. Seismologists state that a serious earthquake occurrence is possible. There are five normal faults in Massachusetts, three of these traverse portions of Berkshire County, but there is no discernable pattern of previous earthquakes along these fault lines. Earthquakes can occur without warning, can occur anywhere within the county, and may be followed by aftershocks. Most buildings and infrastructures in Massachusetts were constructed without specific earthquake resistant design features. Filled, sandy or clay soils are more vulnerable to earthquake pressures than other soils.

Fig. 3.9.1. Peak Ground Acceleration Modified Mercalli Scale for a 100-year Mean Return Period



Source: MEMA 2013

3.9.2. Hazard Profile

Location

New England's earthquakes to date have not aligned along mapped faults. 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. (MEMA, 2013)

Previous Occurrences

According to Alan Kafka, Director of Boston College's Weston Observatory, the most catastrophic earthquake to impact the state was the magnitude 6.0 event off Cape Ann in 1755. It was devastating and felt all over the Northeast. This article was written after earthquakes were felt in the Boston area in 2011 and 2012.[1]

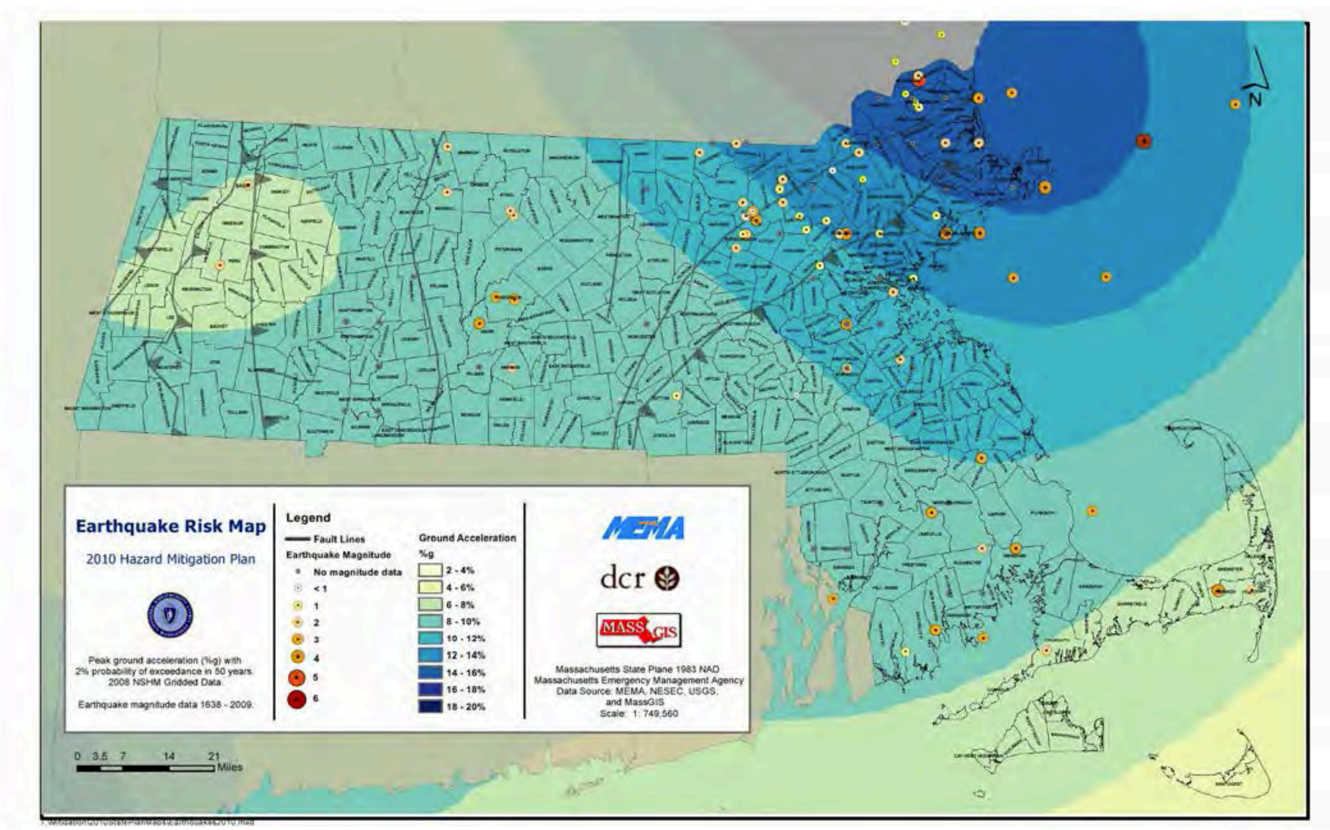
The largest earthquake since 1900 to strike Massachusetts was a magnitude 3.9 on the Richter Scale located east of the Quabbin Reservoir in 1994. According to the USGS, there have been two recent earthquakes with epicenters close to the Berkshires. A magnitude 3.3 on the Richter scale struck the area around Westfield, MA in 2000 and a magnitude 1.9 struck the area around Northampton in 2012.

[1] Quintana, Olivia. 12-6-2016. *New England earthquakes happen more often than you think,* Boston Globe, Boston, MA.

To our west, a magnitude 3.1 struck in the Catskills region of New York in 2009. (USGS Earthquake Hazards Program 2017)

There are conflicting records reporting the occurrences of earthquakes in the Berkshires. According to the 2004 MA State Hazard Mitigation Plan, between 1668 and 1997 only three earthquakes have occurred in the Berkshire region -- 1932, 1963 and 1982. The 1932 event occurred at Lake Garfield in Monterey, but the magnitude is unknown. The 1963 earthquake, which registered as 2.4 on the Richter Scle, is reported to have occurred in North Adams but with coordinates that indicate that it occurred in Savoy. The 1982 earthquake also occurred in North Adams and is registered at 2.0. (The Dewberry Company, 2004) However, the 2013 State Hazard Mitigation Plan indicates that only two earthquakes have occurred in the Berkshires, in Savoy and in the vicinity of the Hinsdale/Peru town border, both of which were in the magnitude of 2.0. The sites are show in Fig. 3.9.2.

Fig. 3.9.2 Earthquake Historic Occurrences and Risk



Source: MEMA 2013

Probability of Future Occurrences

According to the state hazard mitigation plan, earthquakes cannot be predicted and may occur any time of the day and any time of the year. Because the region's geologic faults zones do not correlate well to earthquake locations or aid in predication of occurrence, it is difficult to identify reasonably affordable mitigation measures. Based on the historic occurrences, which have been few and of limited severity, the community could be considered to be at a low risk for major earthquake damage in the future.

Severity

The most commonly used method to quantify potential ground motion is in terms of peak ground acceleration (PGA), which measures the strength of a potential earthquake in terms of the greatest acceleration value of ground movement. The potential damage due to earthquake ground shaking increases as the acceleration of ground movement increases. For example, 100-year mean return period (MRP) event is an earthquake with a 1% chance that the mapped ground motion levels (PGA) will be exceeded in any given year. As shown in Fig. 1, the 100-year earthquake event for Berkshire County is a Modified Mercalli Scale of IV (light impacts), felt by many indoors and a few outdoors, and may feel like passing truck. According to the MA State Hazard Mitigation Plan of 2013, the county could experience heavier impacts during the 500 and 1,000 MRP, with Modified Mercalli Scale ratings of V (moderate), felt by almost everyone, some people awakened, small objects move, and trees and poles may shake.

Because of this low frequency of occurrence and the relatively low levels of ground shaking that would be experienced, the community can be expected to have a low risk to earthquake damage as compared to other areas of the country. However, the impacts at the local level can vary based on types of construction, building density, soil type among other factors. (MEMA, 2013)

Warning Time

There is currently no reliable way to predict the day or month that an earthquake will occur at any given location. Research is being done with early-warning systems that use the low energy waves that precede major earthquake to issue an alert that earthquake shaking is about to be felt. These potential early warning systems can give up to approximately 40-60 seconds notice that earthquake shaking is about to be experienced, with shorter warning times for places closer to the earthquake epicenter. Although the warning time is very short, it could allow for immediate safety measures such as getting under a desk, stepping away from a hazardous material, or shutting down a computer system to prevent damage. (MEMA, 2013)

Secondary Hazards

Secondary hazard can occur to all forms of critical infrastructure and key resources as a result of earthquake. Earthquakes can cause large and sometimes disastrous landslides and mudslides. River valleys are vulnerable to slope failure, often as a result of loss of cohesion in clay-rich soils. Soil liquefaction 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. 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, 2013) Damaged roadways could impede rescue efforts.

Climate Change Impacts

The impacts of global climate change on earthquake probability are unknown. Some scientists feel that melting glaciers could induce tectonic activity. As ice melts and water runs off, tremendous amounts of weight are shifted on the earth's crust. As newly freed crust returns to its original, pre-glacier shape, it could cause seismic plates to slip and stimulate volcanic activity according to research into prehistoric earthquakes and volcanic activity. Secondary impacts of earthquakes could be magnified by climate change. Soils saturated by repetitive storms could be at higher risk of liquefaction during seismic activity due to the increased saturation. Dams storing increased volumes of water due to changes in the hydrograph could fail during seismic events. There are currently no models available to estimate these impacts. (MEMA, 2013)

Exposure

The entire town of Lanesborough is at risk from earthquakes. However, some locations, building types, and infrastructure types are at greater risk than others are, due to the surrounding soils or their manner of construction. (MEMA, 2013)

3.9.3. Vulnerability

To assess the community's vulnerability to the earthquake hazard, probabilistic analyses were run in HAZUS for the 100-year mean return period (MRP) events. The HAZUS -MH model was used to estimate potential losses to these events. For the 2018 plan, a probabilistic assessment was conducted for the 100-year MRP using default settings in HAZUS-MH 4.0 to analyze the earthquake hazard for the community. The 100-year MRP event is an earthquake with a 1% chance that the mapped ground motion levels (PGA) will be exceeded in any given year with a magnitude 5.0 earthquake. This model estimates the total economic loss associated with each earthquake scenario, which includes building and lifeline-related losses (transportation and utility losses) based on the available inventory.

Population

The entire population of Lanesborough is potentially exposed to direct and indirect impacts from earthquakes. The degree of exposure is dependent on many factors, including the age and construction type of the structures people live in, the soil type their homes are constructed on, their proximity to fault location, etc. The region's high percentage of older building stock could increase the risk of damage to some buildings. Business interruption could keep people from working, road closures could isolate populations, and loss of functions of utilities could impact populations that suffered no direct damage from an event itself. (MEMA, 2013)

According to the HAZUS-MH analysis, no injuries or casualties are estimated for the 100-year event and no sheltering is needed.

Critical Facilities

All critical facilities in the planning area are exposed to the earthquake hazard. Earthquakes losses can include structural and non-structural damage to buildings, loss of business function, damage to inventory, relocation costs, wage loss, and rental loss due to the repair/replacement of buildings. Roads that cross earthquake-prone soils have the potential to be significantly damaged during an earthquake event, potentially impacting commodity flows. Access to major roads is crucial to life and safety after a disaster event, as well as to response and recovery operations. In addition, 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. Facilities holding hazardous materials are of particular concern because of potential rupture and leaking into the surrounding area or an adjacent waterway. (MEMA, 2013)

Based on the HAZUS analysis for the community, it is expected that there will be no damages associated with critical municipal facilities, transportation routes or utilities in Lanesborough.

Economy

Direct building losses are the estimated costs to repair or replace the damage caused to the building. HAZUS-MH estimates that three buildings may sustain slight damage and one building might sustain moderate damage during the computed earthquake event. HAZUS-MH estimated that Lanesborough experience $70,000 in total building related losses across the town.

Table 3.9.3. HAZUS-MH Building-Related Economic Loss Estimates (millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	0.00	0.01	0.00	0.00	0.01
	Capital-Related	0.00	0.00	0.01	0.00	0.00	0.01
	Rental	0.00	0.00	0.00	0.00	0.00	0.01
	Relocation	0.00	0.00	0.00	0.00	0.00	0.01
	Subtotal	**0.00**	**0.01**	**0.02**	**0.00**	**0.00**	**0.03**
Capital Stock Losses							
	Structural	0.00	0.00	0.01	0.00	0.00	0.02
	Non-Structural	0.01	0.00	0.01	0.00	0.00	0.02
	Content	0.00	0.00	0.00	0.00	0.00	0.00
	Inventory	0.00	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.01**	**0.01**	**0.01**	**0.00**	**0.00**	**0.04**
Total		**0.02**	**0.01**	**0.03**	**0.00**	**0.01**	**0.07**

Source: HAZUS-MH 2017.

3.9.4. Existing Protections

- The Town of Lanesborough adheres to the Massachusetts Building Code.

3.9.5. Actions

- Continue strict enforcement of the Massachusetts Building Code.

SECTION 4. MITIGATION STRATEGIES AND ACTIONS

4.1 Major Findings

Several major findings of risk surfaced during the planning processes for the Multi-Hazard Mitigation Plan Update and the Municipal Vulnerability Preparedness (MVP) Project. A summary of the Major Findings for the Town of Lanesborough are as follows:

Major Finding #1: The Most Serious Hazards in the Town of Lanesborough

- Winter storms are the most frequent identifiable events to occur in the town.
- Repetitive flooding from storm events at Miner and Putnam Roads, and Summer Street are the sites of most concern to the Town, demanding continual maintenance and straining its budget.
- Contamination of the town water supply has occurred only once, but was the single most threatening event to infrastructure and public health.
- Microbursts have caused tree damage and power outages.
- The April 2008 forest fire on Widow White's Peak was the largest recorded in the county.
- Beavers create chronic flooding problems throughout the town and are currently disrupting the flow of Town Brook.
- Participants of the MVP Workshop held in February 2018 identified Flooding and High Winds as being the top two hazards that threaten the Town and its residents.

Major Finding #2: Our Vulnerability

- The water supply remains vulnerable to contamination from a hazardous materials spill along the Main Street / Rt. 7 corridor and possibly from beaver activity during flood conditions.
- The municipal water supply could be at risk during drought conditions or due to contamination without securing additional withdrawal capacity.
- Several roads are chronically damaged by severe storm events, including increased flooding, washouts and deficient bridges and culverts. Key cross-town transportation routes effected by flooding include Summer Street, Bridge Street, Balance Rock Road and Narragansett Avenue.
- Town Hall is Lanesborough's single most important municipal building. The retaining wall is deteriorating and damage to or loss of function of the building is a concern.
- The majority of properties within the100-year floodplain are located around the densely developed Pontoosuc Lake shoreline.
- There was wide consensus within the MVP Workshop attendees that residents were probably not prepared for an emergency in which they may have to shelter in place or evacuate to a local shelter. The senior population, which is growing and is scattered throughout the town, is most vulnerable.
- First responders do not clearly know where special needs individuals who may need extra medical care in an emergency are located, including the elder population.
- The power line system from the Brodie Mountain wind turbine facility delivers a dangerous 36,000 volts of electricity along lines on Route 7; although the wind turbine owner states that the system will shut down when a fault in the system has been detected, the loss of this road due to downed lines would require extensive detours and increase travel time of emergency transport.

4.2 Goals and Objectives

The Draft Goal, Objectives and Actions within this plan were developed as local vulnerabilities were identified and concerns were being raised by the Lanesborough Emergency Management Committee and input was received by local residents through the public input sessions and MVP Workshop. The Emergency Management Committee revisited and re-adopted the overall goal from the Lanesborough Multi-Hazard Mitigation Plan of 2008, finding still relevant today.

Overall Goal:

Reduce the loss of life, property, and infrastructure, and environmental and cultural resources from disasters through a comprehensive mitigation program that includes planning, prevention and preparedness strategies.

The analysis of historic disaster data and the concerns raised by emergency response were factors in the development of a series of "Major Findings" for the town. These Major Findings listed which disasters have caused the greatest damage, highlighted what areas of town are most vulnerable to disaster impacts, and outlined high priority actions. A summary of the Major Findings is as follows:

Major Objectives to meet the Goal and address the Major Findings:

1. Reduce the risk of flood damage.
2. Secure Lanesborough public drinking water supplies.
3. Increase emergency preparedness and public safety.

4.3. Local Capability Assessment

In addition to gathering data and information from the Lanesborough Emergency Management Committee, interviews were held with key stakeholders to discuss current capabilities of the Town to address natural hazards in Lanesborough. Interviews were held with the Lanesborough Public Works Department, Lanesborough Fire Department and Lanesborough Village Fire & Water District. Risk assessment, strength and weakness were discussed frankly and incorporated into this hazard mitigation plan to identify and prioritize existing protections and future actions. The existing protections have been described throughout the Risk Assessment sections of this plan. Additional findings on local capabilities are described herein.

During the MVP Workshop held in February 2018 residents highlighted the strengths of the Town of Lanesborough and its first responder community. Residents particularly noted the proactive nature of the public work department to address problematic sites across Town, citing the completion of Putnam and Miner Road bridge projects, the monitoring and control of beaver-related flooding, and the ongoing attention to flooding and washouts of roads in the Pontoosuc Lake neighborhoods. Residents also noted the commitment of the first responder community to plan for and respond to public safety issues, although the struggle to maintain ambulance coverage was identified as an ongoing concern.

Capability Self-Evaluation

As part of this Plan update, the Town of Lanesborough conducted a self-evaluation of its hazard mitigation capabilities, reviewing its existing policies, programs, permitting and resources to monitor or reduce natural hazard impacts. As part of this effort key Town staff filled out the Capability Assessment Worksheet developed by FEMA and found in the *Local Mitigation Planning Handbook.* (FEMA, 2013) A summary of the self-evaluation includes:

Planning and Regulatory: In general the Town relies most heavily on state laws that regulate development, such as the Massachusetts Building Code and Wetlands Protection Act. It does however have in place a local Floodplain Overlay District and a Water Supply Protection District that restrict and condition development within these areas. Residents have expressed a desire to strengthen these bylaws to further protect Town Brook, the drinking water source for the Town. Lanesborough has been a NPDES II community for several years, and has enacted bylaws to regulate land disturbance and manage stormwater runoff.

