Westminster, Massachusetts

Hazard Mitigation Plan

June 2021

BETA
315 Norwood Park South
2nd Floor
Norwood, Massachusetts 02062
781.255.1982
www.BETA-Inc.com

Hazard Mitigation Plan

Westminster, Massachusetts

Prepared by: BETA GROUP, INC.
Prepared for: Town of Westminster

June 2021

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

1.0 Introduction

1.1 Federal Disaster Mitigation Act

Congress enacted the Disaster Mitigation Act of 2000 (DMA 2000) on October 10, 2000. The bill was signed into law on October 30, 2002, creating Public Law 106-390. Under the law, all communities are required to have a Hazard Mitigation Plan in place to qualify for future federal mitigation funding and the plan must be updated in five-year intervals. This requirement does not affect disaster assistance funding.

The Federal Emergency Management Act (FEMA) administers hazard mitigation planning and grants programs in Massachusetts in collaboration with the Massachusetts Emergency Management Act (MEMA).

1.2 Hazard Mitigation Plan Purpose

This plan identifies natural hazards impacting the Town of Westminster, assesses the town's vulnerability to these hazards and recommends actions to mitigate the effects identified hazards may have on the town.

This Hazard Mitigation Plan has been prepared based on FEMA's "Local Mitigation Planning Handbook" (March 2013) and was designed to meet the requirements of DMA 2000. The Town of Westminster received a grant in conjunction with the Municipal Vulnerability Preparedness Program. Westminster and BETA Group, Inc. (BETA) developed this Plan to focus specifically on the local issues affecting the town.

Objectives of this plan include the following:

- Detail the planning process and identify members of the local Hazard Mitigation Planning Team
- Create hazard profiles for each hazard with a description and prioritization
- Prepare an inventory of critical facilities
- Complete a risk assessment for each specified hazard and estimate potential losses
- Identify existing hazard mitigation measures already in place
- Develop proposed mitigation actions and strategies based on risk assessment
- Prepare an implementation schedule with procedures ensuring the plans implementation, updating, and revision every five years
- Detail the process where Westminster formally adopts the plan

Implementation of this plan prior to a major disaster occurring can help reduce property damage, loss of life, and interruption of critical services. In addition, adoption of this plan allows funding through FEMA for additional mitigation funding.

2.0 Planning Process

2.1 Local Hazard Mitigation Planning Team

A local hazard mitigation team of town employees with assistance from BETA Group, Inc. was created to develop the Hazard Mitigation Plan.

The planning team consists of the following members:

Table 2-1: Hazard Mitigation Planning Team

Member Name	Affiliation
Kyle Butterfield	Fire Chief
Joshua Hall	DPW Director
Pat Haley	Assistant DPW Director

The planning team brings together people with varying backgrounds, expertise, and experience in hazards affecting the residents and businesses of Westminster. Each member brings an important viewpoint to the planning process and interest to ensure the plan is implemented and reflects the needs of the town.

The planning team met on the following dates: March 13, 2020 & March 16, 2021.

2.2 Planning Process Summary

The purpose of the meetings was to introduce the planning team, gather information on local hazard issues and sites, and identify vulnerable populations and areas for each associated hazard. Later meetings focused on discussion of existing mitigation practices and developing new mitigation actions or measures.

In general, the following steps were taken during the planning process.

1. Identify potential hazards that could affect Westminster;
2. Inventory critical facilities in town;
3. Map hazards and determine potential high hazard locations;
4. Conduct a vulnerability assessment of infrastructure;
5. Identify populations most vulnerable to specified hazards;
6. Outline existing hazard mitigation measures in place; and
7. Propose and evaluate feasibility of new hazard mitigation measures.

Some of this information was also gathered during the Community Resilience Building Workshop, held on March 16, 2021. Members of the community collaborated and informed BETA of many recent town hazards, critical facilities and more. Information and recommendations from previous studies completed by the town were also reviewed and incorporated into the Hazard Mitigation Plan. Information included in the Municipal Vulnerability Preparedness Program were included in Proposed Mitigation Actions in **Section 10**.

The Westminster Planning Board is the primary town agency responsible for regulating development in the town. Participation by the Town Planner on the Hazard Mitigation Planning Team ensured feedback to the Planning Board.

2.3 Public Participation

A Public Listening Session was hosted on April 20th, 2021. Input received from the Public Listening Session is included in the Risk Assessment portion of this plan. A copy of the plan has been posted on the Town's website with language inviting comments through July of 2021. Any input will be included as an appendix to the plan.

A copy of the plan was sent to the Town of Gardner and the City of Fitchburg for review and comment.

3.0 Municipal Vulnerability Preparedness

Westminster received a municipal vulnerability preparedness planning grant from the Executive Office of Energy and Environmental Affairs to conduct a community resilience building workshop and complete a report documenting workshop findings. Findings from the workshop were incorporated by the Hazard Mitigation Planning Team into this plan.

3.1 Community Resilience Building Workshop

16 participants from various departments and boards attended a six-hour workshop session on March 16, 2021 to identify resiliency opportunities that addressed town vulnerabilities identified as part of the workshop. A list of participants and their corresponding departments is shown in **Table 3-1** below.

Table 3-1: Workshop Participants

Name	Affiliation
Joshua Hall	DPW Director
Patrick Haley	Assistant DPW Director
Kyle Butterfield	Fire Chief
Robert Francis	Local Business Owner, Resident and Private Dam Owner
Jon Wyman	Chair of Planning Board
Mark Hawke	Town Administrator
ML Altobelli	Agricultural Committee
Ann Loree	Health Agent
John Deline	Deputy Commissioner of Water Supply (Fitchburg)
Ralph LeBlanc	Chief of Police
Stephanie Lahtinen	Assistant to Town Administrator
Ned LaFortune	Local Business Owner and Resident
Lee Pelletier	Wyman Lake Association
Stephen Wallace	Town Planner
Andy Dennehy	BETA Group Inc
Mary Beth Cops	BETA Group Inc
Katelyn Burke	BETA Group Inc

Attendees were divided into two small working groups. In these groups, they identified the top four hazards facing Westminster; vulnerable infrastructure, societal and environmental assets in the community; and developed a list of actions to mitigate impacts of hazards on vulnerable assets. The small groups then reported their top actions to the large group for discussion and consensus on the top overall actions. Overall priority actions determined in the workshop were:

- Drought Public Outreach
- Culvert Study/ Upsizing as appropriate
- Bridge Study/ Rehabilitation or replacing as appropriate
- Tree Management Program
- Protection of Communication System at Safety Complex
- Hydrological Study of Rivers, streams, lakes and ponds
- Generator @ priority buildings (Esp DPW, senior center)

- Planning With national Grid to discuss backup/rerouting capabilities in event of Power outage
- Outreach/Education for water Conservation
- Look into Beaver/Tick/Mosquito control and prevention – Natural resources program
- Investigate best monitoring/ enforcement for water usage during restricted periods and leak identification.

These actions are included in **Table 10-1** and a report documenting workshop findings was submitted to the Executive Office of Energy and Environmental Affairs.

4.0 COMMUNITY PROFILE

4.1 GEOGRAPHY

The Town of Westminster, Massachusetts is located in Worcester County, 40 miles northwest of Boston and 12 miles north of Worcester. It is bordered by Ashburnham to the north, Fitchburg to the east, Hubbardston to the southwest, Princeton to the southeast, and Gardner to the west. The town encompasses 37 square miles, of which 1.8 square miles is water.

Westminster is part of a higher altitude region with a few elevated regions, including part of Mt. Wachusett. Westminster has multiple bodies of water, including several reservoirs, and rivers within the community. Larger bodies of water within the town include Meetinghouse Pond, Wyman Pond, Round Meadow Pond, Crocker Pond, Muddy Pond, Greenwood Pond, Partridge Pond, Upper Reservoir, Minott Pond, and Noyes Pond. Major rivers include the Whitman River, Phillips Brook, Wymans Brook, and Flag Brook.

4.2 CLIMATE

Westminster averages 48 inches of rain each year and an average of 69 inches per snow. Average temperatures range from highs in the high 70's (°F) in the summer months to lows in the low teens (°F) in the winter months[1].

4.3 DEMOGRAPHICS

The town's population has grown from 6,904 in the 2000 US Census to 7,277 in the 2010 US Census and estimated to be 7,997 in 2019. Current population density is approximately 205.4 people per square mile. Based on 2010 US Census information, Westminster is a largely white community, with 95.9% identifying as such. Hispanic or Latinos is the largest minority group at 3.4%. Average household size is 2.71 people with 34.7% of households with children under 18 years of age. The median age is 34 years with 10.4% of the population over the age of 65 and 27.5% of the population under the age of 18[2].

4.4 INFRASTRUCTURE

Westminster has approximately 8.6 miles of state roads, and 41.6 miles of local roadways[3]. The Town is accessible via Route 2, and Route 2A, which run in a general east-west direction Route 140, Route 31, and Route 12 which run in a general north-south direction

The Westminster Council on Aging provides bus service Monday- Friday for $2 round trip within Westminster and for $3 out of Town limits; pick up service is for senior citizens and disabled individuals.

---

[1] Best Places to Live https://www.bestplaces.net/climate/zip-code/massachusetts/north_attleboro/02760
[2] US Census https://factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml
[3] MassGIS

The Westminster Department of Public Works (WDPW) is a community water supply that receives 100% of its water supply from the City of Fitchburg. Accordingly, the WDPW is classified as a consecutive water system. Westminster's source of finished water is obtained from the City of Fitchburg's Regional Filtration Plant located at 18 Hager Park Road in Westminster. The raw water for the filtration plant comes from Meetinghouse Pond (a terminal reservoir), is filtered, disinfected, fluoridated, and pH adjusted for corrosion control. This treated water flows from the filtration plants clearwells into a 2 MG buried storage tank that is also located at Hager Park. Water supply flows via gravity from here though a transmission main into the City of Fitchburg.

Westminster receives gas from Unitil Gas Utilities and electric service is provided by Fitchburg Electric Department. Communications services are provided by Verizon and Comcast.