Administrative and Technical: General operations for the Town of Lanesborough are overseen by a Town Manager. The Town does not have a certified Floodplain Administrator, but development within floodplain areas are overseen through state law and local overlay district bylaws, combined with staff to inspect and enforce those regulations. The Town does not have the demand or resources to maintain an engineer on staff. The Town does require stormwater management controls in large development projects, such as the detention basins installed as part of the Berkshire Mall development. Technical hazard mitigation data assessment, such as GIS modeling and HAZUS analysis, will likely continue to be conducted when needed by the Berkshire Regional Planning Commission.

Financial: The Town develops and updates as needed its Capital Improvement Plan. Although not a separate and conscious discipline, flood hazard control and mitigation occurs through capital improvements. The Town has not developed a stormwater district or imposed impact fees upon development because of the rural nature of the Town. Town staff apply for grant funds where available to mitigate flooding and other hazards, often requesting technical assistance from the Berkshire Regional Planning Commission for grants of various types.

Education and Outreach: The Town utilizes the Reverse 911 emergency management system. However, cell phone coverage is only to those who voluntarily sign up for it. This system could be promoted more heavily as part of a public outreach campaign to inform residents on how to prepare and response to emergency situations or natural disasters. Improving preparedness has been highlighted as a need through the Multi-Hazard Mitigation Plan Update and the MVP Project planning processes. The regional school district and local police conduct regular emergency preparedness exercises in all its schools, including the elementary school in Lanesborough.

Safe Growth Audit: Lanesborough does not have a Comprehensive Plan. In general the plans the Town does have in place do not specifically refer to its hazard mitigation plan, but cross-referencing is expected to improve as the Town conducts municipal and emergency plans in the future. Guiding development away from natural hazard areas, such as floodplains, is largely done through state and local zoning, and as stated above, there is a desire to review existing floodplain and water supply district bylaws.

Mutual Aid Agreements and Coordination

In general, the first responder communities in the Berkshires coordinate and work well together during emergency situations. The Berkshire region is somewhat isolated due to the Berkshire and Taconic mountain ranges, and the population of the area is relatively small compared to the rest of the state. As a result, local first responders tend to know each other. Formal mutual aid agreements are held by both fire and police, and most communities in the county belong to one of three Regional Emergency Planning Committees (REPCs). Lanesborough is an active member of the Central Berkshire REPC.

Decreasing Volunteerism

Local fire companies are still largely populated by volunteers, including Lanesborough which remains all volunteer, including the Fire Chief. While some communities in the county have a paid core staff to cover fire and ambulance calls, the trend seems to be moving away from local volunteers and towards full-time ambulance companies. Part of this trend is due to greater demands for EMT training and certification, which volunteers struggle to maintain, and part of it is the lack of volunteers to maintain full fire/EMT membership. The lack of volunteers is not unique to Berkshire County, and is due to a variety of societal and population trends, among them:

- Increasing demands for trainings and certifications in both fire-fighting and ambulance services.
- The region's population is aging, increasing demands for emergency response. On top of an increase in demand, many volunteers are aging and retiring from their volunteer fire and ambulance positions.
- Family trends where two-income families are the norm, leaving less free time for volunteerism.
- Decreasing numbers of able-bodied adults in the town to fill in retirees. In the Berkshires this is more severe than other areas of the northeast, where the county's workforce is projected to decrease by another 25% by 2030.
- Trends where the able-bodied population is less interested in volunteer service. The volunteer rate dropped to 25% in 2014, the lowest since the government started issuing a report on volunteerism in 2002 (according to the U.S. Bureau of Labor Statistics). The greatest drops were in people with higher education degrees. (BRPC, 2016)

Fortunately at this time the Fire Chief works for the Lanesborough DPW, and is therefore in town during most work days. However, the Lanesborough Fire Department struggled to maintain its volunteer ambulance service, finding it difficult to meet the state regulations that require dispatched ambulances to have two certified EMTs aboard. To ensure coverage the Town has recently contracted with a private ambulance company to cover Lanesborough. The Town and Fire Department have worked cooperatively to create a shared paid DPW/EMT position to provide back up or additional cover for ambulance service if needed.

The requirement for two EMTs to respond to an ambulance call was highlighted on September 14, 2017 when ambulances in Pittsfield were already dispatched on calls and could not respond to an automobile accident in Pittsfield. Mutual aid was summoned from Dalton and Lenox, highlighting the fact that response could be delayed due to the extra miles required for an out-of-town ambulance to arrive at the scene. Delays in response in Pittsfield are sometimes caused by a high volume of calls, while in other times it is because ambulances serving the city are assisting other towns in the county. [1] As Dalton Fire

[1] Drane, Amanda, 9-14-18. *Berkshire Eagle* article, "Crash highlights gaps in Pittsfield emergency services," Pittsfield MA.

Chief Cahalan stated, "we all stealing from each other" to respond.[2] Efforts to reduce the EMT ambulance requirement to one EMT and one first responder have been discussed, but have not proceeded in the state legislature.

Responding to Natural Hazards and Disasters

Several severe storm events can cause electricity outages, particularly those involving high winds, heavy snow or ice, or flooding. While residents in Lanesborough have not experienced a prolonged power outage in recent memory, some residents in neighboring towns in the region were without electricity for days or weeks during the Ice Storm of 2008. The capacity of the Red Cross in Berkshire County to respond to natural hazards and disasters, particularly its ability to oversee sheltering, has been drastically reduced, placing an additional burden on the first responder community to plan for public safety and response. The demands for local personnel and other resources needed for mass care sheltering in the event of a region-wide disaster may outweigh the capacity of the region to respond.

Participants at the MVP Workshop noted that the elderly population is increasing in Lanesborough while the young adult population is dwindling. The children of many of the Town's senior have moved away, leaving seniors with a smaller circle of support. The increasing senior population will demand more services during a hazard event, while the number of volunteer first responders will decrease, which could lead to a reduction in response and aid to those who may need it most. There is only one senior housing complex in the town and it has relatively few units, so most seniors are scattered throughout the Town in homes or apartments. Although the Lanesborough Council on Aging (COA) and first responders are aware of some seniors who will need specific aid during a power outage, they do not have a list that is in any way complete. The resistance of many seniors to proactively self-report their needs to fire or police is an ongoing issue.

Communication with all residents, especially seniors, will be key to an effective response to a disaster, and although the Town's first responders feel they are prepared to act in an emergency situation, communication may not reach all residents equally. Many people will not know where the shelters are, or how or when to go there. The same would be true for warming or cooling centers during extreme temperature events. The first responders who attended the MVP Workshop cited a desire to be able to work more directly with local residents on public safety and emergency preparedness. For example, the fire and police departments want all residents to install formal, uniformed 911 house numbers to help first responders in answering dispatch calls. They also want to encourage all seniors and others with medical conditions that require special response or medications to self-report to the Lanesborough Police to ensure better response in an emergency. Surprisingly they are finding resistance in both house numbering and self-reporting of medical needs.

Lanesborough Village Fire & Water District

The District, an entity separate from the Town of Lanesborough, provides public drinking water to 80% of the population of Lanesborough. The District is overseen by a Board of Commissioners, two full time staff that conduct day to day operations (Superintendent and Assistant Superintendent), and a few administrative staff. The District, established 80 years ago, struggles financially, due largely to an aging infrastructure that demands constant monitoring, repair and replacement. A replacement cost of the infrastructure system is estimated to in the range of $20-40 million. The District replaces segments of water line pipes each year, prioritizing those with a history of freezing in cold temperatures and those

[2] Drane, Amanda, 12-19-17. *Berkshire Eagle* article, "First responders, emergency personnel try to address growing gaps in ambulance services," Pittsfield MA.

experiencing frequent breaks. The District has refurbished its Bridge Street well and installed a large capacity storage tank for improved reliability, but a new source that draws from a different source is needed for more complete protection from both contamination and drought.

There are a number of threats to the water supply system that could interrupt water supply.

- Contamination of the water supply from a chemical spill on Route 7 (upgradient of Town Brook) remains one of the District's greatest concern. The prior closure of the Bridge Street well due to a petroleum leak from the Mobile gas station on Route 7 is a stark reminder that the water source is at risk from contamination. A plan to draw water from neighboring Pittsfield is in place if needed, but the interconnection should be improved to ensure uninterrupted supply.
- Both the Miner and Bridge Street wells draw from the same aquifer. Another water source has been identified in the Bull Hill area of Lanesborough, and pump-tests conducted indicate that this high-yield well site. Ten years ago the cost to install the well was estimated to be approximately $1.2 million.
- The Bridge Street well and District Office are located in or very near the 100-year floodplain, and the pump equipment is not elevated above flood level. A sump pump can be used to keep equipment dry, but the lack of a generator at the site makes the site vulnerable during a flood event that results in a prolonged power outage.
- A prolonged power outage could stop water distribution. While the District has a generator at the Miner Road well, there is no generator at the Bridge Street well or District Office. Power is lost 3-4 times a year at the water tank, and while there is a back-up battery at the site that can maintain communications with the District office for two hours, a recent 10-hour outage required the District to conduct some operations manually to maintain supply.
- The District does not have a clear plan to issue and enforce a water conservation ban in the event of a drought.

4.4 Prioritizing Actions

Although tornadoes have caused the most serious damages in Berkshire County in the last 50 years, their frequency, location and severity are unpredictable. Severe winter storms and ice storms are serious, annual, relatively predictable events that are viewed as part of life in the Berkshires. It is difficult to identify protection measures to mitigate the impacts of these events.

Flooding can be the end result of several natural hazards, including heavy snowfall/spring melt, ice jams, heavy rains from severe thunderstorms and hurricanes, and beaver activity. Flooding can also occur due to dam failure or poor stormwater management. Flooding is a natural hazard that can reasonably be mitigated through proper land use and structural protections. Therefore, flooding should be a major focus in future mitigation planning and implementation.

The drinking water supply of the Lanesborough Village Fire and Water District has historically been threatened a limited number of times. However, one spill from the Mobil Station was extensive enough to impact the town's drinking water supply and remove a well from use. The continued protection of the town's drinking water supply may depend on the preparedness and quick deployment of a first response team. Therefore, a hazardous materials spill should also be a major focus in future mitigation and planning.

As noted earlier in the Planning Process Section of this plan (Sect. 2), the MVP Project highlighted residents' concerns that the private sector, particularly the senior population, is likely not properly prepared to respond to an emergency situation, such as a prolonged power outage. This same project highlighted first responders' concerns that vulnerable populations, such as seniors, do not self-report their needs.

The Lanesborough Hazard Mitigation Committee followed the prioritization method used in the development of actions for the *Berkshire County Hazard Mitigation Plan*. The Committee developed draft priority levels for the actions and presented these to the Committee. Priority Levels were determined using three general criteria: 1) the level of potential severity of the hazard/disaster event 2) the level of concern for the hazard/disaster, as voiced by local officials, and 3) practicality of implementing each particular action. Although cost was considered as part of criteria #3, it was not a determining factor. Priority Levels were assigned as follows:

- High Priority: Actions that address hazards of greatest severity and concern in the region, as voiced by local officials and the Hazard Mitigation Committee, and which should begin to be implemented immediately to avert or mitigate the impacts of future disasters.
- Medium Priority: Actions that address hazards of a lesser severity and concern, as voiced by local officials and the Hazard Mitigation Committee, and which should be implemented as local capacity and funding becomes available.
- Low Priority: Actions recognized but of lesser importantce than High and Medium Priority Actions.

The draft priorities were accepted as appropriate and are listed below.

4.5 Lanesborough Multi-Hazard Mitigation Actions

The Action Table listed herein is the culmination of the planning process undertaking by the Lanesborough Emergency Management Committee, which oversaw the Multi-Hazard Mitigation Plan Update and the MVP Project. The Town of Lanesborough is proud to report that many of the actions from the previous 2009 plan have been implemented, and these are listed below in Table 4.5.1. The Action Table that follows (Table 4.5.2.) includes many of the original actions that are ongoing from the plan of 2009 and a status of those actions. The Action Table also includes new actions that address concerns that have been identified as part of the planning processes of both the Hazard Mitigation Plan update and the MVP Project.

The Critical Facilities Map that follows the Action Table illustrates the areas in Lanesborough that are of most concern regarding natural hazard impacts.

Table 4.5.1. Actions Completed since 2009

Action	Status of Implementation
Secure funds for design and construction of a permanent solution to Putnam Road crossing	Completed; new bridge constructed w/ FEMA funds
Advocate for the repair of the Miner Road bridge	Completed
Pursue commencement of Narragansett Rd project	Under construction 2018-19
Consider storm drain improvements in all road repair	Installation of sump catch basins now standard; recently

and construction projects to reduce the volume of stormwater discharges to local waterways	installed at lake roads and Putnam and Meadow roads to reduce flooding and ice buildup
Pursue an additional drinking water source and construction of a new water storage tank	Replaced old 300,000 gallon tank with new 750,000 tank in 2011 with USDA grant and long term loan
Sign the Berkshire Addendum	Completed
Wire the police station to more readily allow portable generator hookup	Completed; police station wired and generator-ready
Locate and store shelter equipment, such as cots and blankets	Completed; central region shelter equipment purchased and stored
Encourage owners and managers of special needs facilities to share information about their clients and their facilities to local first responders	Communications between town first responders and special needs group housing agency improved; plans for all new housing now shared w/ town first responders
Work with the CBREPC and other emergency organizations to increase the opportunities for local volunteers to attend NIMS and other trainings	Town first responders receive NIMS and other trainings
Additional actions completed but not included in the 2009 Plan:	Retrofitted vehicle to serve as mobile emergency command center
	Updated Comprehensive Emergency Management Plan

Table 4.2. Action Table

Text in regular font are Actions from the Lanesborough Hazard Mitigation Plan of 2008 – Updates on implementation provided in the right column.
Text in italics are new Actions that have emerged during the Hazard Mitigation and MVP Planning processes.

OBJECTIVE #1: Reduce the risk of flood damage.

Actions	Hazards Addressed	Priority Level High = H Med. = M Low = L	Time Frame	Responsible Parties & Partners	Potential Funding Sources	Actions Taken since Plan adoption 2009
Pursue commencement of Narragansett Avenue project	Flood	H	ASAP	DPW, Town Manager		Planned, with construction targeted for fall 2019
Continue to pursue stormwater management controls in new and redevelopment projects, including Low Impact Development techniques	Flood	M	1-5 yrs	Planning Bd, Cons Com	None needed	Ongoing
Insure the integrity of large beaver dams or breach them in a controlled manner	Flood-related	H	1-3 yrs	Municipalities, Mass. Fish & Game (F&G)	None needed	Ongoing monitoring continues
Continue to employ beaver controls where necessary	Flood	M	Ongoing	DPW, Cons Com	MHD, town funds	Installed "beaver deceiver" flow device at Swamp Road and Silver Street; contractor regularly cleans out all flow devices in town
Pursue right-of-way easements along chronic washout sites along Kessler Road	Flood	M	1-5 yrs	DPW, Town Counsel	Town funds	Easements found to be adequate; town monitors and addresses flooding as needed
Work with Friends of Pontoosuc to continue to identify and mitigate stormwater inputs into the lake	Flood	M	Ongoing	DPW, Cons Com, Friends of Pontoosuc	Town funds, DEP grants	Town allocates funds and staff to maintain 3 stormwater BMPs upslope of the lake

Actions	Hazards Addressed	Priority Level High = H Med. = M Low = L	Time Frame	Responsible Parties & Partners	Potential Funding Sources	Actions Taken since Plan adoption 2009
Investigate and mitigate stormwater runoff into Pontoosuc Lake in the "Indian Streets" section along Narragansett Avenue	Flood	M	1-5 yrs	DPW, Friends of Pontoosuc	DEP grants, Chapter 90, town funds	Improvements to Narragansett Ave., including stormwater controls using Town funds; additional work will be done as funding allows
Hold a workshop for residents within the floodplain area and public officials to update them on the NFIP program and possible flood mitigation techniques that may be appropriate for their properties	Flood	M	1-3	Emergency Management Committee (EMC)	Town funds	No action conducted
Notify all floodplain property owners about the NFIP program and floodproofing options	Flood	M	1-3	EMC	None needed	No action conducted; could be done by posting materials on Town website, Oyblic Access TV, offer brochures at Town Hall
Request verification and updating of FIRM maps for the Pontoosuc Lake area	Flood	L	1-5 yrs	Town Manager, EMD	None needed	No action to date
Continue to support the building inspector and the Conservation Commission in their protection of floodplain and wetlands resource areas	Flood-related	H	Ongoing	Select Bd	Town funds	Ongoing; Commission members attend ongoing training sessions
Work with Mass. Dept. of Transportation during reconstruction of Main Street/Route 7 to improve drainage along the road	*Flood-related*	*H*	*3-5 years (road work to be done FY22*	*DPW, Board of Selectmen, Conservation Commission*	*None needed*	*New action*

OBJECTIVE #2: Secure Lanesborough public drinking water supplies.

Actions	Hazards Addressed	Priority Level High = H Me. = M Low = L	Time Frame	Responsible Parties	Potential Funding Sources	Actions Taken since Plan adoption 2009
Continue to strictly enforce the Water Supply Protection District bylaw.	Haz Mat	H	Ongoing	Planning Bd, Bldg Inspector	None needed	Ongoing
Retain consultant review of bylaw for potential improvements to protect against contamination from future development, including pipelines	*Development Impact, Haz Mat*	*M*	*1-5 yrs*	*Fire & Water District, Planning Bd*	*District Local Technical Assist. (DLTA)*	*New action*
Pursue an additional drinking water source, with Bull Hill Road site being the most promising.	Drought	H	1-3 yrs	Fire & Water District, Town Manager	DEP grants, State Revolving Loan	Additional well site identified but funding not found
Develop a response and spill control plan for the Rt 7 corridor and follow this up by conducting training exercises	Haz Mat	H	ASAP	Fire & Water District, CBREPC	Fire & Water District, grants	No action taken
Consider enacting a Water Supply Protection District for the Berkshire Village Cooperative aquifer	Haz Mat, Drought	M	1-5 yrs	Planning Bd, Select Bd	None needed	Town tried to facilitate USDA grant for Berkshire Coop & F&W District; unsuccessful
Develop wellhead protection plans, including stormwater management and hazardous spill containment, within Zone II areas of public drinking water wells	Haz mat	M	1-3 yrs	Fire & Water District, DEP	DEP grants	No action taken

Actions	Hazards Addressed	Priority Level High = H Me. = M Low = L	Time Frame	Responsible Parties	Potential Funding Sources	Actions Taken since Plan adoption 2009
Protect water pump system from flooding and power outages ▪ *Determine flood elevation at the Bridge St. facility and well pump equipment; elevate and flood-proof as necessary* ▪ *Secure back-up power at the Bridge St. facility* ▪ *Pursue backup electricity source for the storage tank system to protect supply during power outages – solar and/or improved battery storage*	*Flooding; Loss of Electric Power*	*H*	*1-3 yrs*	*Fire & Water District*	*DEP, USDA, Homeland Security*	*New action*
Protect the Town Brook Aquifer ▪ *Map the Zone II of the aquifer* ▪ *Revise the Water Supply Overlay District boundaries and bylaw if necessary due to the Zone II mapping* ▪ *Monitor Town Brook for Rt. 7 salt contamination*	*Flooding; Development Impacts; Haz Mat*	*H*	*1-3 yrs*	*Fire & Water District, Planning Bd (if zoning revisions needed)*	*DEP, DLTA*	*New action*
Consider zoning to restrict density of development in Water Supply Overlay District	*Flooding; Drought*	*M*	*1-5 yrs*	*Planning Bd*	*DLTA*	*New action*
Upgrade water lines, particularly shallow lines in Pontoosuc Lake neighborhoods	*Flooding; Freeze/thaw cycles*	*M*	*1-5 yrs*	*Fire & Water District*	*USDA*	*New action*

OBJECTIVE #3: Increase emergency preparedness and public safety.

Actions	Hazards Addressed	Priority Level High = H Med. = M Low = L	Time Frame	Responsible Parties	Potential Funding Sources	Actions Taken since Plan adoption 2009
Repair the stone retaining wall behind town hall	*Landslide; Flooding*	*M*	*1-5*	*Town Manager*	*MVP, FEMA*	*Engineer has reviewed; applied unsuccessfully for MVP Action Grant 2018; possible reapplication*
Provide workshops to help local businesses to develop disaster mitigation plans for their facilities	All	H	1-3 yrs	MEMA, EMD Chambers of Commerce	FEMA, W. Region Homeland Security Adv. Council (WRHSAC)	No action
Secure adequate sheltering • Consider retrofitting the elementary school with showers • *Secure MOU with elementary school to serve as shelter* • Secure a formal agreement with Berkshire Mall for its use as a mass care shelter • Consider designing the new Community/Senior Center so that it can serve as a shelter, e.g. with power backup and showers	All	M	1-5	EMD, Town Manager, Select Bd, Recreation Committee, CBREPC	WRHSAC	Ongoing: ▪ Showers investigated but space inadequate without extensive renovation ▪ *MOU complete - secured with elem. School* ▪ Mall no longer needed; local & regional shelters secured ▪ Senior Center Feasibility Study conducted; feasibility found to be unaffordable

Actions	Hazards Addressed	Priority Level High = H Med. = M Low = L	Time Frame	Responsible Parties	Potential Funding Sources	Actions Taken since Plan adoption 2009
Educate residents about disaster response • Conduct local disaster response drills at the school and feature them in local news media • Provide evacuation and sheltering information to residents in the floodplain • Provide residents outside the hazard areas with information on how to equip their homes for "on-site" sheltering	All	M	1-5 yrs	EMD, CBREPC	WRHSAC, Town funds	Ongoing: ▪ School drills held in coordination w/ local & state police & fire ▪ No action on floodplain resident education ▪ Onsite sheltering information and Emergency Kit Checklist posted on Town website; links provided for additional information
Pursue funding for the hiring of a full-time EMT / Firefighter position	All	M	Done	Fire Chief, EMD, Select Bd	Town funds	Complete. New combined Town DPW/EMT position created
Work with the CBREPC and other emergency organizations to increase the opportunities for local volunteers to attend NIMS and other trainings	All	M	Ongoing	EMD, Fire Chief, Police Chief, CBREPC, MEMA	Grants, MEMA, WRHSAC	Ongoing; town first responders receive NIMS and other trainings
Acquire 2 new generators for town buildings	*All*	*H*	*1-3 yrs*	*Fire & Police Chiefs, Bd of Selectmen*	*MEMA, WRHSAC*	*Ongoing:* ▪ *All buildings wired for generator use* ▪ *Fire & DPW outfitted with generators* ▪ *Town Hall & Police Station need generators*
Identify vulnerable populations and encourage them to enroll in reverse 911 and self-identify with local first responders	*All*	*M*	*1-5 yrs*	*EMD, COA, Fire & Police Chiefs*	*None needed*	*Ongoing:* ▪ *Forms available for self-reporting* ▪ *COA and Outreach Worker help to identify elderly with needs* ▪ *Fire Dept. regularly meets twice a year as part of Senior Safe Program*

Actions	Hazards Addressed	Priority Level High = H Med. = M Low = L	Time Frame	Responsible Parties	Potential Funding Sources	Actions Taken since Plan adoption 2009
Educate residents on all issues regarding preparedness: educate about and increase enrollment in town's reverse 911 system, what to do in event of electricity loss, flooding, safe evacuation routes, where shelters are	*All*	*M*	*1-5 yrs*	*EMD, COA, Fire & Police Chiefs*	*None needed*	*Ongoing:* ▪ *Reverse 911 ready for use to inform residents and direct them to shelters*
Reduce risk of electricity outages by working with utilities to do enhanced tree trimming, especially along Rt. 7, and encourage underground lines in new development	*All*	*H*	*1-5 yrs*	*Eversource, EMC*	*None needed*	*Ongoing:* ▪ *Eversource currently trimming*
Encourage Pontoosuc Lake homeowners to hook into sewer	*Flooding; Water Quality*	*M*	*1-5 yrs*	*Town*	*Town funds*	*Ongoing:* ▪ *Trunk line extended to Narragansett Causeway 2017-18* ▪ *Can accommodate all homes but not all residents hooked into it*

SECTION 5. REFERENCES

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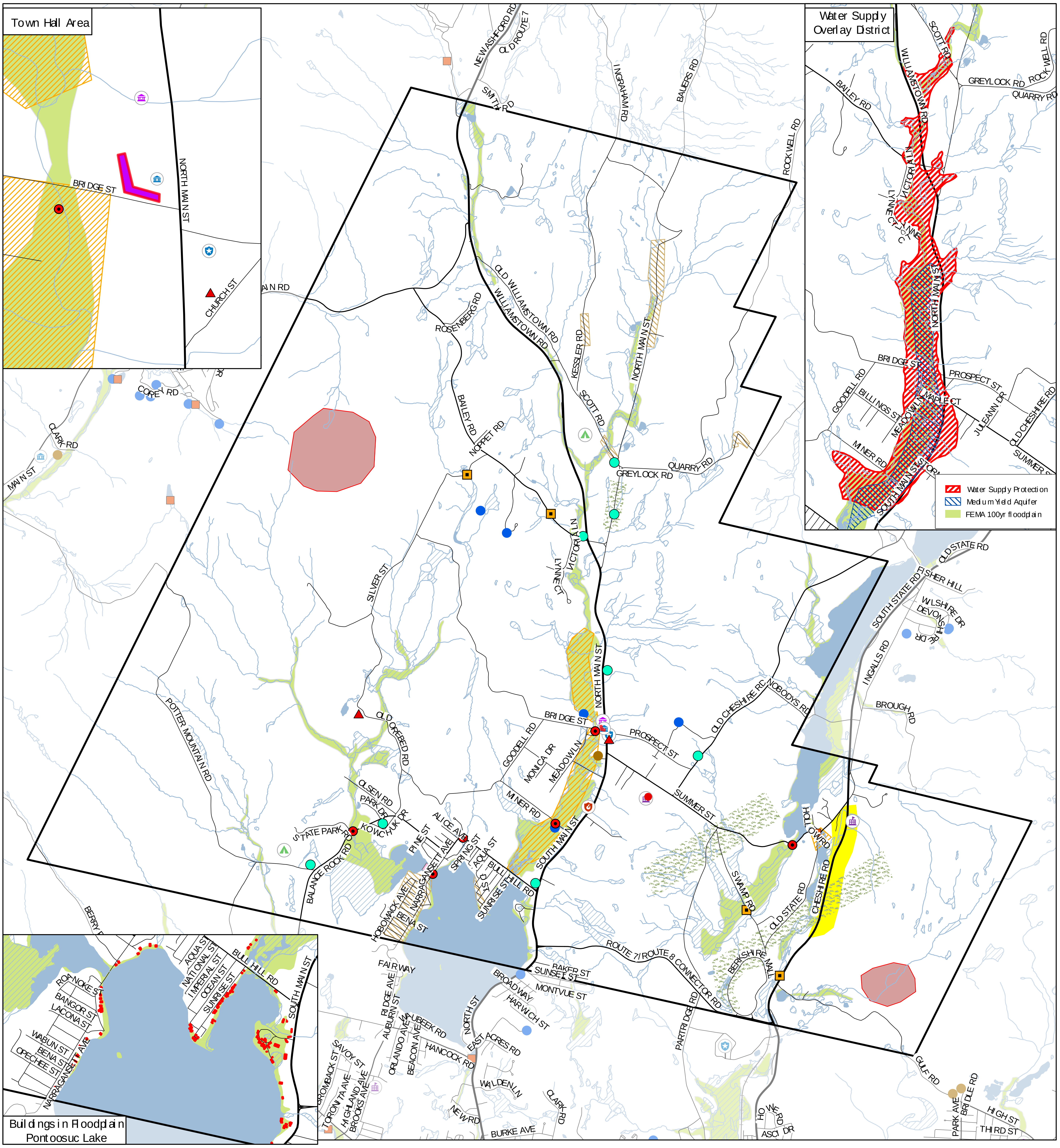
APPENDIX A

Critical Facilities and Areas of Concern Maps

Town of Lanesborough - Critical Facilities and Areas of Concern



Berkshire Regional Planning Commission

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.

Appendix B
HAZUS-MH Reports

Hazus-MH: Flood Global Risk Report

Region Name: Lanesborough

Flood Scenario: Flood100

Print Date: Thursday, November 2, 2017

Disclaimer:

This version of Hazus utilizes 2010 Census Data.
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Flood. These results can be improved by using enhanced inventory data and flood hazard information.

Table of Contents

General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences (NIBS). The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The flood loss estimates provided in this report were based on a region that included 1 county(ies) from the following state(s):

- Massachusetts

Note:
Appendix A contains a complete listing of the counties contained in the region .

The geographical size of the region is 30 square miles and contains 192 census blocks. The region contains over 1 thousand households and has a total population of 3,091 people (2010 Census Bureau data). The distribution of population by State and County for the study region is provided in Appendix B .

There are an estimated 1,542 buildings in the region with a total building replacement value (excluding contents) of 468 million dollars (2010 dollars). Approximately 89.04% of the buildings (and 72.30% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 1,542 buildings in the region which have an aggregate total replacement value of 468 million (2014 dollars). Table 1 and Table 2 present the relative distribution of the value with respect to the general occupancies by Study Region and Scenario respectively. Appendix B provides a general distribution of the building value by State and County.

Table 1
Building Exposure by Occupancy Type for the Study Region

Occupancy	Exposure ($1000)	Percent of Total
Residential	338,532	72.3%
Commercial	93,098	19.9%
Industrial	13,995	3.0%
Agricultural	4,438	0.9%
Religion	11,530	2.5%
Government	1,056	0.2%
Education	5,587	1.2%
Total	**468,236**	**100.0%**

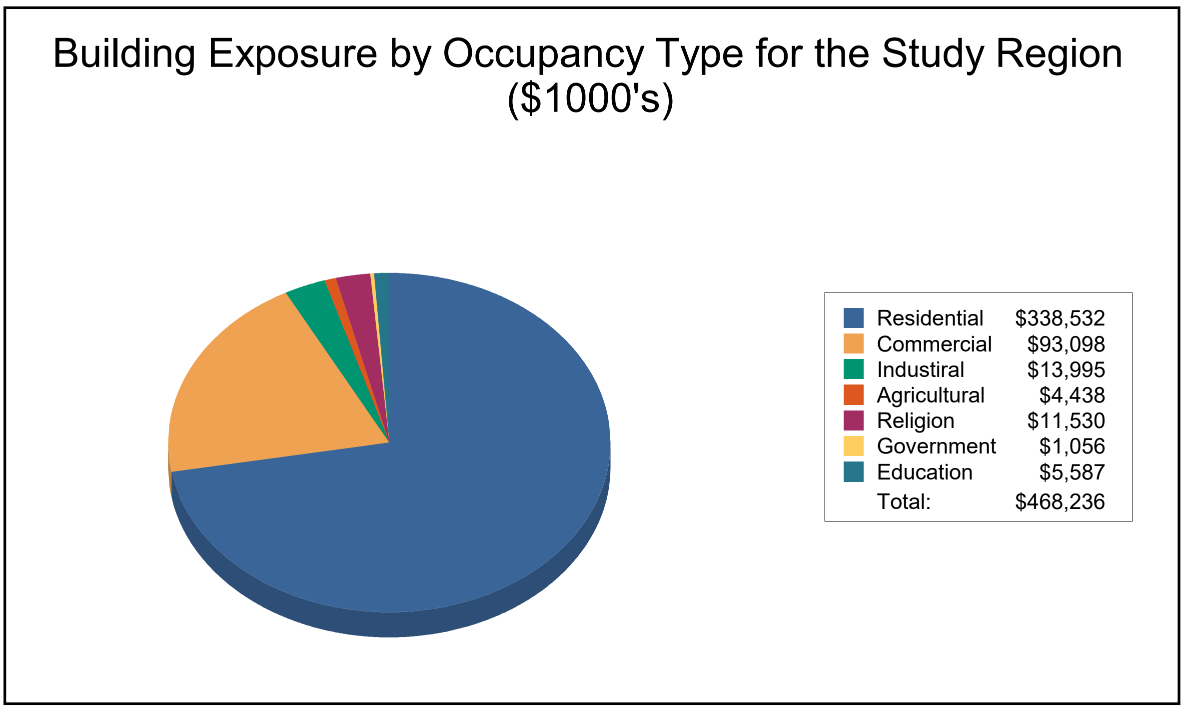
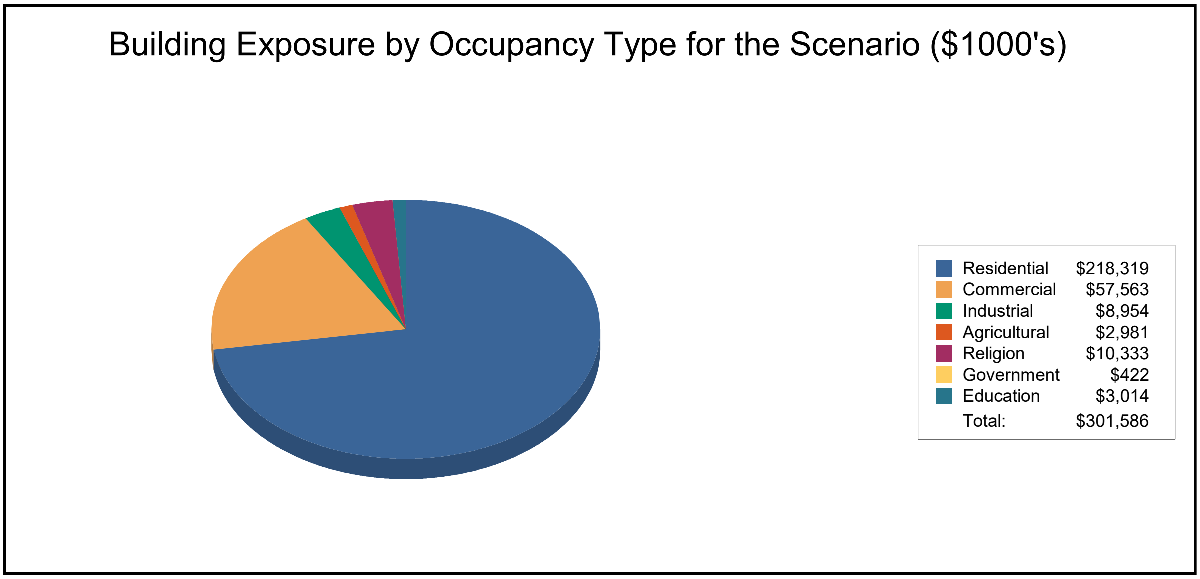


Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	218,319	72.4%
Commercial	57,563	19.1%
Industrial	8,954	3.0%
Agricultural	2,981	1.0%
Religion	10,333	3.4%
Government	422	0.1%
Education	3,014	1.0%
Total	**301,586**	**100.0%**



Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 2 schools, 1 fire station, 1 police station and no emergency operation centers.