4.5 Historic Properties

The National Register of Historic Places lists historic places and areas worthy of preservation is part of a program to coordinate and support private and public efforts to identify, evaluate and protect America's historic and archaeological resources. The following areas in Westminster are listed in the Register of Historic Places for Massachusetts:

- Westminster Village – Academy Hill Historic District
- Ahijah Wood House
- Ezra Wood-Levi Warner Place
- Nathan Wood House

5.0 Critical Infrastructure

The planning team identified numerous building, structures, or locations that are vital to hazard response efforts or would create a secondary disaster if a hazard were to impact it. Critical facilities were identified using local knowledge and expertise from the planning team in combination with MassGIS data. These facilities are listed in **Table 5-1** below and shown in the map in **Appendix B.**

Critical facilities were divided into the following categories:

- Emergency Response Facilities
- Essential, Non-Emergency Response Facilities
- Dams
- Facilities to Protect
- Schools/Daycares
- Historic Districts

Table 5-1: Critical Facilities

Critical Facility	Address	Facility Type
Emergency Response Facilities		
Westminster Police Station	7 South Street	Police Station
Westminster Fire Station	7 South Street	Fire Station
Westminster DPW	2 Oakmont Avenue	Department of Public Works
Meetinghouse School	8 South Street	School/ Emergency Shelter
Oakmont Regional High School	9 Oakmont Drive	School/ Emergency Shelter
Overlook Middle School	10 Oakmont Drive	School/ Emergency Shelter
Westminster Elementary School (Primary)	9 Academy Hill Road	School/ Emergency Shelter

Westminster Senior Center	69 West Main Street	Town Facility/ Emergency Shelter
Westminster Public Safety Building	7 South Street	Town Facility
Westminster Communications Building/Equipment	18 Ellis Road	Town Facility
Essential, Non-Emergency Response Facilities		
Meetinghouse Pond Gate Valve	W. Princeton Road	
Old Mill Restaurant	69 State Road East	Restaurant
Vincent's Grocery Store	Main St	Grocery Store
Advance Coatings Company	42 Depot Road	
Fitchburg Gas & Elec. LNG Facility	122 State Road West	
Fitchburg/Westminster Sanitary Landfill	Fitchburg Road	
Guilford Rail Bridge #1	Rail Line & State Road East	
Guilford Rail Bridge #2	Rail Line & Oakmont Avenue	
Guilford Rail Bridge #3	Rail Line & Swamp	
ITW (Illinois Tool Works, Inc.)	180 State Road East	
MassDOT Maintenance Depot	400 Simplex Drive	
MBTA Wachusett Station Layover Facility	Theodore Drive	
NS AJO Holdings, Inc.	Turnpike Rd/20 Authority Drive	
Ranor Incorporated	1 Bella Drive	
Tyco Simplex Grinnell	50 Technology Drive	
Unitil Gas Valve	State Road East	
Verizon	18 Elliott Street	
Wachusett Animal Hospital and Pet Retreat	29 Theodore Drive	
Wachusett Brewing Company	175 State Road East	
Wachusett Mountain Ski Area	Wachusett Mountain Ski Area	
Walmart Warehouse	95 Aubuchon Drive	
Westminster Pharmacy	Main Street	
Westminster Water Pumping Station	18 Hager Park Road	Water Supply
Regional Water Treatment Facility	18 Hager Park Road	Water Supply
Fitchburg Water Building	Narrows Road	Water Supply
Westminster Water Pumping Station	South Street	Water Supply
Ellis Road Water Tank	18 Ellis Road	Water Supply
Shady Ave Water Tank	Goodridge Drive	Water Supply
Kendall Court Pumping Station	Kendall Court	Water Supply
Ellis Road Sewer Pumping Station	Ellis Road	Sewer System
Frog Hollow Road Sewer Pumping Station	Frog Hollow Road	Sewer System
Whitman River Sewer Pumping Station	State Road East	Sewer System
Whitman River in-line Sewer Storage	State Road East	Sewer System
Narrows Road Sewer Pumping Station	Narrows Road	Sewer System
Val Road Sewer Pumping Station	Val Road	Sewer System
Wachusett Road Sewer Pumping Station	Wachusett Road	Sewer System

Mile Hill Road Sewer Pumping Station	Mile Hill Road	Sewer System
Westminster Town Hall	11 South Street	Town Facility
Forbush Memorial Library	118 Main Street	Town Facility
National Grid	1 State Road West	Electric Substation
National Grid	Depot Road	Electric Substation
Pinetree Power Fitchburg, Inc.	170 Fitchburg Road	Power Supply
Crocker Pond Hydro-electric	South Ashburnham Road	Power Supply
RCI	101 Fitchburg Road	Power Supply
Solar Panels, Aubuchon Hardware	100 Simplex Drive	Power Supply
Dams		
Holmes Park Pond Dam	Miles Street	Dam
Upper Reservoir Dam	Whitney Street	Dam
Smith Pond Dam	Worcester Road/Patricia Road	Dam
Wyman Pond Compensating Reservoir Dam	Narrows Road	Dam
Meetinghouse Pond Dam (Fitchburg)	W. Princeton Road	Dam
Wachusett Reservoir Dam (Fitchburg)	Park Road	Dam
Burnt Mill Pond Dam (Private)	Btwn. Rt 2A and Ellis Road	Dam
Crocker Pond Dam (Private)	S. Ashburnham Road	Dam
Ellis Pond Dam (Private)	Ellis Road	Dam
Minott Pond Dam (Private)	Minott Road	Dam
Narrows Mill Pond Dam (Private)	Depot Road	Dam
Noyes Pond Dam (Private)	Lanes Road/Davis Road	Dam
Pierce Pond Dam (Private)	Shady Avenue	Dam
Rice Meadow Fly Pond Dam (Private)	Notown Road	Dam
Round Meadow Pond Dam (Private)	Merriam Road	Dam
Storage Pond Dam (Private)	Simplex Drive	Dam
Westminster Reservoir Dam (Private)	S. Ashburnham Road	Dam
Crocker Fish Pond Dam (State)	Fitchburg Road	Dam
Crow Hills Pond Dam (State)	Fitchburg Road	Dam
Upper Crow Hills Pond Dam (State)	Fitchburg Road	Dam
Facilities to Protect		
The Wellington House	5 Meeting House Road	Assisted Living
Senior Housing (being developed)	Community Way	Senior Housing
Daniel Irving Medical Practice	South Street	Medical Facility
On-Site Academy	219 Bragg Hill Road	Medical Facility
Recovery Centers of America	9 Village Inn Road	Medical Facility
Westminster Family Practice	116 Main Street	Medical Facility
Sawyer Miller-Masciarelli Funeral Home	123 Main Street	End of Life Facility
Cemetery Department	Narrows Road	Town Facility
Mount Pleasant Cemetery	Ellis Road	Cemetery
Whitmanville Cemetery	South Ashburnham Road	Cemetery
Woodside Cemetery	Narrows Road	Cemetery
100 Simplex Drive Building	100 Simplex Drive	Freight/HAZMAT
Advance Coatings Company	42 Depot Road	Freight/HAZMAT
Cumberland Farms Gas Station	68 Main Street	Freight/HAZMAT
DS Smith Packaging	100 Simplex Drive	Freight/HAZMAT
Fitchburg Gas & Elec. Lng Facility	122 State Road West	Freight/HAZMAT

Fitchburg Welding Co., Inc.	4 Depot Road	Freight/HAZMAT
ITW (Illinois Tool Works, Inc.)	180 State Road East	Freight/HAZMAT
JP Metal Finishing	1 Leominster St	Freight/HAZMAT
MassDOT	400 Simplex Drive	Freight/HAZMAT
Mayhew Basque Plastics, LLC.	100 Simplex Drive	Freight/HAZMAT
Pan-American Railroad Line	Theodore Drive	Freight/HAZMAT
Pinetree Power Fitchburg, Inc.	2 Rowtier Drive	Freight/HAZMAT
Ranor Incorporated	1 Bella Drive	Freight/HAZMAT
Regional Water Treatment Facility	18 Hager Park Road	Freight/HAZMAT
Pan-American Railroad Line	Theodore Drive	Freight/HAZMAT
Pinetree Power Fitchburg, Inc.	2 Rowtier Drive	Freight/HAZMAT
Ranor Incorporated	1 Bella Drive	Freight/HAZMAT
Regional Water Treatment Facility	18 Hager Park Road	Freight/HAZMAT
Seaboard Folding Box Co., Inc.	100 Simplex Drive	Freight/HAZMAT
VERC Enterprises (Gas Station)	21 Village Inn Road	Freight/HAZMAT
Verizon	18 Elliott Street	Freight/HAZMAT
Wachusett Brewing Company	175 State Road East	Freight/HAZMAT
Wachusett Mountain Ski Area	Wachusett Mountain Ski Area	Freight/HAZMAT
Walmart Warehouse	95 Aubuchon Drive	Freight/HAZMAT
Westminster Depot	4 Theodore Drive	Freight/HAZMAT
Westminster Landfill	Fitchburg Road	Freight/HAZMAT
Schools/Daycares		
Appleseed Academy of Child Development	138 Main Street	Child Care
Neighborhood Family Child Care	319 Knower Rod	Child Care
Karen Bourgeois	20 Kurikka Place	Child Care
Hannelore Brown	28 Colony Road	Child Care
Jennifer B. Condon	74 Carter Road	Child Care
Deborah Davis	114 Ellis Road	Child Care
Gretchen B. Faford	134 State Road West	Child Care
Vivien Forbes	201 Ellis Road	Child Care
Nancy Jean Gaudet	12 Whitney Street	Child Care
Victoria Kimber	18 Fenno Drive	Child Care
Jennifer M Konich	62 Knower Road	Child Care
Amanda Palmer-Rosado	319 Knower Road	Child Care
CAPS Collaborative	2 Narrows Rd. Suite 105	School
Meetinghouse School	8 South Street	School
Montachusett Regional Vocational Technical School	Westminster Street	School
Oakmont Regional High School	9 Oakmont Drive	School
Overlook Middle School	10 Oakmont Drive	School
Westminster Elementary School	9 Academy Hill Road	School
CAPS Collaborative	2 Narrows Rd. Suite 105	School
Historic Districts		
Westminster Village-Academy Hill Historic District	Bacon, Adams, Main, Dawley, Academy Hill, Leominster, and Pleasant Sts.	Historic District
Ahijah Wood House	174 Worcester Rd.	Historic Building
Ezra Wood-Levi Warner Place	165 Depot Rd.	Historic Building
Nathan Wood House	164 Depot Rd.	Historic Building

6.0 Risk Assessment

The risk assessment includes a summary of natural hazards that could occur within the Town of Westminster. This section also includes a vulnerability assessment that analyzes the potential damage that could result from hazard events.