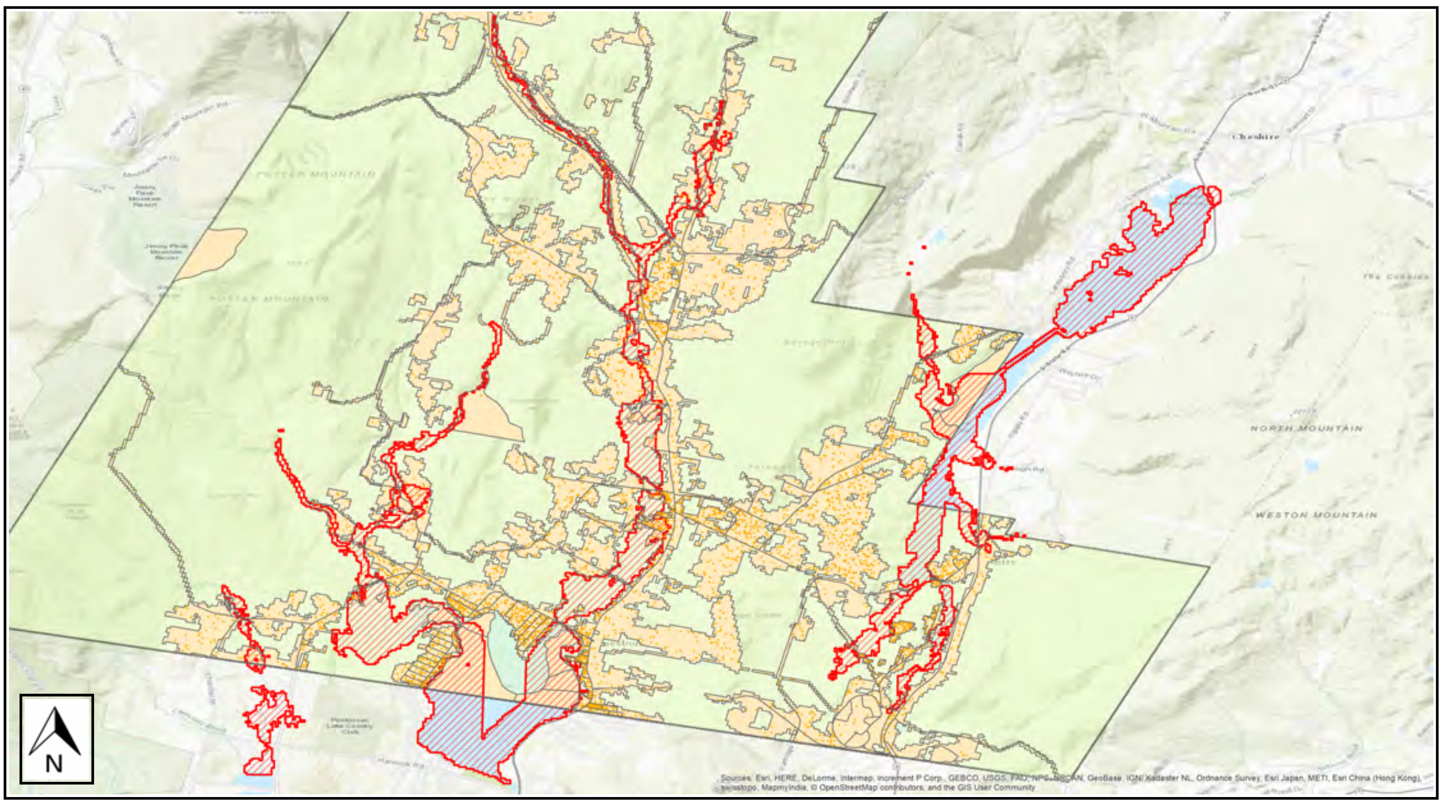
Flood Scenario Parameters

Hazus used the following set of information to define the flood parameters for the flood loss estimate provided in this report.

Study Region Name:	Lanesborough
Scenario Name:	Flood100
Return Period Analyzed:	100
Analysis Options Analyzed:	No What-Ifs

Study Region Overview Map

Illustrating scenario flood extent, as well as exposed essential facilities and total exposure



Building Damage

General Building Stock Damage

Hazus estimates that about 8 buildings will be at least moderately damaged. This is over 100% of the total number of buildings in the scenario. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus Flood Technical Manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 summarizes the expected damage by general building type.

Total Economic Loss (1 dot = $300K) Overview Map

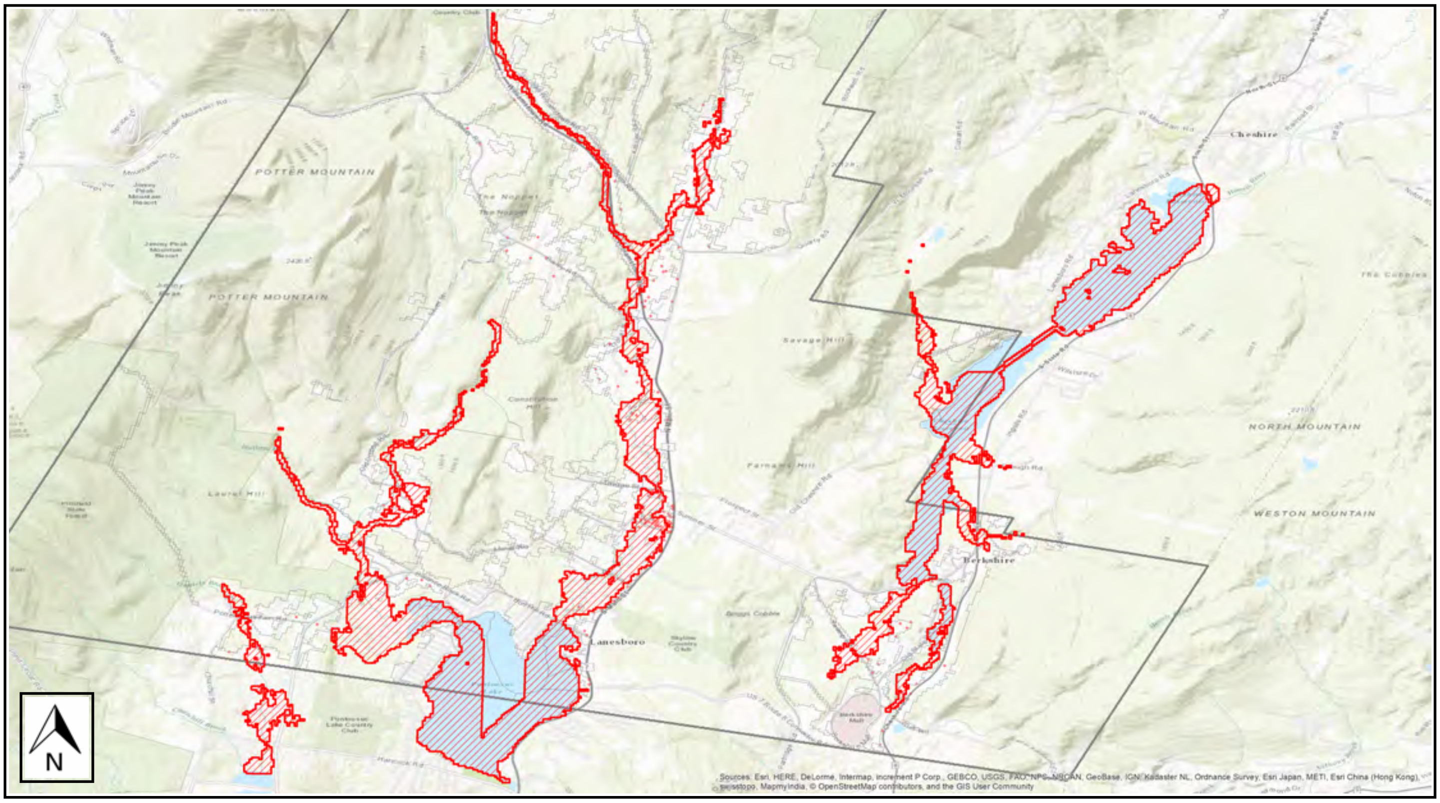


Table 3: Expected Building Damage by Occupancy

	1-10		11-20		21-30		31-40		41-50		Substantially	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Religion	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Residential	5	38.46	7	53.85	1	7.69	0	0.00	0	0.00	0	0.00
Total	**5**		**7**		**1**		**0**		**0**		**0**	

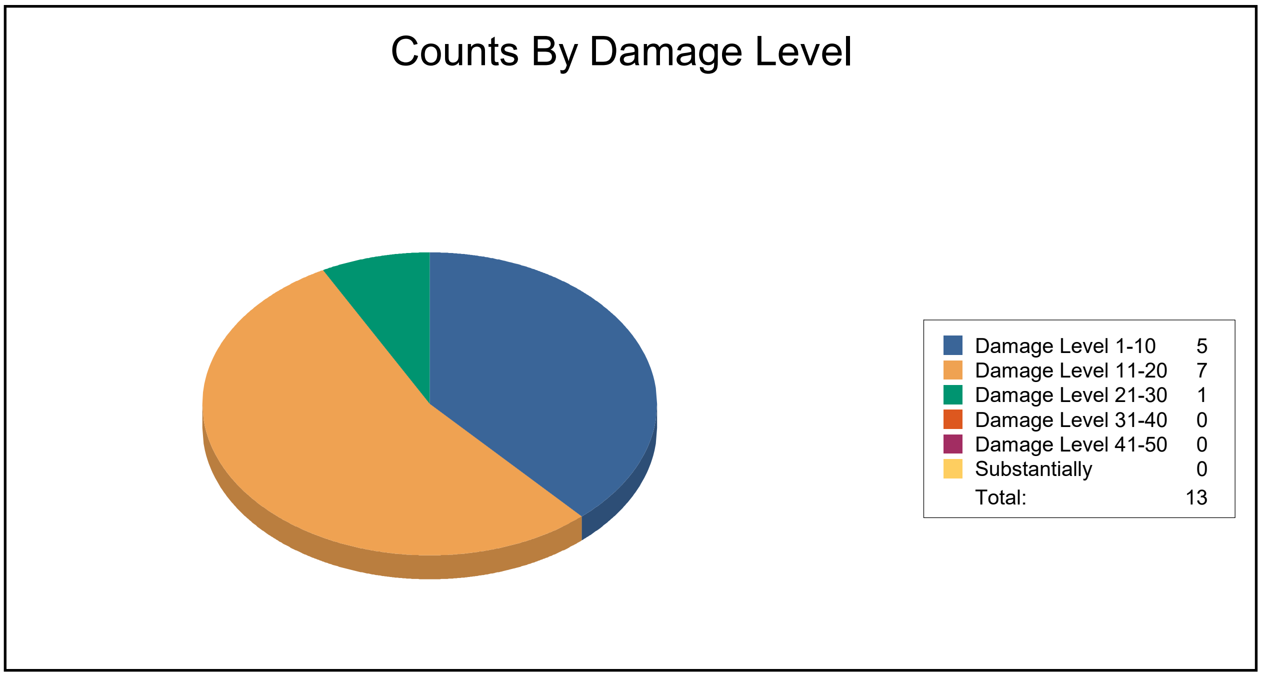


Table 4: Expected Building Damage by Building Type

Building Type	1-10		11-20		21-30		31-40		41-50		Substantially	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	0	0	0	0	0	0	0	0	0	0	0	0
ManufHousing	0	0	0	0	0	0	0	0	0	0	0	0
Masonry	0	0	0	0	0	0	0	0	0	0	0	0
Steel	0	0	0	0	0	0	0	0	0	0	0	0
Wood	5	38	7	54	1	8	0	0	0	0	0	0

Essential Facility Damage

Before the flood analyzed in this scenario, the region had 0 hospital beds available for use. On the day of the scenario flood event, the model estimates that 0 hospital beds are available in the region.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	Total	At Least Moderate	At Least Substantial	Loss of Use
Fire Stations	1	0	0	0
Hospitals	0	0	0	0
Police Stations	1	0	0	0
Schools	2	0	0	0

If this report displays all zeros or is blank, two possibilities can explain this.

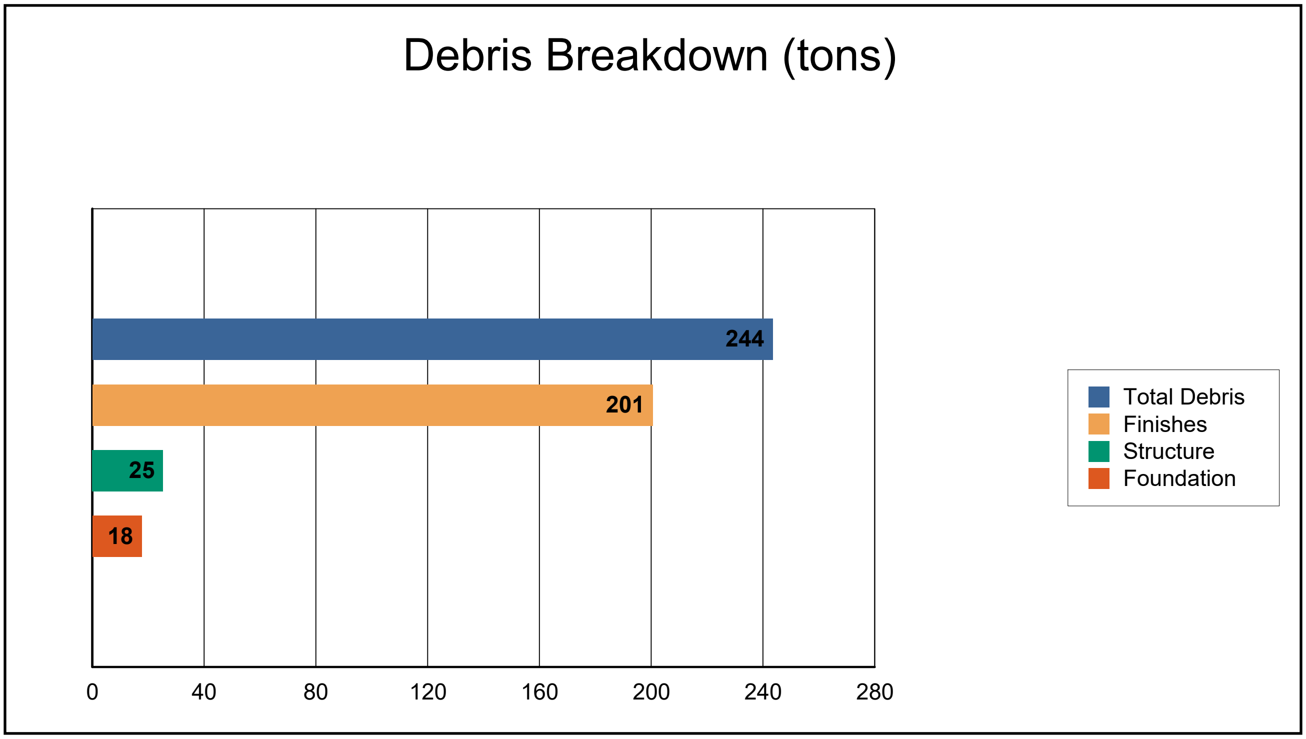
(1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.

(2) The analysis was not run. This can be tested by checking the run box on the Analysis Menu and seeing if a message box asks you to replace the existing results.

Induced Flood Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris.

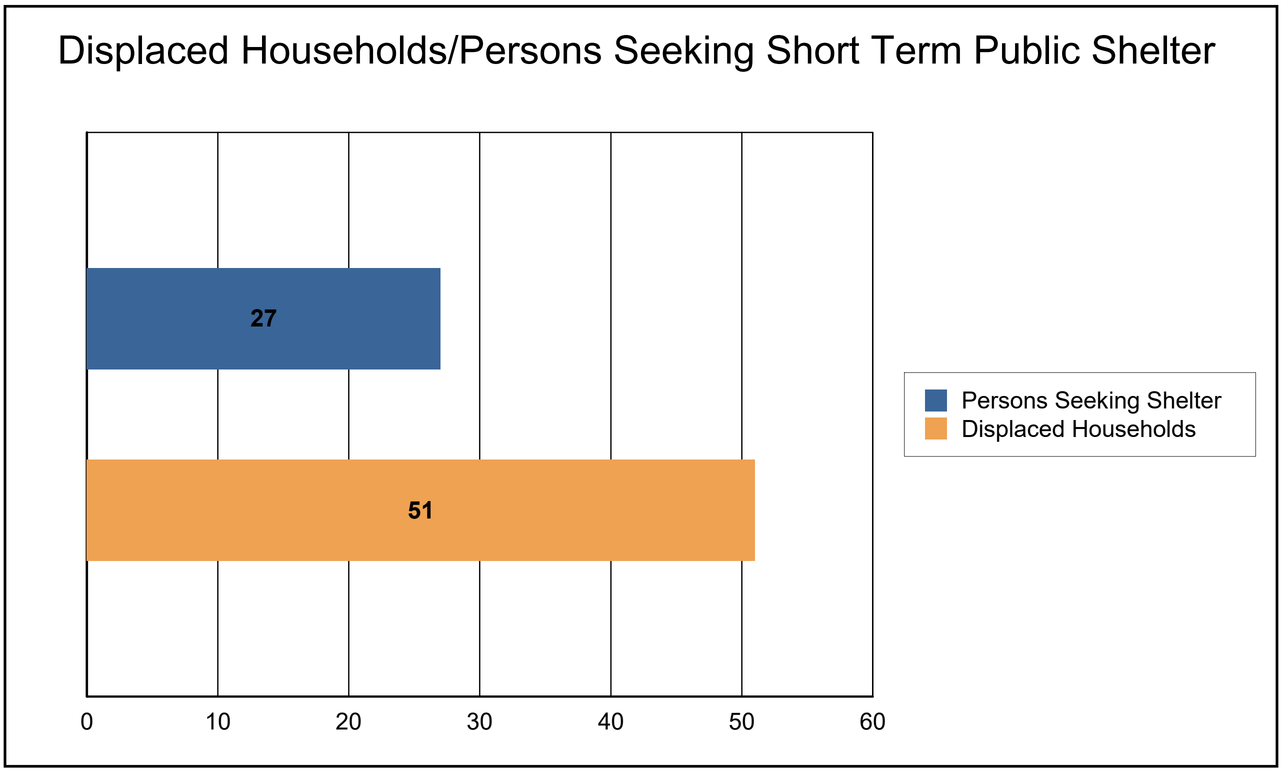


The model estimates that a total of 244 tons of debris will be generated. Of the total amount, Finishes comprises 82% of the total, Structure comprises 10% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 10 truckloads (@25 tons/truck) to remove the debris generated by the flood.

Social Impact

Shelter Requirements

Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 51 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 27 people (out of a total population of 3,091) will seek temporary shelter in public shelters.



Economic Loss

The total economic loss estimated for the flood is 5.90 million dollars, which represents 1.95 % of the total replacement value of the scenario buildings.