BETA compiled the most recently available hazard data and met with the planning team to complete the risk assessment.

6.1 Overview of Hazards and Impacts

All natural hazards have the potential to cause property damage and loss of human life, as well as limit access to essential services in a community, including potable water, wastewater collection, and electrical power.

Westminster identified a number of natural hazards that have occurred or could occur in town and analyzed the hazard risk for each. Analysis included determining the likely frequency, severity, and area of impact for each hazard.

The methodology used to classify each category was based on the following criteria:

Table 6-1: Hazard Classification Index

Classification	Description
Frequency	
Very Low	Events that occur less often than once in 100 years
Low	Events that occur from once in 50 years to once in 100 years
Medium	Events that occur from once in 5 years to once in 50 years
High	Events that occur more frequently that once in 5 years
Severity	
Minor	Limited and scattered property damage, limited damage to public infrastructure and essential services not interrupted, limited injuries or fatalities.
Serious	Scattered major property damage, some minor infrastructure damage, essential services are briefly interrupted, some injuries and/or fatalities
Extensive	Widespread major property damage, major public infrastructure damage (up to several days for repairs), essential services are interrupted from several hours to several days, many injuries and/or fatalities.
Area of Impact	
Negligible	Less than 10% of town impacted or single-point occurrence
Limited	10% - 25% of town impacted or limited single-point occurrences
Significant	25% - 75% of town impacted or frequent single-point occurrences
Extensive	75% - 100% of town impacted or consistent single point occurrences

Based on the town's ranking of each category, an overall risk assessment for each hazard was determined and is discussed in **Section 6.0**. **Table 6-2** below summarizes the hazard risks for Westminster.

Table 6-2: Westminster's Hazard Risk Summary

Hazard	Frequency	Severity	Area of Impact

Flood	High	Minor	Limited
Dam Failure	Low	Extensive	Significant
Hurricane/Tropical Storm	High	Serious	Extensive
Nor'easter	High	Serious	Extensive
Earthquake	Low	Extensive	Significant
Landslide/Erosion	Medium	Minor	Negligible
Snow & Blizzard	High	Serious	Extensive
Ice Storm	Medium	Extensive	Extensive
Wildland Fire	Medium	Serious	Limited
Major Urban Fire	Low	Minor	Negligible
Thunderstorm	High	Serious	Extensive
High Wind	High	Minor	Significant
Tornado	Low	Serious	Limited
Drought	High	Serious	Extensive
Extreme Temperature	High	Minor	Extensive

6.2 Flood Related Hazards

Flooding was not the most prevalent natural hazard identified by local officials in Westminster. Flooding in Westminster typically occurs in isolated areas more often during the summer months when severe thunderstorm, rainstorms, and hurricanes occur in the Northeast United States. Flooding can also occur when winter snows melt, causing the rivers to overflow their banks, or when heavy wet snows backup roadside drainage systems causing flooding in low lying areas.

6.2.1 Hazard Overview

Westminster is impacted by several bodies of water including but not limited to the Whitman River, the Phillips Brook, Lake Wampanoag, Whitman Reservoir, Crocker Pond and several smaller ponds, streams, and wetland areas.

Given the topography of the Town, flooding is localized to these bodies of water and typically have minimal impact to the Town at large.

6.2.2 Significant Hazard Events

There have been a number of major events that have impacted flooding in Westminster over the last 50 years. Events include:

- September 1954 (Hurricane Edna)
- August 1955 (Hurricane Diane)
- September 1960 (Hurricane Donna)
- March 1968
- August 1991 (Hurricane Bob)
- October 1996
- June 1998
- April 2001
- October 2005
- November 2005
- March 2010
- August 2011 (Tropical Storm Irene)
- October 2012 (Hurricane Sandy)

Local data for previous flooding occurrences are not collected by Westminster. The best available data is for Worcester County through the National Climatic Data Center. Worcester County experienced 77 flood events from 2000 to 2020. No deaths or injuries were reported. Total reported property damage for flooding in Worcester County in that time frame was $11.9 million.

6.2.3 Hazard Location

No potential flood hazard areas were identified from FEMA's National Flood Hazard Layer made available by MassGIS. However, there were locations identified as flooding often during the MVP Workshop. Additionally, FEMA has an older layer called "Q3 flood zones" based on the Flood Insurance Rate Maps (FIRM),made available by MassGIS are shown on the map in **Appendix C** and flood zone definitions are listed below. The Q3 flood data were developed to support floodplain management and planning activities but do not replace the official paper FIRMs.

- **Zone A** (1% annual chance)**:** Areas that correspond to the 100-year floodplains. Detailed hydraulic analyses have not been performed in these areas and no base flood elevations (BFEs) or depths are shown.
- **Zone AE and A1-130** (1% annual chance): Areas that correspond to the 100-year floodplains are determined using detailed hydraulic analysis. BFEs are shown within these zones.
- **Zone X500** (0.2% annual chance): Areas that correspond to the 500-year floodplains that are determined by approximate methods. No BFEs or depths are shown.
- **Zone VE** (1% annual chance): Areas that correspond to the 100-year coastal floodplains and have additional hazards associated with waves 3-foot or greater in height.

A list of critical infrastructure at risk from flooding during the 100-year storm is listed in **Table 6-3**. Critical infrastructure locations in relation to FEMA floodplains are shown on the map in **Appendix D**.

Table 6-3: Critical Infrastructure in Flood Plain

Critical Infrastructure	Location	Flooding Risk	River
Whitman River Sewer Pumping Station	State Road East	100-year	Whitman River
Narrows Road Sewer Pumping Station	Narrows Road	100-year	Wyman Pond
Mile Hill Road Sewer Pumping Station	Mile Hill Road	100-year	Ten Mile River
Crocker Pond Recreation Area Well	South Ashburnham Road	100-year	Whitman River

6.2.4 Dam and Dam Failure

The Massachusetts Department of Conservation and Recreation (DCR) Office of Dam Safety is responsible for regulating dams in Massachusetts. There are over 2,900 publicly and privately owned dams in Massachusetts. To be regulated, dams must be greater than 6 feet tall and have storage capacity greater than 15 acre-feet. DCR classifies regulated dams as high, significant, or low hazard. These classifications are defined below.

DCR Dam Hazard Classification

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

Under 302 CMR 10.00 Dam Safety, low hazard dams shall be formally inspected every ten years, significant hazard dams every five years, and high hazard dams every two years.

Dam failure can occur from structural failure, independent of a hazard event, or from impacts from a hazard event. Dam failures are infrequent but can result in serious property damage and loss of life. The number of casualties and amount of property damage depends of numerous factors including, amount of warning given to downstream residents, number of people living or working in the inundation zone and the number of buildings in the inundation zone.

There are twenty dams in Westminster. Dams are shown on the map in **Appendix B** and summarized in **Table 6-4**. Hazard rating potential has no relationship to the current structural integrity, operational status, flood routing capability, or safety condition of the dam.

Table 6-4: Dams Located in Westminster

Dam Name	Impoundment	Receiving Waterbody	Owner	Hazard Potential
Burnt Mill Pond	Burnt Mill Pond	-	Private	Low
Crocker Fish Pond Dam	Crocker Fish Pond	Whitman River	State	Low
Crocker Pond Dam	Crocker Pond	Flag Brook	Private	High
Crow Hills Pond Dam	Crow Hills Pond	Flag Brook	State	Significant
Ellis Pond Dam	Partridge Pond	Burnt Mill Pond	Private	Significant
Holmes Park Pond Dam	Holmes Park Pond	-	Westminster	-
Meetinghouse Pond Dam	Meetinghouse Pond	Smith Brook	Fitchburg	Significant
Minott Pond Dam	Minott Pond	Upper Reservoir	Private	Significant
Narrows Mill Pond Dam	Narrows Mill Pond	-	Private	-
Noyes Pond Dam	Noyes Pond	-	Private	Significant
Pierce Pond Dam	Greenwood Pond	Mahoney Brook	Private	Significant
Rice Meadow Fly Pond Dam	Rice Meadow Pond	-	Private	Low
Round Meadow Pond Dam	Round Meadow Pond	-	Private	Significant
Smith Pond Dam	Smith Reservoir	Smith Brook	Westminster	-
Storage Pond Dam	Storage Pond	-	Private	-
Upper Crow Hills Pond Dam	Upper Crow Hills Pond	Crow Hills Pond	State	Significant
Upper Reservoir Dam	Upper Reservoir	Wrights Reservoir	Westminster	Significant
Wachusett Reservoir Dam	Wachusett Lake	Wyman Pond	Fitchburg	Significant
Westminster Reservoir Dam	Whitmanville Reservoir	Whitman River	Private	High
Wyman Pond Compensating Reservoir Dam	Wyman Pond	-	Fitchburg	High

There have not been any dam failures in Westminster, and the town regularly works with the city of Fitchburg and private dam owners to ensure inspections and maintenance schedules are up to date.

6.3 HURRICANES AND TROPICAL STORMS

6.3.1 HAZARD OVERVIEW

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

The National Hurricane Center classifies tropical cyclones into different categories based on the storm's intensity and wind speed. The weakest are tropical depressions, which are organized systems of clouds and thunderstorms with a defined surface circulation and sustained winds of 25-33 mph. A tropical storm is a named event which has sustained winds of 34-73 mph.

If sustained winds reach 74 mph or greater, the storm becomes a hurricane. The Saffir-Simpson scale ranks hurricanes based on sustained wind speeds—from Category 1 (74 to 95 mph) to Category 5 (156 mph or more). Category 3, 4, and 5 hurricanes are considered "major" hurricanes. Hurricanes are categorized based on sustained winds; wind gusts associated with hurricanes may exceed the sustained winds and cause more severe localized damage.

Table 6-5 shows the Saffir-Simpson Hurricane Scale which is used to organize hurricanes into their 5 different categories as well as the classifications for tropical cyclones[4].

Table 6-5: Saffir-Simpson Hurricane Scale

Saffir-Simpson Scale for Hurricane Classification			
Strength	**Wind Speed (Kts)**	**Wind Speed (mph)**	**Typical Damage**
Category 1	64- 82	74- 95	*Some damage:* Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days
Strength	**Wind Speed (Kts)**	**Wind Speed (mph)**	**Typical Damage**
Category 2	83- 95	96-110	*Extensive damage:* Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks.
Category 3	96-113	111-130	*Devastating damage:* Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes.

[4] National Hurricane Center, https://www.nhc.noaa.gov/aboutsshws.php

Category 4	114-135	131-155	*Catastrophic damage:* Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months
Category 5	>135	>155	*Catastrophic damage:* A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.
Tropical Cyclone Classification			
Tropical Depression			20-34kts
Tropical Storm			35-63kts
Hurricane			64+kts or 74+mph

6.3.2 Significant Hazard Events

According to the Northeast States Emergency Consortium (NESEC), 25 hurricanes and 14 tropical storms have impacted New England since 1900. Of the 25 hurricanes to impact New England, 9 made landfall and 7 of those were classified as a category 2 or 3.

Table 6-6 lists hurricanes that have affected the region since 1938.

Table 6-6: Hurricanes/Tropical Storms in Westminster

Hurricane/Tropical Storm Name	Date	Saffir/Simpson Category
Great New England Hurricane of 1938	September 21, 1938	Category 3
Great Atlantic Hurricane	September 14-15, 1944	Category 3
Carol	August 31, 1954	Category 3
Edna	September 11, 1954	Category 3
Diane	August 18-20, 1955	Tropical Storm
Donna	September 12, 1960	Category 2
Belle	August 9-10, 1976	Minor Storm
Gloria	September 27, 1985	Category 2
Bob	August 19, 1991	Category 2
Bertha	July 12-13, 1996	Tropical Storm
Floyd	September 18, 1999	Tropical Storm
Irene	August 28, 2011	Tropical Storm
Sandy	October 29-30, 2012	“Super Storm”
Jose	September 20, 2017	Tropical Storm

Isaias	August 4, 2020	Tropical Storm

6.3.3 Hazard Location

Because of the regional nature of hurricanes and tropical storms, all of Westminster is at risk. The town is impacted by high winds and rain of hurricanes and tropical storms, regardless of whether or not the storm tracks through the town.

Falling trees and branches from high winds are a significant problem because they can result in power outages or block traffic and emergency routes. Areas susceptible to flooding are also likely to be affected by heavy rainfall.

Based on previous occurrences, hurricanes are a considered a high frequency event in Westminster.

6.4 Nor'easter

6.4.1 Hazard Overview

A nor'easter is a storm that occurs along the East Coast of North America with winds from the northeast (NWS, n.d.). A nor'easter is characterized by a large counter-clockwise wind circulation around a low-pressure center that often results in heavy snow, high winds, and rain. A nor'easter gets its name from its continuously strong northeasterly winds blowing in from the ocean ahead of the storm and over the coastal areas. These storms occur most often in late fall and early winter. The storm radius is often as much as 100 miles, and nor'easters often sit stationary for several days, affecting multiple tide cycles and causing extended heavy precipitation. Sustained wind speeds of 20 to 40 mph are common during a nor'easter, with short-term wind speeds gusting up to 50 to 60 mph. Nor'easters are commonly accompanied with a storm surge equal to or greater than 2.0 feet.

***6.4.2** Significant Hazard Events*

Table 6-7 lists some previous nor'easters to impact Worcester County as well as a short description of the event and property damage amounts for Worcester County[5].

[5] National Centers for Environmental Information, Storm Events Database, https://www.ncdc.noaa.gov/stormevents/

Table 6-7: Nor'easter Events in Worcester County

Nor'easter Event	Description	Property Damage
Feb 1978	Snowfall totals ranged from 12 to 36 inches with snowfall rates of at least 3 inches per hour. 73 people were killed in Massachusetts and a ban on non-emergency vehicle traffic lasted for a week in eastern Massachusetts.	Unknown
Oct 1991	Winds were measures over 80 mph with waves over 30 ft along some parts of the coast. Rainfall of up to 5.5 inches fell in southeastern Massachusetts.	Unknown
Dec 1996	Very heavy snowfalls were reported from the higher terrain in the central and western part of the state. The snow was heavy and wet, causing scattered power outages, affecting up to 1,000 customers west and southwest of Boston. Very poor road conditions were reported in parts of western and central Massachusetts. Worcester had 10 inches of snow	Unknown
Feb 1998	Strong winds were felt in Worcester County, where some tree limbs were blown down causing scattered power outages. A large tree limb fell on a house.	$2,500
Apr 1998	A strong low pressure system passing over the Atlantic to the south and southeast of Cape Cod brought rain and strong winds to central and eastern MA. This nor'easter caused winds gusting to 40-50 mph and snowfall of 6-8 in. In Worcester County, a large section of an oak tree fell and damaged telephone lines and blocked a local road.	Unknown
Feb 1999	A powerful nor'easter, which passed about 200 miles southeast of Cape Cod, brought heavy snow and strong winds to the eastern third of the state. Worcester reported 10.5 in of snow	$0
April 2000	Low pressure moving across SE New England brought heavy rain to much of central and eastern MA, resulting in widespread urban flooding and minor flooding of rivers and streams. Worcester County reported 4.40 inches of rain. Phillips Brook in Leominster flooded a portion of Route 12, and a pickup truck was stranded in flood waters.	$0
June 2000	An unusual June nor'easter brought strong winds, heavy rain, and a brief period of flooding. Rainfall totals of 3-5 in were common throughout much of the state, but were more concentrated along the east slopes of the Berkshires. In Worcester, the high temperature for the day only reached 51 degrees, which broke the previous record for coolest high temperature from 1993.	$0
Feb 2006	Snowfall totals ranged between 12 and 18 inches across central and eastern Massachusetts. Strong winds brought down tree limbs and wires and visibility was reduced to less than ¼ mile at times.	$30,000
May 2005	An unusually late season and long duration nor'easter brought strong winds, heavy rainfall, and flooding. Most wind gusts were reported between 45 and 55 mph, but some gusts were estimated as high as 60 mph bringing down trees and power lines over a large area. NOAA suggested this was the worst late May winterlike nor'easter since 1967.	$10,000
Jan 2011	Thirteen to twenty-three inches of snow fell across southern Worcester County in a 24-hr period. In addition, the Automated Surface Observing System at Worcester Regional Airport (KORH) recorded a 46 mph wind gust.	$0
Mar 2011	Four to eight inches of heavy wet snow fell across northern Worcester County. Trees and wires were downed throughout Leominster as a result of the heavy snow.	$15,000
Oct 2011	Eight to twenty-two inches of snow fell across northern Worcester County. Heavy wet snow fell on foliated trees, breaking branches and downing trees and wires, resulting in widespread power outages. Downed trees and power lines resulted in the closure of Rte 67 and 148.	$80,000

6.4.3 Hazard Location

High winds that develop during nor'easters can cause damage to buildings and result in fallen trees and downed power lines. Rainfall can result in localized flooding of rivers as well as stormwater ponding from overwhelmed drainage catch basins. Flooding as well as downed trees and wires can block roadways and evacuation routes.

While nor'easters may impact the entire Commonwealth, the 78 coastal communities are especially vulnerable to the damaging impacts of nor'easters along more than 1,500 miles of varied coastline However, nor'easters can also bring heavy snow, which can paralyze inland cities or regions as well. Inland areas, especially those in floodplains, are also at risk for flooding and wind damage

The entire town of Westminster is at risk from the high wind, rain, or snow from a nor'easter. The town would not be impacted by any coastal hazards based on its inland location.

6.5 Earthquake

6.5.1 Hazard Overview

An earthquake is the vibration of the Earth's surface that follows a release of energy in the Earth's crust. These earthquakes often occur along fault boundaries. New England, experiences intraplate earthquakes because it is located deep within the interior of the North American plate. Scientists are still exploring the cause of intraplate earthquakes, and many believe these events occur along geological features that were created during ancient times and are now weaker than the surrounding areas.

The Richter scale is used to measure the magnitude of an earthquake. It expresses the seismic energy released by the earthquake by determining the size of the greatest vibration recorded. Typical effects of earthquakes of various magnitudes are summarized in **Table 6-8** below[6].

Table 6-8: Earthquake Richter Scale and Typical Effects

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

The intensity of an earthquake is measured using the Modified Mercalli Scale. This scale quantifies the effects of an earthquake on the Earth's surface, humans, objects of nature, and man-made structures. Descriptions of the levels of Modified Mercalli intensity are shown in Table 6-9.

[6] Michigan Technical University, Geological and Mining Engineering and Sciences, http://www.geo.mtu.edu/UPSeis/magnitude.html

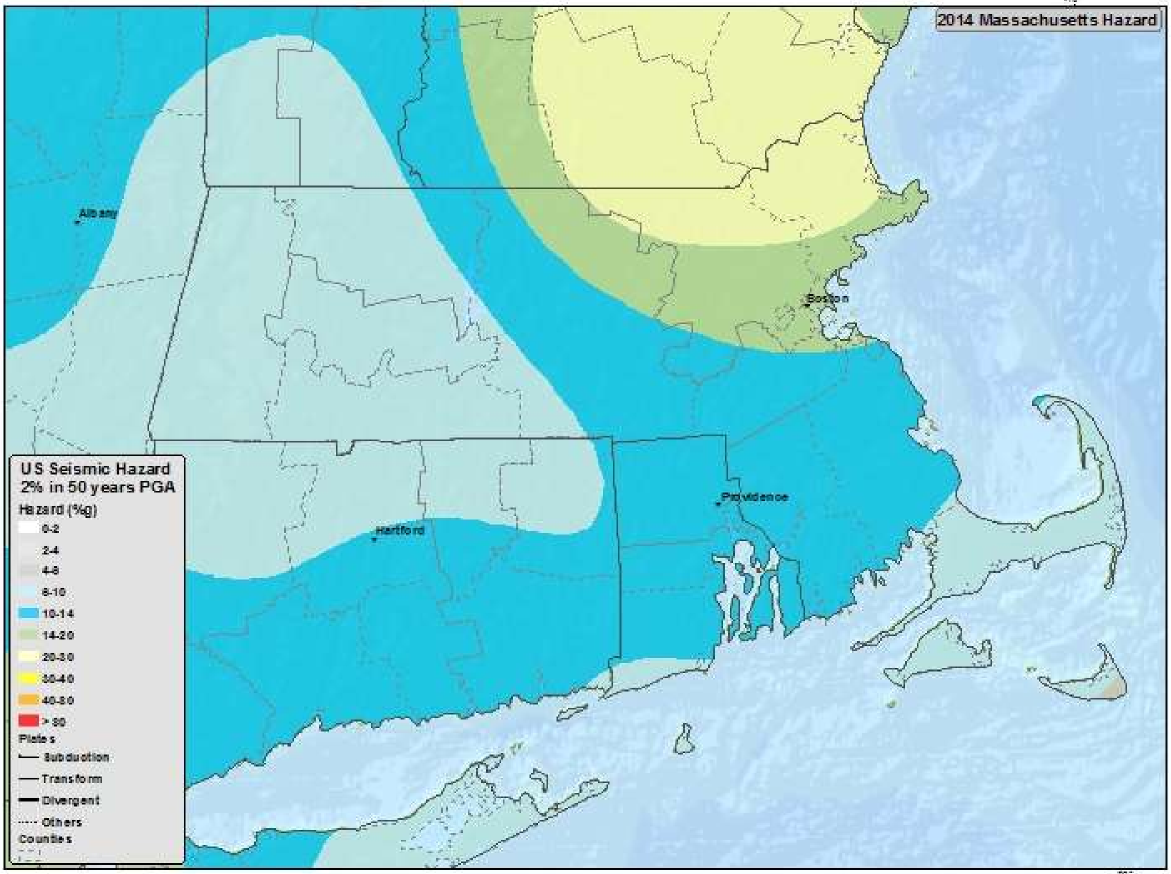
Table 6-9: Modified Mercalli Scale and Typical Effects[7]