Building-Related Losses

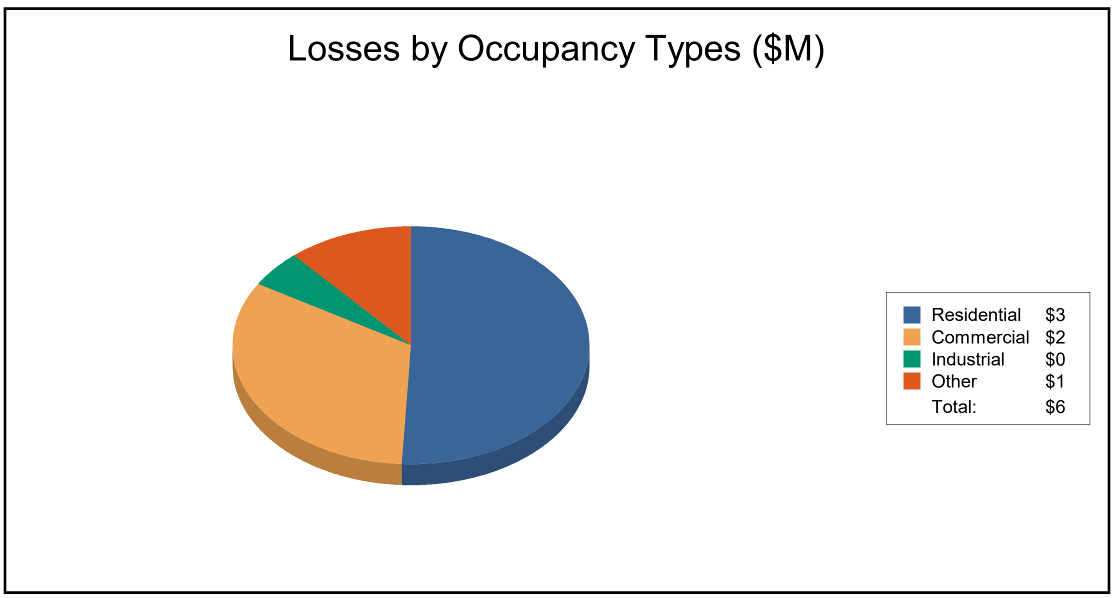
The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood.

The total building-related losses were 5.88 million dollars. 0% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 50.72% of the total loss. Table 6 below provides a summary of the losses associated with the building damage.

Table 6: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	2.04	0.42	0.12	0.08	2.66
	Content	0.95	1.49	0.16	0.59	3.18
	Inventory	0.00	0.02	0.02	0.00	0.04
	Subtotal	**2.99**	**1.93**	**0.30**	**0.67**	**5.88**
Business Interruption						
	Income	0.00	0.01	0.00	0.00	0.01
	Relocation	0.00	0.00	0.00	0.00	0.00
	Rental Income	0.00	0.00	0.00	0.00	0.00
	Wage	0.00	0.00	0.00	0.00	0.01
	Subtotal	**0.00**	**0.01**	**0.00**	**0.00**	**0.01**
ALL	**Total**	**2.99**	**1.93**	**0.30**	**0.67**	**5.90**



Appendix A: County Listing for the Region

Massachusetts

- Berkshire

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Massachusetts				
Berkshire	3,091	338,532	129,704	468,236
Total	**3,091**	**338,532**	**129,704**	**468,236**
Total Study Region	**3,091**	**338,532**	**129,704**	**468,236**

Hazus-MH: Hurricane Global Risk Report

Region Name: Lanesborough

Hurricane Scenario: Probabilistic 100-year Return Period

Print Date: Thursday, November 2, 2017

Disclaimer:
This version of Hazus utilizes 2010 Census Data.
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Hurricane. These results can be improved by using enhanced inventory data.

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The hurricane loss estimates provided in this report are based on a region that includes 1 county(ies) from the following state(s):

- Massachusetts

Note:
Appendix A contains a complete listing of the counties contained in the region.

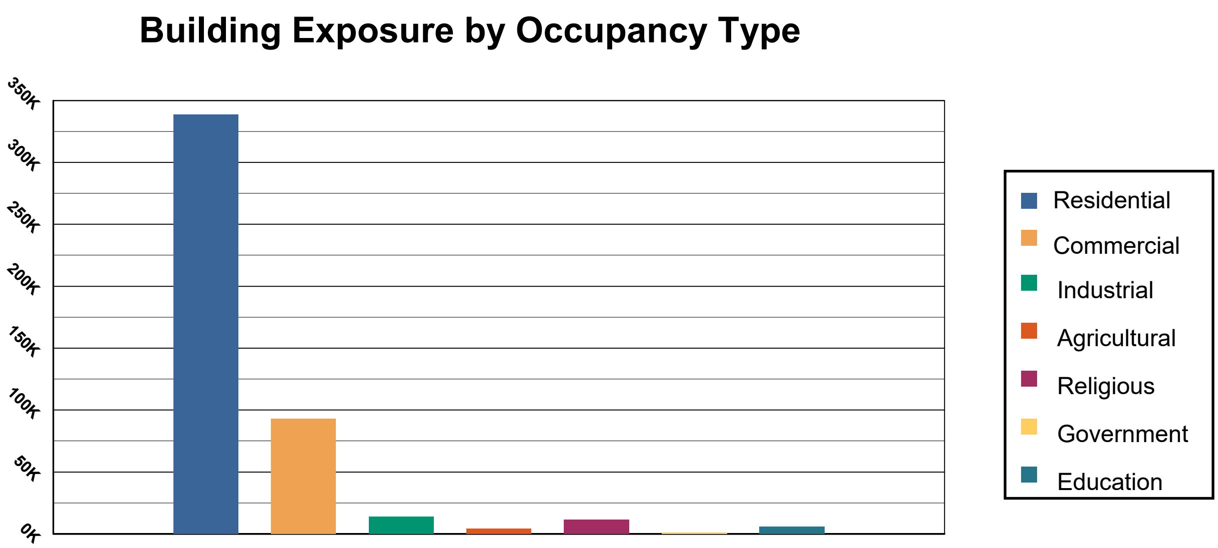
The geographical size of the region is 29.58 square miles and contains 1 census tracts. There are over 1 thousand households in the region and has a total population of 3,091 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 1 thousand buildings in the region with a total building replacement value (excluding contents) of 468 million dollars (2014 dollars). Approximately 89% of the buildings (and 72% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 1,542 buildings in the region which have an aggregate total replacement value of 468 million (2014 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.



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Industrial	13,995	2.99%
Agricultural	4,438	0.95%
Religious	11,530	2.46%
Government	1,056	0.23%
Education	5,587	1.19%
Total	**468,236**	**100.00%**

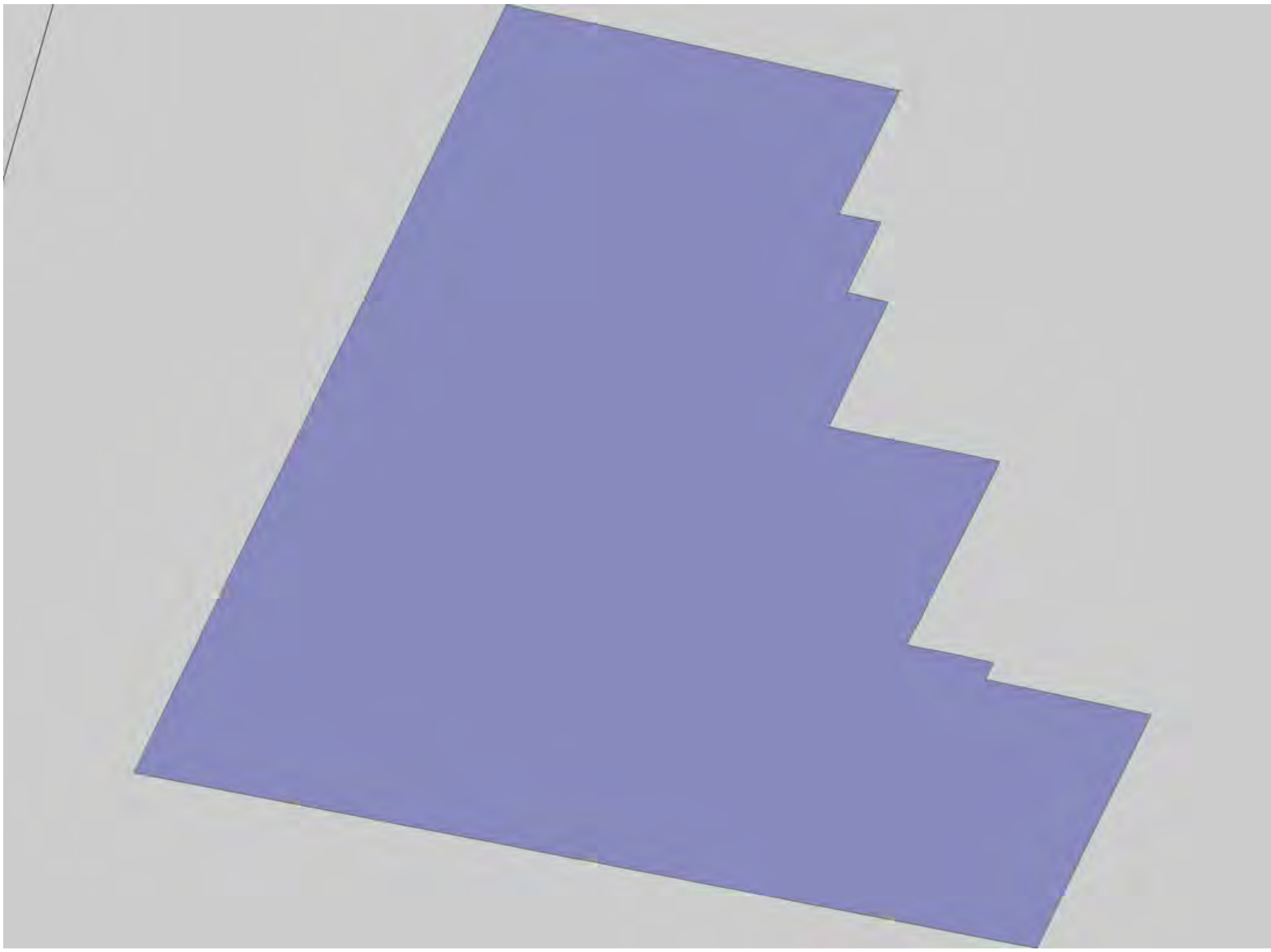
Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 2 schools, 1 fire stations, 1 police stations and no emergency operation facilities.

Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

Thematic Map with peak gust windfield and HU track



Scenario Name: Probabilistic

Type: Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 0 buildings will be at least moderately damaged. This is over 0% of the total number of buildings in the region. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 6 of the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

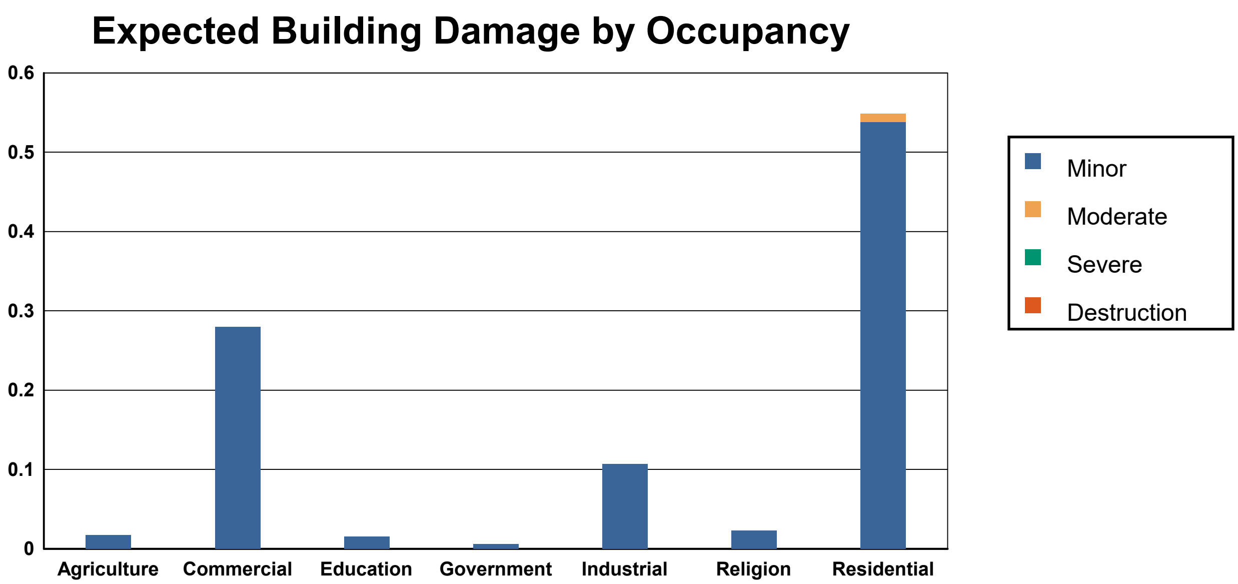


Table 2: Expected Building Damage by Occupancy : 100 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	9	99.81	0	0.19	0	0.00	0	0.00	0	0.00
Commercial	104	99.73	0	0.27	0	0.00	0	0.00	0	0.00
Education	5	99.69	0	0.31	0	0.00	0	0.00	0	0.00
Government	2	99.70	0	0.30	0	0.00	0	0.00	0	0.00
Industrial	38	99.72	0	0.28	0	0.00	0	0.00	0	0.00
Religion	11	99.79	0	0.21	0	0.00	0	0.00	0	0.00
Residential	1,372	99.96	1	0.04	0	0.00	0	0.00	0	0.00
Total	**1,541**		**1**		**0**		**0**		**0**	

Table 3: Expected Building Damage by Building Type : 100 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	8	99.61	0	0.39	0	0.00	0	0.00	0	0.00
Masonry	70	99.68	0	0.31	0	0.01	0	0.00	0	0.00
MH	9	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	78	99.68	0	0.32	0	0.00	0	0.00	0	0.00
Wood	1,292	99.99	0	0.01	0	0.00	0	0.00	0	0.00

Essential Facility Damage

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (0%) are available for use by patients already in the hospital and those injured by the hurricane. After one week, none of the beds will be in service. By 30 days, none will be operational.

Thematic Map of Essential Facilities with greater than 50% moderate

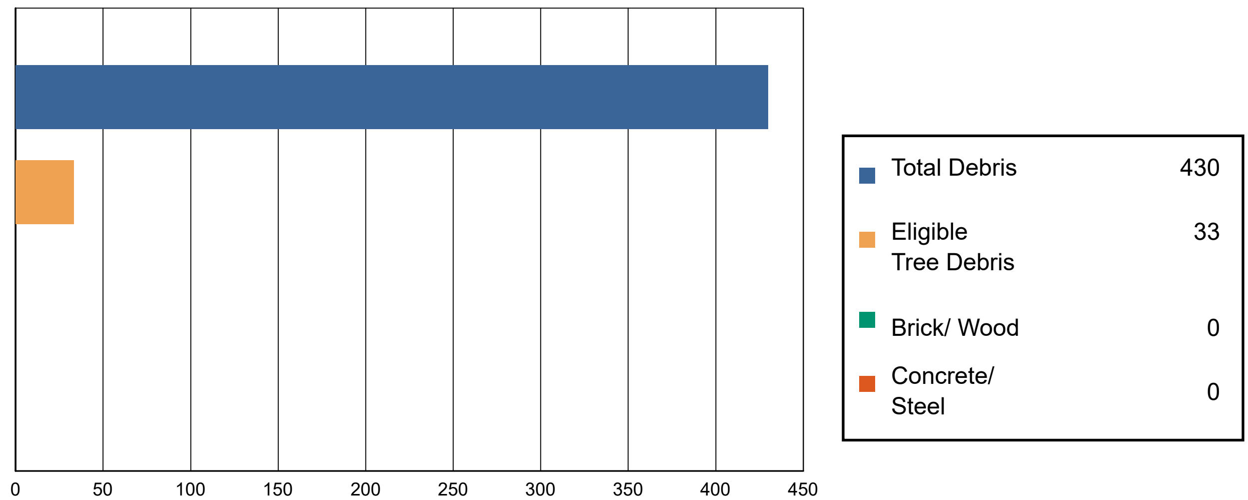
Table 4: Expected Damage to Essential Facilities

		# Facilities		
Classification	Total	Probability of at Least Moderate Damage > 50%	Probability of Complete Damage > 50%	Expected Loss of Use < 1 day
Fire Stations	1	0	0	1
Police Stations	1	0	0	1
Schools	2	0	0	2

Induced Hurricane Damage

Debris Generation

Estimated Debris (Tons)

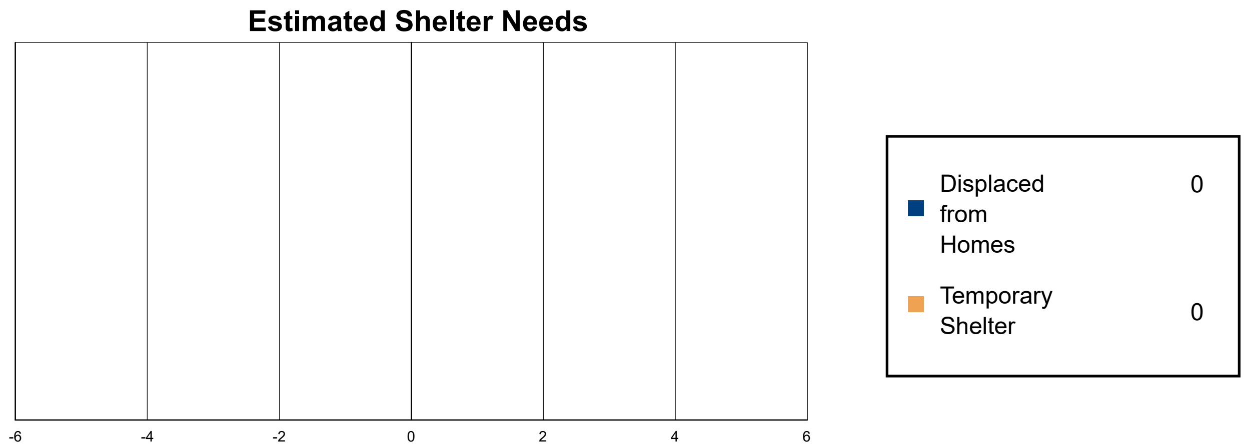


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 430 tons of debris will be generated. Of the total amount, 397 tons (92%) is Other Tree Debris. Of the remaining 33 tons, Brick/Wood comprises 0% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 33 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

Social Impact

Shelter Requirement



Hazus estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters . The model estimates 0 households to be displaced due to the hurricane. Of these, 0 people (out of a total population of 3,091) will seek temporary shelter in public shelters.