Intensity	PGA (%)	Shaking	Description/Damage
I	<0.17	Not felt	Not felt except by a very few under especially favorable conditions.
II	0.17 – 1.4	Weak	Felt only by a few persons at rest, especially on upper floors
III	1.4 – 3.9	Weak	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
IV	3.9 – 9.2	Light	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V	9.2 – 18	Moderate	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI	18 – 34	Strong	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII	34 – 65	Very strong	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures
VIII	65 – 124	Severe	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
IX	>124	Violent	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
X	>124	Extreme	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.

Another measure of earthquake risk is peak ground acceleration (PGA) or ground motion. PGA is expressed as a percentage of gravity (%g). The range of PGA with a 2% probability of exceedance of 50 years in Massachusetts ranges from 6 %g to 30 %g. Westminster is in the middle part of the range for Massachusetts, at 14 %g to 20%g, making it a moderate area of earthquake risk within the state. Massachusetts, as a whole, is considered to have a low risk of earthquakes compared to the rest of the United States. A map showing PGA with 2% probability of exceedance in 50 years for Massachusetts is shown in **Figure 6-1.**

[7] UGSG, The Modified Mercalli Intensity Scale, https://earthquake.usgs.gov/learn/topics/mercalli.php

Figure 6-1: Massachusetts Seismic Hazard with 2% Probability of Exceedance in 50 Years[8]



6.5.2 Significant Hazard Events

According to the Massachusetts State Hazard Mitigation Plan, New England experiences an average of six earthquakes per year. From 1668 to 2016, 408 earthquakes were recorded in Massachusetts although a damaging earthquake has not occurred since 1755[9]. Damaging earthquakes have taken place historically in New England. According to the Weston Observatory Earthquake Catalog, 6,470 earthquakes have occurred in New England and adjacent areas. However, only 35 of these events were considered significant. [10]

Some of the more significant earthquakes with magnitude greater than 3.5 in the region since 1900 are shown in **Table 6-10** below.

Table 6-10: Significant Massachusetts Earthquakes[11]

Location	Date	Magnitude
Dartmouth, MA	November 8, 2020	3.6
Tiverton, RI	March 11, 1976	3.5
Hardwick, MA	October 2, 1994	3.7

[8] USGS, Massachusetts, 2014 Seismic Hazard Map https://earthquake.usgs.gov/earthquakes/byregion/massachusetts-haz.php
[9] The Northeast Sates Emergency Consortium, Earthquake Hazards, http://nesec.org/earthquakes-hazards/
[10] Massachusetts State Hazard Mitigation and Climate Adaptation Plan, September 2018
[11] USGS, Massachusetts, All Earthquakes 1900 - Present, https://earthquake.usgs.gov/earthquakes/byregion/massachusetts.php

Even though there have not been many major earthquakes in the area, there are several factors which make Westminster more vulnerable to smaller events as well. 75 – 80 % of the town is serviced by well water. These systems go deep into the ground and can be seriously affected by a small tremor a few miles away. Earthquakes have compounding effects on these systems; a small tremor might cause a small crack that doesn't cause noticeable damage, but over time, one more tremor results in total system failure

Some of the more significant earthquakes with magnitude greater than 3.5 in the region since 1900 are shown in **Table 6-10** below.

Table 6-111: Earthquakes felt by Westminster[12]

Location	Date	Magnitude
Templeton, MA	December 21, 2018	1.4
Templeton, MA	December 23, 2018	2.2
Gardner, MA	January 28, 2019	1.6

6.5.3 Hazard Location

Earthquakes can have multiple impacts beyond building collapse. They can cause damage to roadway, blocking traffic and cutting off evacuation routes. They can also cause breaks in underground water, sewer, and drain pipes which can cause flooding. Earthquakes can also result in gas line breaks which can result in fires and explosions.

Because of the regional nature of earthquakes, the entire Town of Westminster is susceptible to earthquakes. Westminster is not geographically located near a fault line and there have been no recorded earthquake epicenters within Westminster.

6.6 Landslide

6.6.1 Hazard Overview

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

Landslides are generally caused by erosion, weakening of steep slopes by snow melt or heavy rain, earthquakes, and stockpiling of rock from waste piles or man-made structures. Landslides can result in structural damage to buildings, blocking roads and evacuation routes, and sedimentation in water.

Historical landslide data for the Commonwealth suggests that most landslides are preceded by 2 or more months of higher-than-normal precipitation, followed by a single, high-intensity rainfall of several inches or more (Mabee and Duncan, 2013). This precipitation can cause slopes to become saturated. Landslides associated with slope saturation occur predominantly in areas with steep slopes underlain by glacial till or bedrock.

[12] USGS, Massachusetts, All Earthquakes 1900 - Present, https://earthquake.usgs.gov/earthquakes/byregion/massachusetts.php

6.6.2 Significant Hazard Events

There are no documented previous occurrences of significant landslides in Westminster.

6.6.3 Hazard Location

Although Westminster has a varied topography, there are not many slopes steep enough to cause landslides in town as seen in **Figure 6-2**[13] and local officials state that landslides are not a major threat in Westminster.

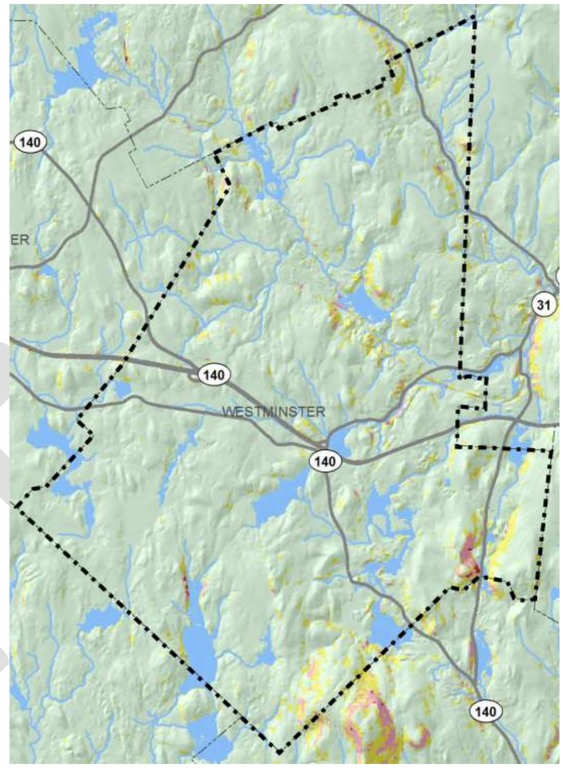


Figure 6-2: Slope Stability Map of Westminster, MA

Should a landslide occur, the type and degree of impacts would be highly localized. There is potential for building damage, localized road closures, and damage to other infrastructure. However, no specific concerns were noted by local officials. The most likely location is in the eastern corner of the Town in the Leominster State forest near Crow Hills. This is an unpopulated area, so there is no foreseen loss of life or significant property damage in the unlikely event of a landslide.

In the State Hazard Mitigation Plan, Worcester County has 1% of its population in Moderate or Low instability areas. 0% of the population is in unstable areas.

Westminster was classified as having a low risk for landslides. Based on past occurrences, landslides are considered low frequency events that may occur once in 50 to 100 years (a 1% to 2% chance of occurring each year).

6.7 Snow & Blizzard

6.7.1 Hazard Overview

A blizzard is a winter snowstorm with sustained or frequent wind gusts to 35 mph or more, accompanied by falling or blowing snow that reduces visibility to or below a quarter of a mile (NWS, 2018). These conditions must be the predominant condition over a 3-hour period. Extremely cold temperatures are often associated with blizzard conditions, but are not a formal part of the definition. 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.

NOAA's National Climatic Data Center (NCDC) is now producing the Regional Snowfall Index (RSI) for significant snowstorms that impact the eastern two thirds of the United States. The RSI ranks snowstorm impacts on a scale from 1 to 5 and includes societal impacts. RSI ranking categories are listed in Table 6-12.

.

[13] Mabee, SB, Duncan, C, Massachusetts Geological Survey, Slope Stability Map of Massachusetts, mgs.geo.umass.edu/biblio/slope-stability-map-massachusetts

Table 6-12: Regional Snowfall Index Rankings[14]

Category	Description	RSI Value
1	Notable	1-3
2	Significant	3-6
3	Major	6-10
4	Crippling	10-18
5	Extreme	18+

6.7.2 Significant Hazard Events

Winter storm events are a common occurrence in Westminster. Since 1958 there have been multiple storms that have been categorized with an RSI of 3 or higher in the Northeast that impacted Westminster. Storms are listed in **Table 6-133** below.

Table 6-13: Significant Snow Events in the Northeast[15]

Storm Date	RSI Value	RSI Category
February 14, 1958	7.866	3
March 2, 1960	6.899	3
February 2, 1961	8.276	3
February 22, 1969	34.026	5
February 5, 1978	18.422	5
February 10, 1983	7.860	3
January 6, 1996	21.708	5
February 15, 2003	14.671	4
December 4, 2003	9.398	3
February 7, 2013	9.212	3
January 25, 2015	6.158	3
January 22, 2016	17.758	4
March 12, 2017	10.658	4
January 30, 2021	6.188	3

Westminster does not keep local records of winter storms. The best available data is for Worcester County. According to NCDC records, from 2000 to 2020, Worcester County experienced 62 blizzard or heavy snowfall events, resulting in $262,200 worth of property damage. No deaths or injuries were reported[16].

Blizzards and heavy snow are considered to be high frequency events and occur more than once in five years, with a greater than 20% chance of occurring each year.

6.7.3 Hazard Location

The entire town of Westminster is susceptible to snow and blizzards. The average annual snowfall is approximately 68.6 inches. Severity of blizzards and snow storms depend on multiple factors including snowfall rate, wind speed, time of season, time of day, temperature, and duration. The amount of warning provided by meteorologists also affects the potential impacts. The more warning given, the more people can prepare for winter weather and suffer less adverse impacts.

---

[14] National Centers for Environmental Information, Regional Snowfall Index (RSI), https://www.ncdc.noaa.gov/snow-and-ice/rsi/
[15] National Centers for Environmental Information, Regional Snowfall Index (RSI), Map Viewer, https://gis.ncdc.noaa.gov/maps/ncei/rsi
[16] National Centers for Environmental Information, Storm Events Database, https://www.ncdc.noaa.gov/stormevents/

6.8 ICE STORMS

6.8.1 HAZARD OVERVIEW

Ice storm conditions are defined by liquid rain falling and freezing on contact with cold objects, creating ice buildups of one-fourth of an inch or more. These can cause severe damage. An ice storm warning, which is now included in the criteria for a winter storm warning, is issued when a half 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.

6.8.2 SIGNIFICANT HAZARD EVENTS

Ice storms occur more frequently in higher elevations of Western and Central Massachusetts. Between 1950 and 2020, only 5 ice storm events have impacted Worcester County according to available NOAA data, but the damage in those storms amounts to over $23.3 million in damages, not including damage to private property.

6.8.3 HAZARD LOCATION

The entire town of Westminster is susceptible to ice storms. Impacts are primarily public safety issues. Road and sidewalk conditions can make driving and walking dangerous. The weight of ice on tree branches can result in fallen branches and power lines making roads impassable or damaging buildings.

Based on past occurrences, ice storms are considered to be medium frequency events.

6.9 WILDFIRES

6.9.1 HAZARD OVERVIEW

There are many types and causes of fires. Wildfires, arson, accidental fires and other types of fires pose a danger to communities and individuals. Fire can be simply defined as the result of a chemical chain reaction between a fuel and atmospheric air, combined in the right combination with a heat source. These three elements; fuel, oxygen and heat make up what is called the fire triangle and explains what is necessary for burning to occur.

In addition to the elements of the fire triangle; weather, regional topography and human behavior can influence the potential for fire. Natural weather occurrences in central Massachusetts range from severe storms involving high winds, lightning, and heavy precipitation to drought conditions. Lightning can start a wildfire and ensuing high winds can affect its direction of travel and spread rate. Drought conditions will add ready, combustible "fuel to the fire" and advance a fire's rate of progression. Generally, fire hazard is higher in the spring and fall when conditions are dry and windy.

Westminster’s topography does not encourage rapid fire spread through convection or radiation transfer of heat; however, the forest vegetation covering the region does. The region has a variety of vegetative coverage, including 23% of the region covered in pitch pine/scrub oak which is extremely flammable due to its resiny and waxy characteristics. Other vegetation in Worcester County include Mountain Laurel, Juniper and Atlantic Cedar; all of which are flammable and quick to burn under the right conditions. The Massachusetts Bureau of Fire Control estimates for this region that wildfires can burn 20 acres per minute given the right combination of temperature, wind, humidity and topography factors.

Human behavior can also affect fire hazard. The Bureau of Fire Control reports that nearly 98% of wildfires in the state are caused by human carelessness. Transportation avenues such as roads and rail lines may act as a source of fire where people carelessly dispose of smoking materials, sparks are emitted from passing trains, or accidents occur where flammable materials are spilled and ignited. In addition, the spread of urban development into forested areas creating a wildland/urban interface increases fire hazard, its probability, and severity. Where wildland fires in the past may have been allowed to burn themselves out with minimum firefighting and containment efforts; they now require more aggressive efforts to prevent damages to surrounding homes or commercial areas and prevent smoke threats to the health and safety of citizens located in those areas.

Structure fires are caused in many ways from human carelessness or intentional acts of arson, to accidents or natural causes, such as lightning strikes or earthquakes. As urban sprawl develops into wildland interface, structure fires can also affect nature if they cause the adjacent wildland to catch fire as well. Structure fires, depending upon their type, location and surrounding exposures may affect utilities, businesses and commerce, and transportation; cause injuries and/or fatalities; and cause the release of hazardous materials. Even though improved building codes and materials, fire alarm systems, sprinkler systems, code enforcement, fire service equipment and practices and public awareness have all combined to reduce the overall number of structure fires; they will never be eliminated from possibility.

6.9.2 Significant Hazard Events

As with many communities with growing populations and large numbers of wooden structures, Westminster has experienced occasional fires, both wildland and structural in nature, throughout the past century.

6.9.3 Hazard Location

The risk of wildfire is difficult to predict based on location. Areas and structures that are surrounded by dry vegetation that has not been suitably cleared, such as untouched forests are at high risk.

Urban fire risk depends on a wide range of factors including, but not limited to, population or building density, building use, fire safety practices, building occupants, and arson. Urban fires are typically caused by human activities. Westminster has not experienced any urban fires caused by natural events. Urban fires can affect almost any area of town because buildings exist anywhere people live and work.

Based on past occurrences, wildland fires are medium frequency events and urban fires are low frequency events.

6.10 Thunderstorms

6.10.1 Hazard Overview

A thunderstorm is a storm originating in a cumulonimbus cloud. Cumulonimbus clouds produce lightning, which locally heats the air to 50,000 degrees Celsius, which in turn produces an audible shock wave, known as thunder. Frequently during thunderstorm events, heavy rain and gusty winds are present. Less frequently, hail is present, which can become very large in size. Tornadoes can also be generated during these events. A thunderstorm is classified as “severe” when it produces damaging wind gusts in excess of 58 mph (50 knots), hail that is 1 inch in diameter or larger (quarter size), or a tornado (NWS, 2013).

Three basic components are required for a thunderstorm to form: moisture, rising unstable air, and a lifting mechanism. The sun heats the surface of the earth, which warms the air above it. If this warm surface air is forced to rise—by hills or mountains, or areas where warm/cold or wet/dry air bump together causing a rising motion—it will continue to rise as long as it weighs less and stays warmer than the air around it. As the warm surface air rises, it transfers heat from the surface of the earth to the upper levels of the atmosphere. The water vapor it contains begins to cool, releasing the heat, and the vapor condenses into a cloud. The cloud eventually grows upward into areas where the temperature is below freezing. Some of the water vapor turns to ice, and some of it turns into water droplets. Both have electrical charges. When a sufficient charge builds up, the energy is discharged in a bolt of lightning, which causes the sound waves we hear as thunder.

An average thunderstorm is 15 miles across and lasts 30 minutes; severe thunderstorms can be much larger and longer. Southern New England typically experiences 10 to 15 days per year with severe thunderstorms. Every thunderstorm has an updraft (rising air) and a downdraft (sinking air). Sometimes strong downdrafts known as downbursts can cause tremendous wind damage that is similar to that of a tornado. A small (less than 2.5 mi path) downburst is known as a "microburst" and a larger downburst is called a "macro-burst." An organized, fast-moving line of microbursts traveling across large areas is known as a "derecho." These occasionally occur in Massachusetts. The strongest downburst recorded was a downburst in North Carolina of 175 mph. Winds exceeding 100 mph have been measured from downbursts in Massachusetts

6.10.2 Significant Hazard Events

Thunderstorms are a common occurrence in central Massachusetts. According to the State Hazard Mitigation Plan, Southern New England typically experiences 20 to 30 days per year with severe thunderstorms.

Table 6-14 lists some previous occurrences of thunderstorms in the Westminster region since 2000 along with associated property damage costs.

Table 6-144: Thunderstorms in Westminster Since 2000[17]

Date	Magnitude (knots)	Property Damage Reported
June 26, 2005	50	$20,000
June 23, 2006	50	$10,000
May 18, 2017	50	$1,000

6.10.3 Hazard Location

Severe thunderstorms are a town-wide hazard for Westminster. Previous damage from severe thunderstorms in town has primarily been to trees and power lines. High winds can lead to fallen branches, power outages, and road blockages which cause lots of difficulty for the town. Heavy rain during thunderstorms can also result in localized flooding.

Based on previous occurrences, severe thunderstorms are high frequency events in Westminster.

6.11 Tornadoes

6.11.1 Hazard Overview

A tornado is a narrow, violently rotating column of air that extends from the base of a cumulonimbus cloud to the ground. The observable aspect of a tornado is the rotating column of water droplets, with dust and debris caught in the column. Tornadoes are the most violent of all atmospheric storms.

The following are common factors in tornado formation: very strong winds in the middle and upper levels of the atmosphere, clockwise turning of the wind with height (i.e., from southeast at the surface to west aloft), increasing wind speed in the lowest 10,000 feet of the atmosphere (i.e., 20 mph at the surface and 50 mph at 7,000 feet), very warm, moist air near the ground, with unusually cooler air aloft, a forcing

[17] National Centers for Environmental Information, Storm Events Database, https://www.ncdc.noaa.gov/stormevents/

mechanism such as a cold front or leftover weather boundary from previous shower or thunderstorm activity

Tornadoes can form from individual cells within severe thunderstorm squall lines. They can also form from an isolated supercell thunderstorm. They can be spawned by tropical cyclones or the remnants thereof, and weak tornadoes can even occur from little more than a rain shower if air is converging and spinning upward. Tornadoes that form from a super-cell thunderstorm are the most common and often the most dangerous.