Economic Loss

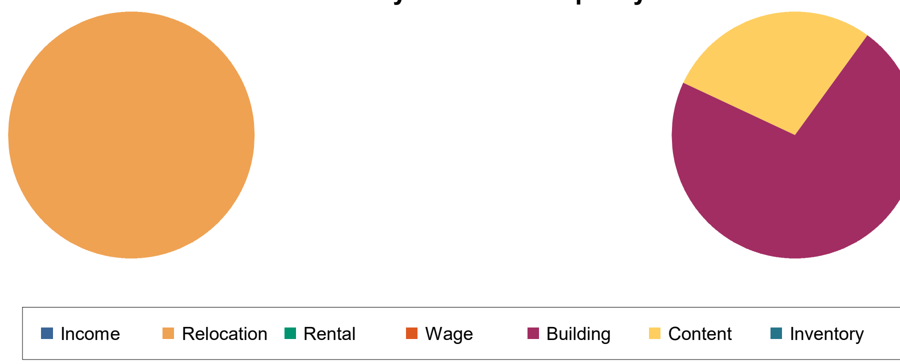
The total economic loss estimated for the hurricane is 0.1 million dollars, which represents 0.03 % of the total replacement value of the region's buildings.

Building-Related Losses

The building related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.

The total property damage losses were 0 million dollars. 0% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 100% of the total loss. Table 5 below provides a summary of the losses associated with the building damage.

Total Loss by General Occupancy



Total Loss by Occupancy Type

Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	100.58	0.00	0.00	0.00	100.58
	Content	39.41	0.00	0.00	0.00	39.41
	Inventory	0.00	0.00	0.00	0.00	0.00
	Subtotal	**139.99**	**0.00**	**0.00**	**0.00**	**139.99**
Business Interruption Loss						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	0.02	0.00	0.00	0.00	0.02
	Rental	0.00	0.00	0.00	0.00	0.00
	Wage	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.02**	**0.00**	**0.00**	**0.00**	**0.02**
Total						
	Total	**140.00**	**0.00**	**0.00**	**0.00**	**140.01**

Appendix A: County Listing for the Region

Massachusetts
- Berkshire

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars) Residential	Non-Residential	Total
Massachusetts				
Berkshire	3,091	338,532	129,704	468,236
Total	**3,091**	**338,532**	**129,704**	**468,236**
Study Region Total	**3,091**	**338,532**	**129,704**	**468,236**

Hazus-MH: Earthquake Global Risk Report

Region Name: Lanesborough

Earthquake Scenario: quake100

Print Date: November 06, 2017

Disclaimer:
This version of Hazus utilizes 2010 Census Data.
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

Table of Contents

General Description of the Region

Hazus is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop earthquake losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 1 county(ies) from the following state(s):

Massachusetts

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 29.57 square miles and contains 1 census tracts. There are over 1 thousand households in the region which has a total population of 3,091 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 1 thousand buildings in the region with a total building replacement value (excluding contents) of 468 (millions of dollars). Approximately 89.00 % of the buildings (and 72.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 440 and 5 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 1 thousand buildings in the region which have an aggregate total replacement value of 468 (millions of dollars) . Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 84% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

Hazus breaks critical facilities into two (2) groups: essential facilities and high potential loss facilities (HPL). Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 0 hospitals in the region with a total bed capacity of 0 beds. There are 2 schools, 1 fire stations, 1 police stations and 0 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 0 dams identified within the inventory. Of these, 0 of the dams are classified as 'high hazard'. The inventory also includes 0 hazardous material sites, 0 military installations and 0 nuclear power plants.

Transportation and Utility Lifeline Inventory

Within Hazus, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 445.00 (millions of dollars). This inventory includes over 78 kilometers of highways, 10 bridges, 283 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

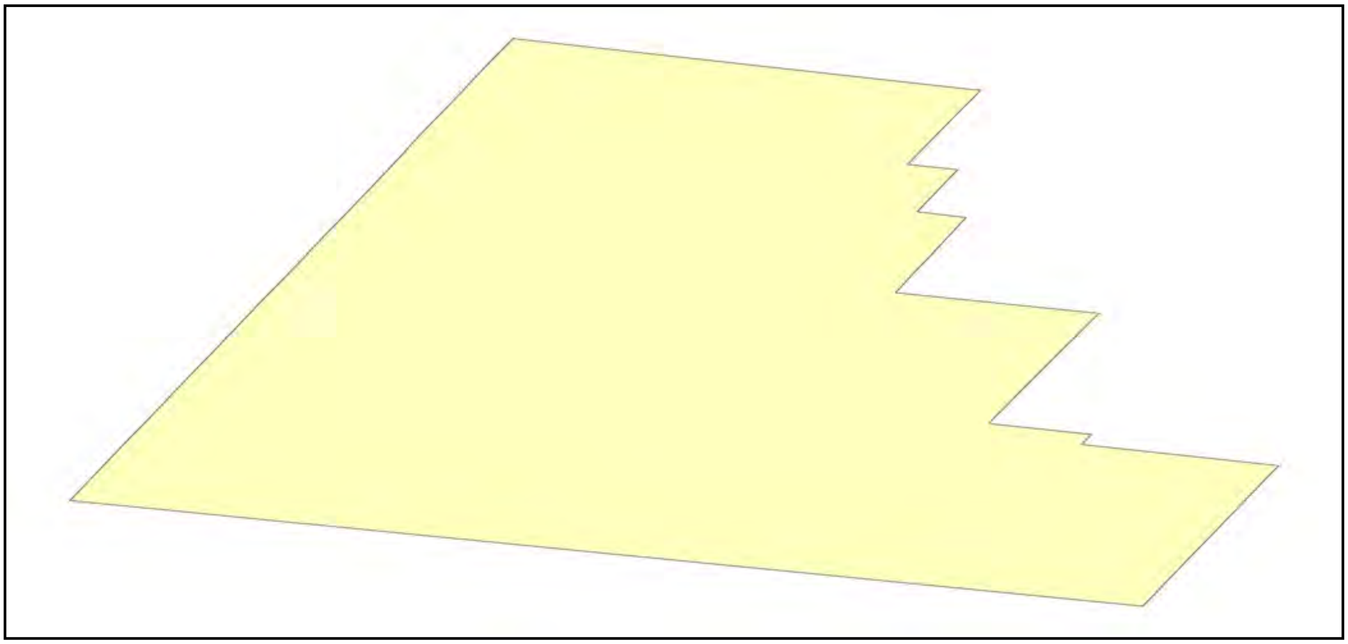
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	10	30.50
	Segments	15	387.50
	Tunnels	0	0.00
		Subtotal	**418.00**
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	2	22.30
	Tunnels	0	0.00
		Subtotal	**22.30**
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Bus	Facilities	0	0.00
		Subtotal	**0.00**
Ferry	Facilities	0	0.00
		Subtotal	**0.00**
Port	Facilities	0	0.00
		Subtotal	**0.00**
Airport	Facilities	0	0.00
	Runways	0	0.00
		Subtotal	**0.00**
		Total	**440.30**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	2.80
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**2.80**
Waste Water	Distribution Lines	NA	1.70
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**1.70**
Natural Gas	Distribution Lines	NA	1.10
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**1.10**
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Electrical Power	Facilities	0	0.00
		Subtotal	**0.00**
Communication	Facilities	0	0.00
		Subtotal	**0.00**
		Total	**5.70**

Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.



Scenario Name	quake100
Type of Earthquake	Probabilistic
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	100.00
Longitude of Epicenter	NA
Latitude of Epicenter	NA
Earthquake Magnitude	5.00
Depth (km)	NA
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	NA

Building Damage

Building Damage

Hazus estimates that about 0 buildings will be at least moderately damaged. This is over 0.00 % of the buildings in the region. There are an estimated 0 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Damage categories by General Occupancy Type

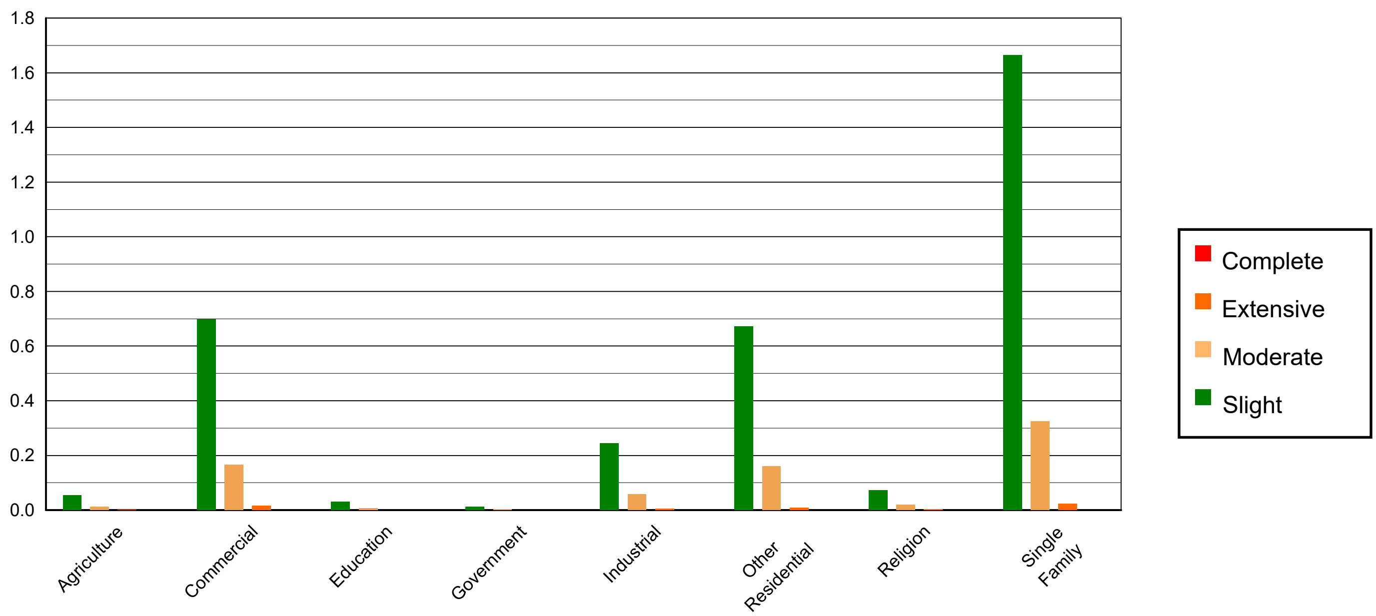


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	9	0.58	0	1.59	0	1.52	0	1.91	0	0.00
Commercial	103	6.71	1	20.23	0	22.13	0	27.92	0	0.00
Education	5	0.32	0	0.89	0	0.96	0	1.19	0	0.00
Government	2	0.13	0	0.34	0	0.34	0	0.37	0	0.00
Industrial	38	2.45	0	7.11	0	7.75	0	9.31	0	0.00
Other Residential	96	6.25	1	19.47	0	21.30	0	14.47	0	0.00
Religion	11	0.71	0	2.10	0	2.72	0	3.79	0	0.00
Single Family	1,274	82.85	2	48.27	0	43.28	0	41.04	0	0.00
Total	**1,538**		**3**		**1**		**0**		**0**	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	1,301	84.60	1	32.21	0	17.24	0	0.00	0	0.00
Steel	80	5.19	0	11.91	0	10.48	0	8.73	0	0.00
Concrete	14	0.88	0	1.67	0	1.18	0	0.00	0	0.00
Precast	5	0.35	0	1.61	0	3.15	0	4.79	0	0.00
RM	19	1.24	0	3.07	0	4.47	0	5.52	0	0.00
URM	98	6.35	1	39.07	0	53.18	0	80.96	0	0.00
MH	22	1.40	0	10.45	0	10.30	0	0.00	0	0.00
Total	**1,538**		**3**		**1**		**0**		**0**	

*Note:
RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 0 hospital beds available for use. On the day of the earthquake, the model estimates that only 0 hospital beds (0.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 0.00% of the beds will be back in service. By 30 days, 0.00% will be operational.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**At Least Moderate Damage > 50%**	**Complete Damage > 50%**	**With Functionality > 50% on day 1**
Hospitals	0	0	0	0
Schools	2	0	0	2
EOCs	0	0	0	0
PoliceStations	1	0	0	1
FireStations	1	0	0	1

Transportation Lifeline Damage

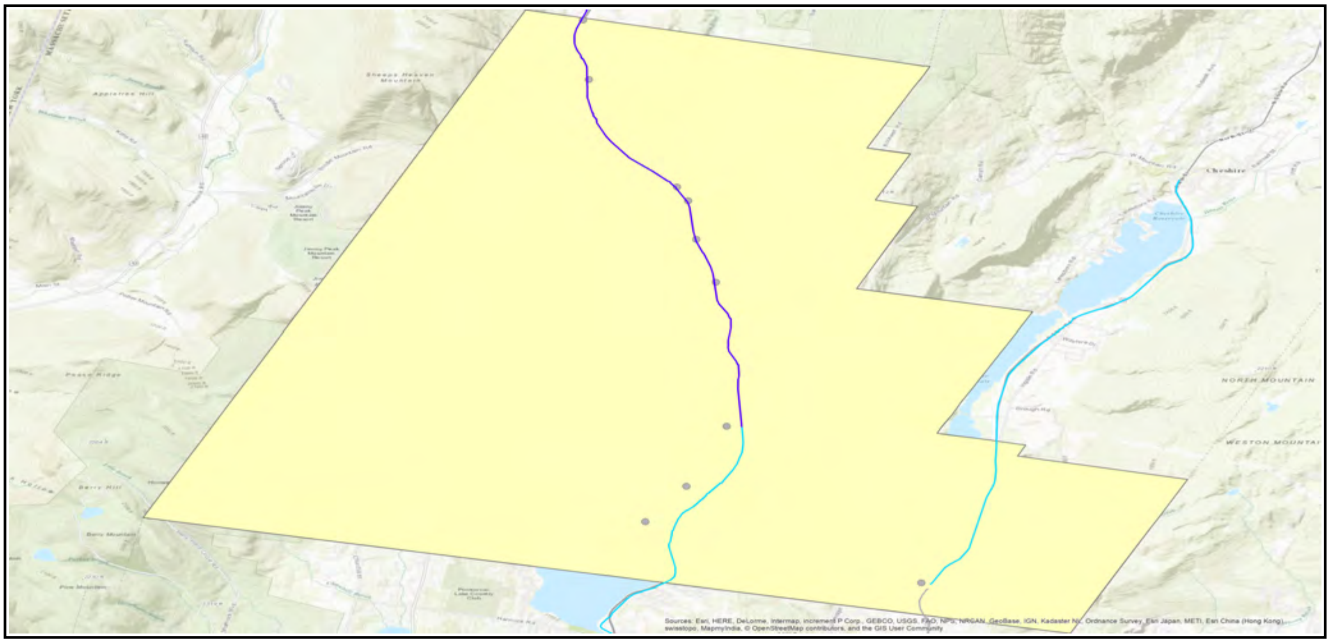


Table 6: Expected Damage to the Transportation Systems

System	Component	Number of Locations_				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	15	0	0	13	13
	Bridges	10	0	0	10	10
	Tunnels	0	0	0	0	0
Railways	Segments	2	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	0	0	0	0	0
	Runways	0	0	0	0	0

Table 6 provides damage estimates for the transportation system.

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, Hazus performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	0	0	0	0	0
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	0	0	0	0	0

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	142	0	0
Waste Water	85	0	0
Natural Gas	57	0	0
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	1,291	0	0	0	0	0
Electric Power		0	0	0	0	0

Induced Earthquake Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 0.00 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 79.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Earthquake Debris (millions of tons)

Brick/ Wood	Reinforced Concrete/Steel	Total Debris	Truck Load
0.00	0.00	0.00	0 (@25 tons/truck)

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the earthquake. Of these, 0 people (out of a total population of 3,091) will seek temporary shelter in public shelters.