Most tornadoes occur in the late afternoon and evening hours when the heating is the greatest. The most common months for tornadoes to occur are June, July, and August, although the Great Barrington, Massachusetts, tornado (1995) occurred in May and the Windsor Locks, Connecticut, tornado (1979) occurred in October.

A tornadic waterspout is a rapidly rotating column of air extending from the cloud base (typically a cumulonimbus thunderstorm) to a water surface, such as a bay or the ocean. They can be formed in the same way as regular tornadoes, or can form on a clear day with the right amount of instability and wind shear. Tornadic waterspouts can have wind speeds of 60 to 100 mph, but since they do not move very far, they can often be navigated around. They can become a threat to land if they drift onshore.

Prior to 2007, Tornado damage severity was measured by the Fujita Tornado Scale, in which wind speed is not measured directly but rather estimated from the amount of damage. As of February 01, 2007, the National Weather Service rates tornadoes using the Enhanced Fujita-scale (F-scale). It is considerably more complicated than the original F-scale and allows surveyors to create more precise assessments of tornado severity. **Table 6-15** below illustrates the EF-scale.

Table 6-15: Tornado Fujita and Enhanced Fujita Scale and Typical Effects[18]

Fujita (F) Scale			Enhanced Fujita (EF) Scale		
F Number	**Fastest ¼ mile (mph)**	**3-second gust (mph)**	**EF Number**	**3-second gust (mph)**	**Description of Damage**
0	40 – 72	45 – 78	**0**	65 – 85	Light damage, tree branches broken, chimneys damaged, shallow-rooted trees toppled
1	73 – 112	79 – 117	**1**	86 – 110	Moderate damage, windows broken, roof surfaces peeled off, some tree trunks snapped, unanchored manufactured home over turned, attached garages may be destroyed
2	113 – 157	118 – 161	**2**	111 – 135	Considerable damage, roof structures damaged, manufactured homes destroyed, debris becomes airborne, large trees snapped or uprooted
3	158 – 207	162 – 209	**3**	136 – 165	Severe damage, roofs and some walls torn from structures, some small buildings destroyed, non-reinforced masonry buildings destroyed, most trees uprooted
4	208 – 260	210 – 261	**4**	166 – 200	Devastating damage, well-constructed homes destroyed, some structures lifted from foundations

[18] National Weather Service, Storm Prediction Center, https://www.spc.noaa.gov/faq/tornado/ef-scale.html

					and blown some distance, cars blown some distance, large debris becomes airborne
5	261 – 318	262 – 317	**5**	Over 200	Incredible damage, strong frame homes lifted from foundations, reinforced concrete structures damaged, automobile-size debris becomes airborne, trees completely debarked

6.11.2 Significant Hazard Events

According to the Massachusetts State Hazard Mitigation Plan, areas at greatest risk of a tornado touchdown in Massachusetts run from central to northeastern part of the state, including Westminster. On average, six tornadoes touchdown in the Northeast every year.

The most destructive tornado in New England history was the Worcester tornado of June 9, 1953. The F4 tornado hit at about 3:30 p.m. The funnel quickly intensified, carving a 46-mile path of death and destruction as it moved through seven towns. The twister tore through Barre, Rutland, Holden, Worcester, Shrewsbury, Westborough, and Southborough. It killed 94 people and left approximately 1,300 people injured. The National Storm Prediction Center has ranked this as one of the deadliest tornados in the nation's history. With wind speeds between 200 to 260 mph, the force of the tornado carried debris miles away and into the Atlantic Ocean. A music box and a 3-foot aluminum trap door were found about 35 miles away, according to the National Oceanic and Atmospheric Administration. Based on the extent of destruction, it was believed that this tornado may have been an EF5 — the most severe on the Enhanced Fujita Tornado Scale. Two other deadly tornadoes occurred later the May 29, 1995 Great Barrington tornado, an EF4, which claimed 3 lives and injured 24; and the August 28, 1973 West Stockbridge tornado, an EF4, which killed 4 and injured 36.

Since 1950, there have been 44 total tornadoes in Worcester County on 33 days. A tornado touched down in Westminster on June 22, 1981 as it passed from Hubbardston to downtown Westminster. It caused 3 injuries, $2,500 of damage and was categorized as an F3 tornado. These 44 tornadoes resulted in 92 deaths, 1254 injuries and over $264 million in damages. **Table 6-16** summarizes these events.

Table 6-16: Tornado Events in Worcester County[19]

Date	Fujita Scale	Fatalities	Injuries	Width (yds)	Length (mi)	Damage
6/9/1953	4	90	1228	900	34.9	$250,000,000
6/9/1953	3	0	1	667	14.9	$2,500,000
10/24/1955	1	0	0	33	3	$2,500
06/1/1956	1	0	14	33	0	$25,000
11/21/1956	2	0	0	17	0.1	$2,500,000
6/19/1957	1	0	0	33	1.8	$25,000
7/5/1957	2	0	0	20	0.5	$2,500
7/11/1958	1	0	0	133	0.4	$250
7/11/1958	1	0	0	50	0.1	$2,500
7/16/1958	1	0	1	33	0.1	$2,500
7/29/1958	1	0	0	33	2	$2,500
10/12/1962	2	0	0	133	4.1	$25,000
5/20/1963	2	0	0	17	3.8	$25,000
5/20/1963	2	0	0	33	1.5	$25,000

[19] National Centers for Environmental Information, Storm Events Database, https://www.ncdc.noaa.gov/stormevents/

5/20/1963	2	0	0	50	0.3	$2,500
8/31/1966	2	0	0	67	1	-
8/31/1966	0	0	1	50	1	$250
7/17/1968	1	0	0	17	0.3	$2,500
5/29/1969	1	0	0	13	1	$2,500
10/3/1970	3	0	0	60	35.4	$250,000
7/1/1971	1	0	2	20	2	$25,000
11/7/1971	1	0	0	27	0.1	$2,500
8/9/1972	2	0	1	10	9.7	$25,000
5/3/1976	1	0	0	27	0.2	$2,500
8/10/1979	2	2	2	30	9.7	$2,500,000
6/22/1981	3	0	3	167	7.1	$25,000
8/8/1986	1	0	0	100	1	$2,500
7/10/1989	1	0	0	50	0.3	$250,000
7/10/1989	1	0	0	50	0.3	$250,000
7/10/1989	1	0	0	50	0.3	$250,000
7/10/1989	1	0	0	50	0.4	$250,000
8/10/1990	0	0	0	10	1	$30
6/17/2001	1	0	0	600	0.8	$25,000
7/23/2002	1	0	0	75	0.4	$50,000
7/19/2007	EF0	0	0	50	1.5	-
6/1/2011	EF3	0	0	880	6.06	-
6/1/2011	EF0	0	0	25	1.42	-
8/31/2014	EF0	0	0	176	2.06	$100,000
6/23/2015	EF0	0	0	75	0.52	$25,000
7/26/2018	EF1	0	0	200	4.4	$25,000
7/26/2018	EF1	0	0	100	1.04	$40,000
8/4/2018	EF1	0	1	300	0.47	$5,000,000
10/23/2018	EF1	0	0	350	0.8	-
10/23/2018	EF0	0	0	100	1	-

6.11.3 Hazard Location

Tornadoes and their associated winds can cause damage to buildings, trees, and power lines. Evacuation routes may be blocked by downed trees and other debris.

Tornadoes are a town-wide hazard for Westminster however damage due to tornadoes depends on the track of the tornado. Based on previous occurrences, tornadoes are a low frequency event in Westminster.

6.12 Drought

6.12.1 Hazard Overview

A drought is a period of months or years when a region receives less than the normal amount of rainfall and develops a deficiency in its water supply. Drought is a normal, recurrent feature of climate. It occurs in virtually all climatic zones yet its characteristics vary significantly from one region to another. It originates from a deficiency of precipitation over an extended period of time, usually two winters or more. This deficiency results in a water shortage for some activity, group, or environmental sector. The beginning of a drought is difficult to determine. Several weeks, months, or even years may pass before people know that a drought is occurring.

The first evidence of drought usually is seen in rainfall records. Within a short period of time, the amount of moisture in soils can begin to decrease. The effects of a drought on flow in streams and rivers or on water levels in lakes and reservoirs may not be noticed for several weeks or months. Water levels in wells may not reflect a shortage of rainfall for a year or more after a drought begins. The end of a drought can occur as gradually as it began. Dry periods can last for 10 years or more.

The severity of a drought depends on the degree of moisture deficiency, duration, and size and location of affected area. Five levels of drought severity are used in Massachusetts: normal, advisory, watch, warning, and emergency. These levels provide a framework for actions to take to assess, communicate, and respond to drought conditions.

Drought levels begin with a normal situation where data is routinely collected and distributed, move to heightened vigilance with increased data collection during an advisory, and to increased assessment and proactive education during a watch. Water restrictions may be appropriate at the watch or warning stage. A warning level indicated a severe situation and the possibility that a drought emergency may be necessary. A drought emergency is when a mandatory water restriction or use of emergency supplies is necessary.

Massachusetts uses a multi-index system to determine the severity of a drought or extended dry period conditions. Drought levels are declared on a regional basis. Westminster is within the central region of Massachusetts. A determination of drought is based on seven indices:

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

6.12.2 Significant Hazard Events

Westminster does not collect data relative to drought events. Because droughts are typically regional in nature, state data is the best available data for drought events.

Massachusetts is often considered a "water-rich" state. Under normal conditions, regions across the state annually receive between 40 and 50 inches of precipitation. The precipitation occurs nearly evenly throughout the year. However, Massachusetts can experience extended periods of dry weather, from single season events to multi-year events such as experienced in the mid-1960s. Historically, most droughts in Massachusetts have started with dry winters, rather than a dry summer.

Massachusetts has experienced multi-year drought periods in 1879-83, 1908-12 , 1929-32, 1939-44, 1961-69, and 1980- 83. During the summer of 2002, one-third of the country, including Massachusetts, experienced drought conditions. From July 2016 to January 2017, Massachusetts was under drought warning levels for most of the state.

The most severe drought on record in the northeastern United States was during 1961-69. Water supplies and agriculture were affected because of the severity and long duration of the drought. Precipitation was less than average beginning in 1960 in western Massachusetts and beginning in 1962 in eastern Massachusetts.