Displaced Households/ Persons Seeking Short Term Public Shelter

Displaced households as a result of the earthquake	Persons seeking temporary public shelter
0	0

Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**0**	**0**	**0**	**0**
2 PM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**0**	**0**	**0**	**0**
5 PM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**0**	**0**	**0**	**0**

Economic Loss

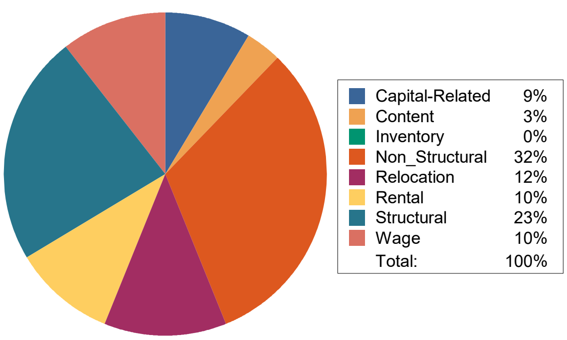
The total economic loss estimated for the earthquake is 0.07 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 0.07 (millions of dollars); 41 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 42 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Earthquake Losses by Loss Type ($ millions)



Earthquake Losses by Occupancy Type ($ millions)

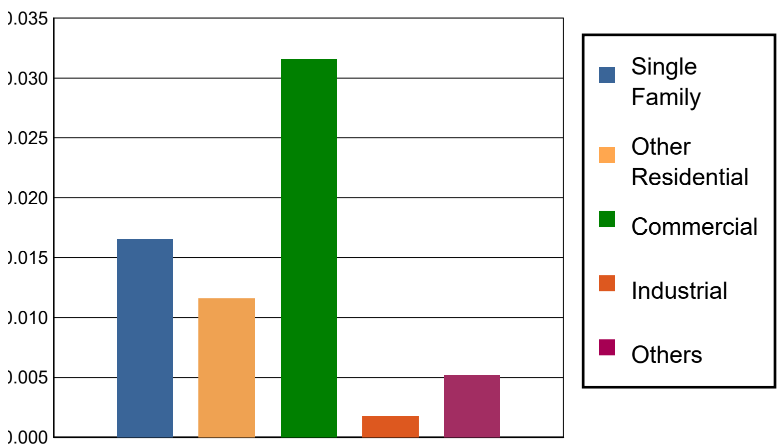


Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	0.00	0.01	0.00	0.00	0.01
	Capital-Related	0.00	0.00	0.01	0.00	0.00	0.01
	Rental	0.00	0.00	0.00	0.00	0.00	0.01
	Relocation	0.00	0.00	0.00	0.00	0.00	0.01
	Subtotal	**0.00**	**0.01**	**0.02**	**0.00**	**0.00**	**0.03**
Capital Stock Losses							
	Structural	0.00	0.00	0.01	0.00	0.00	0.02
	Non_Structural	0.01	0.00	0.01	0.00	0.00	0.02
	Content	0.00	0.00	0.00	0.00	0.00	0.00
	Inventory	0.00	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.01**	**0.01**	**0.01**	**0.00**	**0.00**	**0.04**
	Total	**0.02**	**0.01**	**0.03**	**0.00**	**0.01**	**0.07**

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, Hazus computes the direct repair cost for each component only. There are no losses computed by Hazus for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

Table 12: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	387.51	$0.00	0.00
	Bridges	30.47	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Subtotal	**418**	**0.00**	
Railways	Segments	22.34	$0.00	0.00
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**22**	**0.00**	
Light Rail	Segments	0.00	$0.00	0.00
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0**	**0.00**	
Bus	Facilities	0.00	$0.00	0.00
	Subtotal	**0**	**0.00**	
Ferry	Facilities	0.00	$0.00	0.00
	Subtotal	**0**	**0.00**	
Port	Facilities	0.00	$0.00	0.00
	Subtotal	**0**	**0.00**	
Airport	Facilities	0.00	$0.00	0.00
	Runways	0.00	$0.00	0.00
	Subtotal	**0**	**0.00**	
	Total	**440.30**	**0.00**	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	2.80	$0.00	0.00
	Subtotal	**2.83**	**$0.00**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	1.70	$0.00	0.01
	Subtotal	**1.70**	**$0.00**	
Natural Gas	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	1.10	$0.00	0.00
	Subtotal	**1.13**	**$0.00**	
Oil Systems	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Electrical Power	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Communication	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**$0.00**	
	Total	**5.66**	**$0.00**	

Appendix A: County Listing for the Region

Berkshire,MA

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Massachusetts					
	Berkshire	3,091	338	129	468
Total State		**3,091**	**338**	**129**	**468**
Total Region		**3,091**	**338**	**129**	**468**

Appendix C – Public Outreach and Input

- February 28, 2018 Public Forum Promotional Materials
  - Save the Date inserts in town-wide census mailing
  - Flyers posted in public gathering places
  - Public announcements in local paper
- Public Forum Powerpoint Presentation
- Public Forum MVP Top Actions Poster with Voting Results
- Public Forum Hazard Mitigation Plan Action Table Update
- Public Forum Large Informational Poster
- Announcement of Public Review of Draft Plan in Town e-Newsletter
- Posting of Draft Plan on Town of Lanesborough website

Save the Date! February 28, 2018
Public Workshop on Natural Disaster Planning and Action

The Town of Lanesborough is updating its Natural Hazard Mitigation Plan and needs your help to make sure that we've properly documented the risks from hazards such as flooding, drought, fire and hurricanes. The Mitigation Plan is the final product of a "pre-disaster" planning effort that identifies actions that can reduce or eliminate the risk to life and property in the event that a natural disaster occurs. Some actions already completed in Lanesborough include replacing undersized culverts and bridges, upgrading the public water system, and improving the emergency notification system.

As part of the planning work the Town will hold a public workshop on February 28, 2018 at the Town Hall. At the workshop town officials and residents will learn what natural disasters Lanesborough is most likely to experience and what actions can be taken up front to reduce the impacts. Workshop attendees will be a key part in developing and prioritizing the actions that they believe the Town should invest in.
So, save the date and keep an eye out for more information!

What is Natural Hazard Mitigation?

Pre-disaster natural hazard mitigation planning assesses a town's vulnerability to disaster events and identifies actions that can eliminate or reduce the risk to life and property in the event that a disaster occurs -- it is the work done up front to reduce the impacts of the disaster. Pre-disaster mitigation actions include:

- Replacing an undersized culvert with a larger one to reduce the risk of flooding or road washout.
- Upgrading road stormdrain systems to handle higher volumes of water.
- Retrofitting shelters and cooling centers with generators.
- Securing additional water supply sources in the event of drought conditions.
- Protecting wetlands and floodplains to provide storage capacity during severe flooding events.

Why Attend the February 28th Workshop?

Town Officials and Staff work on your behalf, but they need to hear from Lanesborough residents.

- Learn about disasters and bring your fresh perspective into the planning process to help local officials develop and prioritize actions.
- Learn more about disaster planning for your home and family.

LANESBOROUGH RESIDENTS:
WE NEED YOUR INPUT

Lanesborough Hazard Mitigation and Vulnerability Preparedness

Come to a public forum to learn about how the Town is updating its Hazard Mitigation Plan and to give your input on the Actions the Town should undertake to reduce the impacts of natural hazards and disasters.

When:

Wed., Feb. 28, 6-8 pm

Where:

Town Hall

PRESS RELEASE - LISTING FOR COMMUNITY CALENDAR

Lanesborough Residents: Public Forum planned for February 28, 2018 at Lanesborough Town Hall 6-8 p.m.

The Town of Lanesborough is updating its Natural Hazard Mitigation Plan. This involves assessing the Town's vulnerability to disaster events and identifying actions that can eliminate or reduce the risk to life and property in the event that a disaster occurs -- it is the work done up front to reduce the impacts of the disaster. Residents are invited to attend the forum to: 1) Learn what natural disasters Lanesborough is most likely to experience; 2) evaluate the Action Items that town staff and residents identified during a recent workshop, and 3) help them prioritize the actions that the Town should invest in. Forum attendees will also learn more about disaster planning for their home and family. Light snacks will be offered.

night truck

a committee's work to plan a ge, that project fell by the way- movement to build a new ga- Sheffield was reinvigorated in n the Highway Design Garage ee formed. Since the commit- rgely looking at prefabricated s, Town Administrator Rhonda rd said it is less likely to need nding set aside for it years ago.

Town Hall project, plans call for ing to get a new back entry that re a covered entrance and ac- eople with disabilities.

ork is expected to cost about in total. Most of the project is d for by a Community Develop- ck Grant. The money the town vide would cover project add- unanticipated costs. Officials e work will be completed in the summer.

---

onomic Development Commis- on member Kevin Towle.

Marketing and promoting local ricultural businesses and more ents at centrally located Bill aston Memorial Park also scored the 70th percentile of the resi- nts' top priorities.

Lanesborough has already bol- ered its image by getting on the Berkshire website, marketing the wn as a destination for business d tourism, according to town d regional planners.

"1Berkshire serves the role as a gional chamber of commerce," rennan said. "Joining them is e getting a number of beneficial emberships. I think that was an portant step to take."

Brennan also envisions the onomic report becoming a blue- int for a town master plan. She ted Lanesborough is among the ndful of Berkshire municipali- es without a master plan to guide e town's growth.

IN THE BERKSHIRES

CHESHIRE

Annual town census mailed to residents

The annual town census has been mailed to residents. The census is mandated by Mass. General Law and is valuable to have a current and correct residential count in order for the town to apply for state and federal aids and grants.

The count is also valuable to the Adams-Cheshire School District.

Residents should review, make necessary corrections, sign, and return the census to the town clerk's office in the provided envelope. Census returns may be mailed or dropped off at the Town Hall.

This form cannot be used to register to vote or to change party enrollment.

Any resident who has not received a form should call the town clerk at 413-743-1690, ext. 22, or email townclerk@cheshire-ma.gov.

LANESBOROUGH

Hazard mitigation public forum slated

Residents are invited to attend a public forum on the town's Natural Hazard Mitigation Plan updates from 6 to 8 p.m. Wednesday at the Town Hall.

The plan assesses the town's vulnerability to disaster events and identifies actions that can eliminate or reduce the risk to life and property in the event that a disaster occurs.

Forum attendees will also learn more about disaster planning for their home and family. Light snacks will be offered.

NORTH ADAMS

Berk. Food Project sets annual meeting

The Berkshire Food Project Inc. will hold its annual meeting at 4:30 p.m. Tuesday at First Congregational Church, 134 Main St.

PITTSFIELD

Civitan sponsors SoupFest benefit

The Civitan Club of Pittsfield will hold its 12th annual SoupFest benefit at 6 p.m. Friday at the Berkshire Hills Country Club, 500 Benedict Road. All SoupFest profits are given to area soup kitchens and food pantries.

The SoupFest includes soup tastings, appetizers, desserts, cash bar, silent auction, and raffles. One of this year's raffles is a new Feed Our Towns raffle with $1,000 in restaurant gift certificates as first prize.

This year's soup samples come from approximately 20 local restaurants and organizations. Over half the soups will be meatless.

Tickets may be obtained from Civitan members Karen Ruscio at 413-212-6832 or karenruscio@aol.com, Nancy Lamarre at 413-443-5530, or at the door. The cost is $25 per person. Reservations are available for tables of 10.

Those who cannot attend may make donations payable to The Civitan Club of Pittsfield, P.O. Box 42, Pittsfield, MA 01202.

STAMFORD, VT.

Farmer to present Seed Savers talk

Gardeners of all ages and levels of experience are invited to a Stamford Seed Savers presentation from 6 to 7:30 p.m. Tuesday at the Stamford Community Library, 986 Main St.

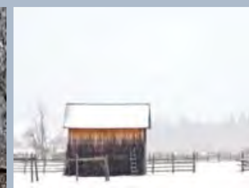
"Planning a Vegetable Garden for Pleasure, Beauty and Good Food" will be presented by Sharon Wyrrick, the farmer and owner of Many Forks Farm in Clarksburg, Mass.

Wyrrick will discuss a multitude of considerations that come into play when planning and managing a successful

TONIGHT'S AGENDA

1. **View posters to learn about Natural Hazards**
   6:00-6:20 pm
2. **Presentation on findings**
   6:20-6:45 pm
3. **Public feedback and suggestions**
   6:45-?

Natural Hazard Mitigation and Municipal Vulnerability Preparedness


Town of Lanesborough
February 28, 2018

What Are We Evaluating?

Hazard Mitigation Plan – Emergency Management Committee

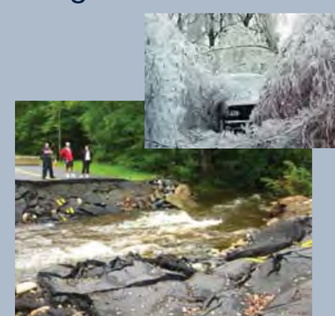
- Assesses the vulnerability of a community to the natural hazards / disasters
- Describes activities that can be done to mitigate the hazards before they occur
- Mitigation Plan is a REQUIREMENT to maintain eligibility for some FEMA funds

Municipal Vulnerability Preparedness -- Workshop

- Consider weather pattern observations and climate change projections
- MVP certified communities will have priority status for some state grants

Natural Hazards Evaluated for Lanesborough

Hazards Evaluated	
Flood	Tornado
Dam Failure	Extreme Temperature
Hurricane / Tropical Storm	Drought
Nor'easter	Wildland Fire
Snow & Blizzard	Major Urban Fire
Ice Storm	Earthquake
Thunderstorm	Landslide
High Winds	Ice Jam
Beaver Activity	



Key Observed Climate Changes in MA

Temperature: ↑ **2.8°F** since 1895 (7-10°F by 2100)
Berk. temp. up 1.7°F since 1960

Growing Season: ↑ **10 Days**
Since 1950

Strong Storms: ↑ **71%**
Since 1958

Observed Number of Warm Nights

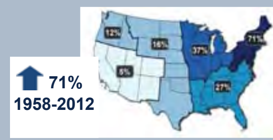
Projected In Berkshires:
Day temps. > 90° F increase from 2 per year to 27 by 2090

Observed In MA:
Number of nights where minimum temp. > 70° F in MA

Observed No. Extreme Precip. Events

- Number of Events w/ Precipitation > 2" in 1 day
  "Stepped Increase" in 1970-80s, and continues

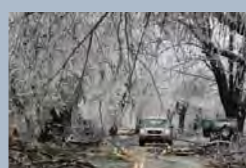
https://statesummaries.ncics.org/ma

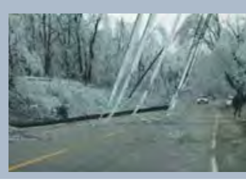


Flood-plain Mapping

Ice Storm December 2008

- **Loss of electricity for 1+ million customers**
- **>500,000 lost power during peak of storm, some for > 2 weeks**
- **FEMA obligates >$32 million in Mass.**
  - State costs >$7 million
  - Municipal costs >$5 million
  - National Grid claims damages of >$30 million
  - Small businesses without electricity "lose tens of millions of dollars"*





* MA Climate Change Action Plan

T.S. Irene 2011

- 500,000+ MA residents without electricity
- 6 out of 8 stream gages in Deerfield & Hoosic Rivers reach highest peaks of record
- >100-year flood but <500-year flood in Hoosic River
- 50-year storm (2% chance flood event) in central Berkshire County
- Dubbed the "costliest Category 1 storm" ($15.8 billion in damages)
- Fed. Disaster in MA: FEMA $5.6 million to households, $30 million for public assistance
- Fed. Highways: $46 million for roads and bridges, much of it for Rt 2

Irene and Shelburne Falls

Don't take Water for Granted

- Drought cycles due to increased temperatures and evaporation
- Lower groundwater recharge
- More water in summer/fall comes in extreme storm events with higher, earlier peak flows and more runoff
- Berkshires got off lightly this time

Assessing Vulnerability in Lanesborough

- Approx. 4 miles of roadway travel through floodplain
- 76 Buildings in the Town are in the 100-yr floodplain (BRPC 2018)
  - 74 are residential homes, many of which are along north shore of Pontoosuc Lake
  - Been only 3 flood insurance claims in town since 1978
  - Only 6 properties have active flood insurance policies

Assessing Vulnerability in Lanesborough

HAZUS-MH Modeling

- Scenario: 100-year flood event
- 8 buildings are at least moderately damaged
- 51 households displaced due to being within or very near inundation area
- 27 people would seek shelter
- $6 million in potential losses

(structural only - not including losses for down time for town or businesses)

HAZUS-MH Est. of Losses in 1% Annual Chance of Occurrence (commonly called 100-Yr storm event) Losses in Millions of Dollars

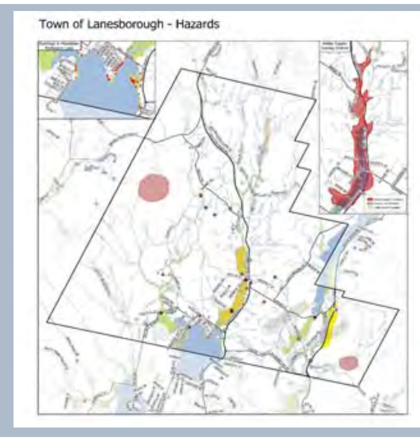
	Res. Bldgs.	Com. Bldgs.	Ind. & Other Bldgs.	Total
Building Losses	$2.04	$0.42	$0.20	$2.66
Content & Inventory Losses	$0.95	$1.51	$0.77	$3.23
Total Losses	$2.99	$1.93	$0.97	$5.89

Concerns around Lanesborough

(Emerg. Management Committee and MVP Workshop)

- Protection of drinking water (supply, potential contamination)
- Undersized culverts / bridges
- Beaver activity (flooding, public health)
- Dirt road erosion, washouts, sediment deposition
- Stability of town hall stone retaining wall
- Microbursts, severe rains
- Electricity outage for ≥ 4 days
- Educating residents about preparedness

Where are Greatest Risks?



Now it's Your Turn!

Help town officials, first responders and fellow residents prioritize the most important actions

LANESBOROUGH MUNICIPAL VULNERABILITY PREPAREDNESS WORKSHOP

Major Actions Needed

OBJECTIVE #1: Protect Water Supply

Actions	
Protect water pump system from flooding and power outages	**3**
Tighter enforcement and limit businesses with contamination risk in Water Supply Overlay District	**1**
Work with Mass. Dept. of Transportation to clean up / maintain their ditches and storm drains on Rt. 7	**0**
Zoning to restrict more densely populated areas in Water Supply Overlay District	**1**
Upgrade water lines, particularly shallow lines in Pontoosuc Lake neighborhoods	**0**
Monitor Town Brook for salt contamination from Rt 7	**0**
Continue to support the Conservation Commission	**0**

OBJECTIVE #2: Preparedness Education

Actions	
Educate residents on all issues regarding preparedness: educate about and increase enrollment in town's reverse 911 system, what to do in event of electricity loss, flooding, safe evacuation routes, where shelters are	**1**
Generators for town buildings – fixed generators at all buildings or at minimum wire buildings to accept mobile generators	**6**
Secure MOU with elementary school to serve as shelter	**1**
Identify vulnerable populations, particularly homebound residents who may need special aid during emergencies, and encourage them to enroll in reverse 911 and self-identify with local first responders; encourage group homes to install back-up power	**7**
Educate homeowners in floodplain	**0**

OBJECTIVE #3: Increase Public Safety

Actions	
Repair the stone retaining wall behind town hall	**7**
Reduce risk of electricity outages by working with utilities to do enhanced tree trimming, especially along Rt. 7, and encourage underground lines in new development	**2**
Address lack of EMT coverage during daytime business hours (volunteer EMTs working)	**6**
Remove debris along town brook to reduce local flooding; search for grant funding to do this	**2**
Address sedimentation in wetlands and at lake to restore flood storage capacity	**1**
Investigate extending sewer to those neighborhoods around Ponstoosuc Lake that don't have it	**3**
Facilitate senior housing through zoning to allow senior-specific group housing or modified apartments	**2**

LANESBOROUGH HAZARD MITIGATION PLAN UPDATE

Existing Action Plan with Action Status

OBJECTIVE #1: Reduce the risk of flood damage.

Actions	Actions Taken since Plan adoption 2009
Secure funds for design and construction of a permanent solution to Putnam Road crossing	*Completed; new bridge constructed w/ FEMA funds*
Advocate for the repair of the Miner Road bridge	*Completed*
Pursue commencement of Narragansett Rd project	*Scheduled in TIP for FY 16 construction*
Continue to pursue stormwater management controls in new and redevelopment projects, including Low Impact Development techniques	
Consider storm drain improvements in all road repair and construction projects to reduce the volume of stormwater discharges to local waterways	*Ongoing – installation of sump catch basins now standard; recently installed at lake roads and Putnam and Meadow roads to reduce flooding and ice buildup*
Insure the integrity of large beaver dams or breach them in a controlled manner	
Continue to employ beaver controls where necessary	*Installed "beaver deceiver" flow device at Swamp Road; contractor cleans out as needed*
Pursue right-of-way easements along chronic washout sites along Kessler Road	
Work with Friends of Pontoosuc to continue to identify and mitigate stormwater inputs into the lake	*Town allocates funds and staff to maintain 3 stormwater BMPs upslope of the lake*
Investigate and mitigate stormwater runoff into Pontoosuc Lake in the "Indian Streets" section along Narragansett Avenue	*Town unsuccessfully sought funds at Annual Town Meeting 2015 to begin this work; some work conducted using Chapter 90 funds*
Hold a workshop for residents within the floodplain area and public officials to update them on the NFIP program and possible flood mitigation techniques	
Notify all floodplain property owners about NFIP program and floodproofing options	
Request verification and updating of FIRM maps for the Pontoosuc Lake area	
Continue to support the building inspector and the Conservation Commission in their protection of floodplain and wetlands resource areas	*Ongoing; Commission members attend ongoing training sessions*

OBJECTIVE #2: Secure public drinking water supplies.

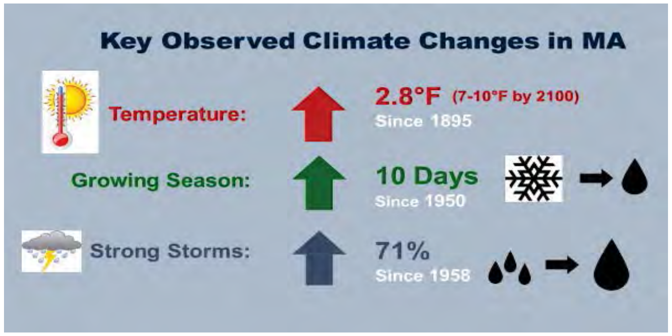
Actions	Actions Taken since Plan adoption 2009
Continue to strictly enforce the Water Supply Protection District bylaw	*Ongoing*
Pursue additional drinking water source and construction of a new water storage tank	*Installed new 750,000 tank in 2011 with USDA grant and long term loan; additional well site identified but funding not found*
Develop a response and spill control plan for the Rt 7 corridor and follow this up by conducting training exercises	
Consider enacting a Water Supply Protection District for the Berkshire Village Cooperative aquifer	
Develop wellhead protection plans, including stormwater management and hazardous spill containment, within Zone II areas of public drinking water wells	

OBJECTIVE #3: Increase emergency preparedness.

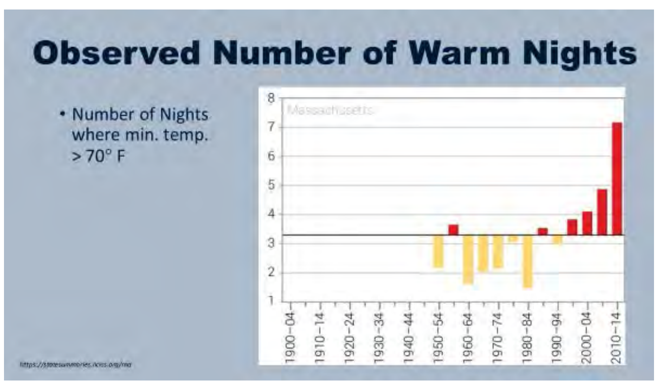
Actions	Actions Taken since Plan adoption 2009
Provide workshops to help local businesses to develop disaster mitigation plans for their facilities	
Secure adequate sheltering • Consider retrofitting the elementary school with showers • Wire the police station to more readily allow portable generator hookup • Secure a formal agreement with Berkshire Mall for its use as a mass care shelter • Consider designing the new Community/Senior Center so that it can serve as a shelter, e.g. with power backup and showers • Locate and store shelter equipment, such as cots and blankets	*. Shelter plans w/ Pittsfield secured* *. Police station wired and generator ready* *. Land purchased for Senior Center* *. Central region shelter equip. purchased and stored*
Educate residents about disaster response • Conduct local disaster response drills at the school and feature them in local news • Provide evacuation and sheltering information to residents in the floodplain • Provide residents outside the hazard areas with information on how to equip their homes for "on-site" sheltering	*MEMA video on homeowner preparedness shown periodically on public access TV; focuses on shelter-in-place*
Encourage owners and managers of special needs facilities to share information about their clients and their facilities to local first responders	*Improved; Communications between town first responders and special needs group housing agency improved; plans for all new housing now shared w/ town first responders*
Pursue funding for the hiring of a full-time EMT / Firefighter position	*Funding pursued but not successful*
Work with the CBREPC and other emergency organizations to increase the opportunities for local volunteers to attend NIMS and other trainings	*Ongoing; town first responders receive NIMS and other trainings*
Sign the Berkshire Mutual Aid Addendum	*Completed*
	Retrofitted vehicle to serve as mobile emergency command center

CLIMATE CHANGE OBSERVATIONS

The Basics for the Berkshires

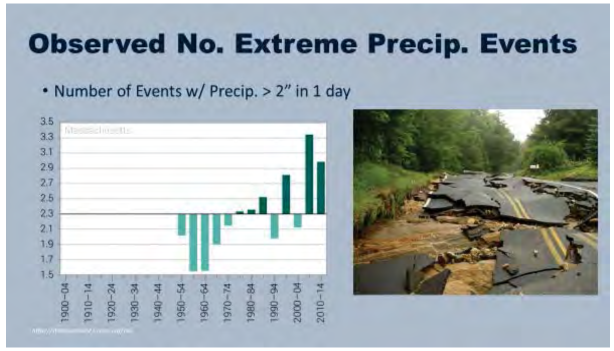


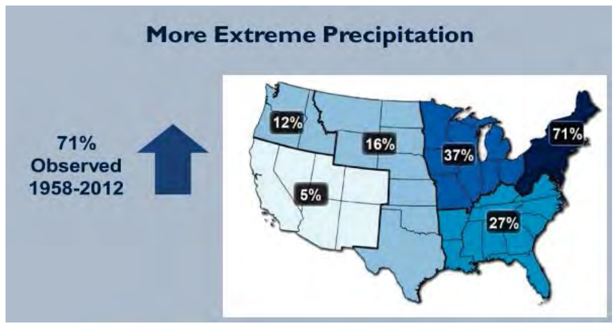
- **Warmer Temperatures** –
  - More evaporation, less soil moisture, increased risk for fire, drought, human health risks (particularly for elderly, other vulnerable pops.)
  - Greater temp. increases in winter
    - Less snow, but still cycles of freezing temperatures = infrastructure vulnerability
    - Rain-on-Snow = more overland winter flooding, ice jams
  - Increased temps. = increased heat stress for people, livestock, wildlife
  - Great evening temps. = inability for people and homes to cool down and “catch up” to normal temps.
  - Increased risk of thunderstorms and other severe rain events
  - New and expanding pests: ticks, mosquitos, forest and crops
  - Increased growing season
    - Pros: new farming opportunities
    - Cons: increased allergen season and increased potency



Precipitation Trends

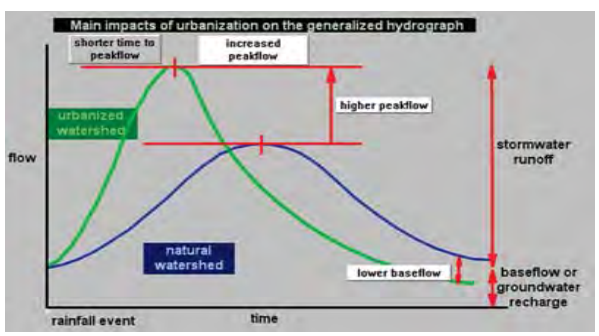
- **Increase in Extreme Rain Events** = increased risks and damages to municipal infrastructure
- **Engineering Standards** -- engineers now directed to use new data sets that include post-1970s precipitation data





Development = Altered Flows

Greater surface runoff leads to accelerated and higher peak stream and river flows = more severe flooding



Reconsider Floodplain Development

Berkshire County floodplain maps are from the 1980s

- **Urban Infill Example**
  new residential building on corner lot, outside of 100-yr floodplain

- **New FEMA floodplain Study**
  new building now inside floodplain recharge

- **Same building**
  March 2010 flood (approx. 40-year flood)

A Last Thought

Pity the Snowshoe Hare
December 2012

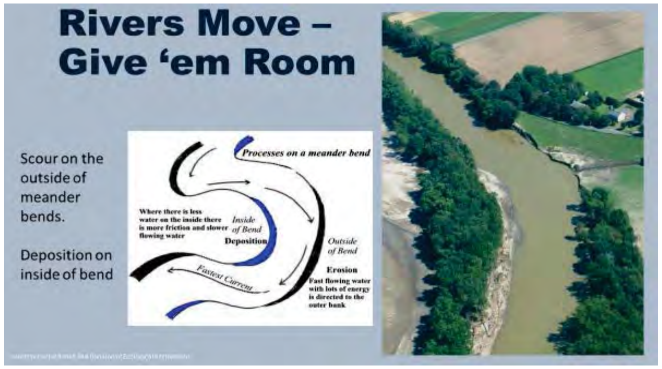
Its instinct is to sit still when danger approaches, thinking it blends in with its surroundings .

Centuries ago, even decades ago, there would likely be some snow cover to provide camouflage for this species.

Humans have the ability to adapt, unlike our hare.

OPPORTUNITIES TO REDUCE RISK

Water Movement



Above: Housatonic River at New Lenox Rd, Lenox

Right:

Sediment deposition dur to flood waters in floodplain area

Potential Mitigation Action

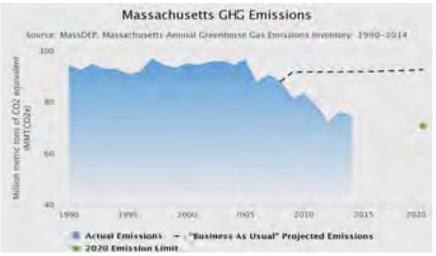
- **Protect and Restore Natural "Green Infrastructure"** –
  - Maintain or restore floodplain functions
- **Structural Protections & Improvements** –
  - Stabilize roads
  - Improve stream and river crossings; prioritize highest risks
  - Elevate structures above flood level
  - Monitor and maintain dams
- **Guide Future Development –**
  - Strictly enforce floodplain bylaws
  - Revisit zoning – does the town:
    - *Require that stormwater runoff be retained on site*
    - *Encourage Low Impact Development techniques*
    - *Restrict development on steep slopes*
- **Incorporate New Data for Mitigation, Resilience, Adaptation–**
  - Incorporate new floodplain data and boundaries when available
  - Monitor data and climate change projections

Why Focus on Flood Risks?

- **Flood events and recurrence intervals calculated (even if they need to be adjusted)**
- **Floodplain boundaries delineated (even if they need to be adjusted)**
- **Benefits of keeping development out of floodplains well documented**
- **Predicting large storm events and warning times are fairly reliable**
- **Mitigation techniques are feasible and benefits tangible**

MA Energy Reduction

MA GHG Emissions dropped 21% while Gross State Product increased 70% in same time period



Reduce Runoff from New Development

- **Minimize disturbance of natural vegetation and soils**
  - Maintain natural tree and shrub cover
- **Reduce the amount of hard, impervious surface areas**
  - Pervious pavers
- **Capture runoff that is generated by homes, driveways, patios**
  - Retention basins, rain gardens

A mature deciduous tree intercepts 500-2,000 gal. of water per year.

A mature evergreen intercepts up to 4,000 gal/yr.

Bridges and Culvert Improvements

Bronson Brook, Worthington

Left:

- *Box culvert washed out in 2003, closing road to all traffic.*
- *Had a history of clogging with debris.*

Left:

- *Post-T.S. Irene*
- *Channel-spanning tree was mobilized above this bridge, but passed through this upgraded design.*
- *Road remained open and passable.*

TROPICAL STORM IRENE: an inland storm of reference for the Berkshires

The Basics

- Tropical Storm (39-73 mph) hit the Berkshires August 28-29
- Eye of the storm travels over Berkshires approx. winds of ~50 mph
- "Catastrophic floods" in NYS and New England, with rain totals of 5"-10" in Western Mass., 7"-10"+ in VT and NYS; this rain fell on already saturated soils from previous rainstorm events
- Devastating flash flooding across mountain valleys ranking second worst in history; entire villages in Catskills uninhabitable and VT residents stranded for days by washed out bridges and roads; 500,000+ MA residents without electricity
- 6 out of 8 stream gages in Deerfield & Hoosic Rivers reach highest peaks of record
- Calculated as >100-year but <500-year flood in Hoosic River
- 50-year storm (2% chance flood event) in central Berkshire County
- Roads washed out, bridges damaged or washed out across many towns in Berkshire County; Rt. 2 is closed for 3 ½ months for repairs
- Dubbed the "costliest Category 1 storm" ($15.8 billion in damages)
- Fed. Disaster DR 4028: FEMA $5.6 million to households, $30 million for public assistance
- Fed. Highways: $46 million for roads and bridges, cost $23 million o repair 6 miles of Rt 2

Rain Totals

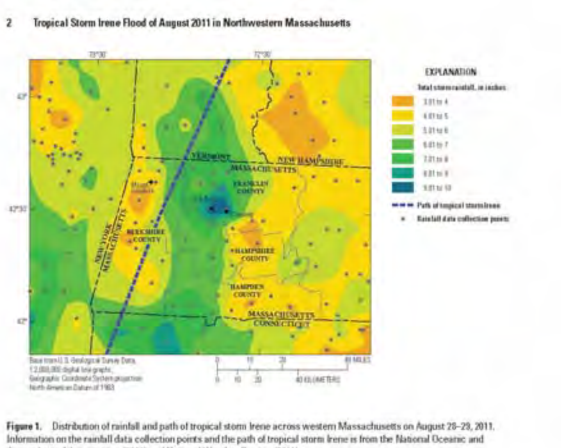
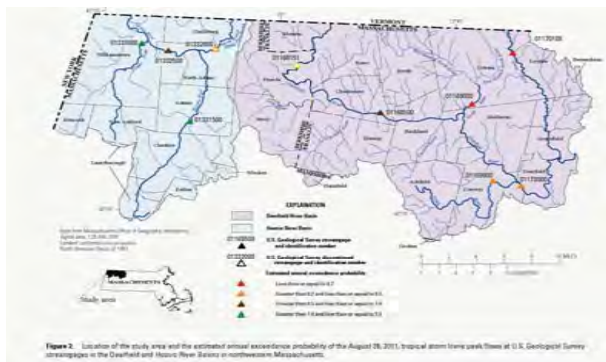


Figure 1. Distribution of rainfall and path of tropical storm Irene across western Massachusetts on August 28–29, 2011. Information on the rainfall data collection points and the path of tropical storm Irene is from the National Oceanic and Atmospheric Administration (2011) and National Weather Service (2011).

Raging Rivers and Streams

T.S. Irene estimated to be near or more than the 100-yr storm along the Hoosic River



Shelburne Falls

Deerfield River in Shelburne Falls flowed at 30,000 cubic feet per second – 40 times normal flow

Left – Bridge of Flowers during storm and under normal conditions.

Below – Bridge Street bridge – critical link to town

The Spruces, Williamstown

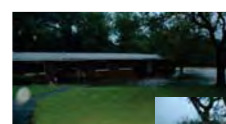
- Building and health inspectors declare 75% of homes uninhabitable
- If >50% of home value is damaged, current building codes must be met
- If FEMA funds used to repair or replace homes it must be elevated 6'–10' above floodplain elevation + additional 2' clearance; this requires that some homes to be placed 12' above ground level
- Residents in all 225 mobile home units permanently displaced

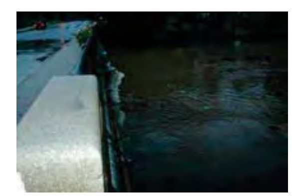
Route 2 and Green River Dam

Left: Historic covered bridge in Greenfield damaged by dam failure upstream

Right, below: Rt. 2 road collapse and landslide along Cold River in Florida & Charlemont

Dalton – 50-year storm





Evacuations at Pomeroy Manor and risks to water, sewer, gas lines on Main St Bridge

APPENDIX D

Certificate of Adoption

CERTIFICATE OF ADOPTION

TOWN OF LANESBOROUGH, MASSACHUSETTS

A RESOLUTION ADOPTING THE

TOWN OF LANESBOROUGH MULTI- HAZARD MITIGATION PLAN

WHEREAS, the Town of Lanesborough authorized the Lanesborough Emergency Management Committee to prepare the *Town of Lanesborough Multi-Hazard Mitigation Plan*; and

WHEREAS, the *Town of Lanesborough Multi-Hazard Mitigation Plan* contains several potential future projects to mitigate potential impacts from natural hazards in Lanesborough, and

WHEREAS, a duly-noticed public meeting was held by the Lanesborough Board of Selectmen on March 25, 2019, and

WHEREAS, the Lanesborough Board of Selectmen authorizes responsible departments and/or agencies to executes their responsibilities demonstrated in the plan, and

NOW, THEREFORE BE IT RESOLVED that the Lanesborough Board of Selectmen adopts the *Town of Lanesborough Multi-Hazard Mitigation Plan*, in accordance with M.G.L. c. 40.

ADOPTED AND SIGNED this 25th day of March, 2019.

John W. Goerlach, Chairman
Lanesborough Board of Selectmen

ATTEST: ______________