Since 1850, Massachusetts has reached a drought emergency five times and a drought warning five times.

6.12.3 Hazard Location

Drought conditions affect Westminster town-wide. Based on previous occurrences, emergency drought conditions are a low frequency event.

The primary impact to a community from a drought is increased risk of wildfires and forest fires, damage to agricultural businesses, damage to the ecosystem, and reduction in water for human consumption.

6.13 Extreme Temperature

6.13.1 Hazard Overview

Westminster has four well-defined seasons. The Town is susceptible to extreme heat in summer (June to August) and extreme cold in winter (December to February). Average temperatures for Westminster for summer and winter are available through NOAA's National Weather Service Forecast Office. The average temperature for summer in Westminster 77.3°F. The average temperature for winter in Westminster is 33°F. Record high temperature in Worcester of 99°F occurred in September 1953. Record low temperature in Worcester of -12°F occurred in January 1981.

6.13.1.1 Extreme Heat

Extreme heat for this region is typically defined as three or more consecutive days above 90° F, often accompanied by high humidity.

The National Weather Service issues a Heat Advisory if the heat index is measured at 100°F to 104°F for two or more hours. An excessive heat advisory is issued if the heat index reaches 105°F or greater for two or more hours. The heat index is shown in Table 6-17**.**

Table 6-17: Heat Index[20]

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	125 °F – Higher	Heat stroke highly likely
Danger	103 °F – 124 °F	Heat cramps or heat exhaustion likely, and heat stroke possible with prolonged exposure and/or physical activity
Extreme Caution	90 °F – 103 °F	Heat stroke, heat cramps, or heat exhaustion possible with prolonged exposure and/or physical activity
Caution	80 °F – 90 °F	Fatigue possible with prolonged exposure and/or physical activity

6.13.1.2 EXTREME COLD

Extreme cold for this region is considered to be when temperatures are well below normal and accompanied by winds, which introduce wind chill factor that can be extremely harmful to exposed skin.

Extreme cold is typically measured through the Wind Chill Temperature Index. The National Weather Service issues a wind chill advisory if the wind chill is between -15°F to -24°F for three or more hours. A wind chill warning is issued if the wind chill is -25°F or colder for three or more hours.

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

[20] National Weather Service. https://www.weather.gov/safety/heat-index

Wind Chill Temperature Index designed to more accurately calculate how cold air feels on human skin. Figure 4-42 shows the Wind Chill Temperature Index.

The National Weather Service implemented a new Wind Chill Temperature Index in 2001 to more accurately calculate how cold air feels on human skin. The new Wind Chill Temperature Index is shown in **Table 6-18**. The Index also shows how long a person can be exposed to the cold and wind before frostbite develops.

Table 6-18: Wind Chill Temperature Index[21]

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

6.13.2 Significant Hazard Events

6.13.2.1 Extreme Heat

Westminster does not collect data on extreme heat events. The best available local data is for Worcester County, through the National Climactic Data Center. From 1950 to 2017, there have been two excessive heat days: July 6, 2010 and July 22, 2011. No deaths, injuries, or property damages were reported in association with these events.

6.13.2.2 Extreme Cold

Westminster does not collect data on extreme cold temperature events. The best available local data is for Worcester County, through the National Climactic Data Center. From 1950 to 2017, there has been one extreme cold day: February 14, 2016. No deaths, injuries, or property damages were reported in association with this event.

6.13.3 Hazard Location

Extreme temperatures affect Westminster town-wide. Based on previous occurrences, extreme temperatures are a medium frequency event.

---

[21] National Weather Service. https://www.weather.gov/safety/cold-wind-chill-chart

Extreme temperatures pose the greatest risk to human life. Elderly and children are at a potentially greater risk however, everyone can be impacted by both extreme heat and extreme cold.

6.14 Coastal Erosion

6.14.1 Hazard Overview

Westminster has four well-defined seasons. The Town is susceptible to extreme heat in summer (June to August) and extreme cold in winter (December to February). Average temperatures for Boston for summer and winter are available through NOAA's National Weather Service Forecast Office. The average temperature for summer in Boston 71.3°F. The average temperature for winter in Boston is 35.6°F. Record high temperature in Boston of 104°F occurred in July 1911. Record low temperature in Boston of -18°F occurred in February 1934.

6.14.2 Significant Hazard Events

Westminster does not collect data on extreme cold temperature events. The best available local data is for Worcester County, through the National Climactic Data Center. From 1950 to 2017, there has been one extreme cold day: February 14, 2016. No deaths, injuries, or property damages were reported in association with this event.

6.14.3 Hazard Location

Extreme temperatures affect Westminster town-wide. Based on previous occurrences, extreme temperatures are a medium frequency event.

Extreme temperatures pose the greatest risk to human life. Elderly and children are at a potentially greater risk however, everyone can be impacted by both extreme heat and extreme cold.

7.0 Vulnerability Assessment

The following section provides an assessment of Westminster's vulnerability to the natural hazards identified in the risk assessment and an estimate of damage that may result from each natural hazard was determined. **Table 7-1** provides a summary of building values in Westminster, based on 2020 assessor data provided to MassGIS.

Table 7-1: Westminster Building Values

Property Type	Number of Properties	Total Building Value
Residential	3,822	$935,350,340
Commercial	158	$57,264,225
Industrial	48	$47,096,244
Other	20	$3,104,600
TOTAL	**4,048**	**$1,042,815,409**

Most of the natural hazards identified have the potential to affect the entire town. However, there are some hazards, such as tornadoes, which are unpredictable and difficult to determine location or severity of the hazard. In these cases, the town's vulnerability to the hazard may range significantly.

The vulnerability assessments represent a worst-case scenario and assume the entire building would need to be replaced if impacted by a hazard event, unless otherwise stated. Estimates do not include the cost to replace land. It is assumed all structures may be rebuilt in the same location.

Based on the vulnerability and risk assessment, an overall hazard index rating was determined, identifying highest to lowest risk hazards for Westminster on a scale of 1 to 3 as follow:

1 – High risk
2 – Medium risk
3 – Low risk

Ranking is qualitative and based partly on local knowledge of past experiences. A summary of hazard rankings is shown in **Table 7-2.**

Table 7-2: Westminster Hazard Rankings

Hazard	Frequency	Severity	Area of Impact	Hazard Risk Index Rating
Flood	High	Minor	Limited	3
Dam Failure	Low	Extensive	Significant	2
Hurricane/Tropical Storm	High	Serious	Extensive	1
Nor'easter	High	Serious	Extensive	1
Earthquake	Low	Extensive	Significant	3
Landslide/Erosion	Medium	Minor	Negligible	3
Snow & Blizzard	High	Serious	Extensive	1
Ice Storm	Medium	Extensive	Extensive	2
Wildland Fire	Medium	Serious	Limited	3
Major Urban Fire	Low	Minor	Negligible	3
Thunderstorm	High	Serious	Extensive	1
High Wind	High	Minor	Significant	2
Tornado	Low	Serious	Limited	3
Drought	High	Serious	Extensive	1
Extreme Temperature	High	Minor	Extensive	2

Westminster's greatest risk from natural hazards is from drought, hurricanes/tropical storms, and snow and blizzards. A detailed vulnerability analysis can be found in **Section 7.1– 7.12**.

7.1 Flood Related Hazards

Westminster has several areas within FEMA mapped 100-year and 500-year flood plain as shown on the map in **Appendix C.** These areas are most vulnerable to flooding. Most of the properties in these areas are residential. Roads, water, sewer, drainage, and other utilities are also vulnerable within mapped flood plains.

To assess vulnerability of structures in Westminster, FEMA 100-year flood plain was overlain over town GIS information to determine which properties as well as town-owned and other critical facilities were within mapped flood plains.

Table 7-3 summarizes properties, total building value, and total estimated structural damage for buildings impacted by flooding.

FEMA's *Understanding You Risks: Identifying Hazards and Estimating Losses* document was used to estimate structural damage and content losses. The majority of Westminster's infrastructure is one or two story buildings with basements and the flood depth (the difference between FEMA base flood elevation and lowest floor elevation) for properties within the 100-year flood zone averages 3-feet. Per FEMA's *Understanding You Risks: Identifying Hazards and Estimating Losses,* that criteria corresponds to approximately 23% structural damage per building.

With the exception of the dams, the only critical facility in the 100-year or 500-year flood plains is the Narrows Road Sewer Pump Station. The estimated structural damage caused by flooding for these properties is included in **Table 7-3** below.

Table 7-3: Estimated Damage from Flooding Event

Property Type	Number of Properties within FEMA 100-year flood plain	Total Building Value	Total Estimated Structural Damage
Residential	332	$81,249,364	$18,687,353
Commercial	44	$15,946,964	$3,667,801
Industrial	13	$12,755,223	$2,933,701
Other	5	$776,150	$178,515
TOTAL	**394**	**$110,727,701**	**$25,467,370**

The most vulnerable population during a flooding event is the elderly. This population is more likely to seek medical attention during a flooding event, which may not be available because their route to a medical facility is blocked or impacted by flooding.

7.1.1 Repetitive Loss Properties

A Repetitive Loss Property is any insurable building for which two or more claims of more than $1,000 were paid by the NFIP within a 10-year period since 1978. Severe Repetitive Loss Properties are residential properties with four or more NFIP claim payments of more than $5,000 each, with at least two of those payments occurring in a 10-year period, and with the total claims paid exceeding $20,000, or two or more claim payments that cumulatively exceeded the building's value.

FEMA reports that there was one property in Westminster that is considered Repetitive Loss Property.

7.1.2 Dam Failure

A dam failure can cause significant downstream flooding depending on the magnitude of the failure. As noted in **Section 6.2.4** there are three dams in Westminster classified as High hazard potential dams due to potential loss of life and property should dam failure occur. These dams are summarized below in **Table 7-4**.

Table 7-4: High Hazard Dams in Westminster

Dam Name	Impoundment	Receiving Waterbody	Owner	Hazard Potential
Crocker Pond Dam	Crocker Pond	Flag Brook	Private	High
Westminster Reservoir Dam	Whitmanville Reservoir	Whitman River	Private	High
Wyman Pond Compensating Reservoir Dam	Wyman Pond	-	Fitchburg	High

The areas and critical facilities immediately downstream of the dams are most vulnerable and these potential inundation areas are specified in the Emergency Actions Plans (EAP) that dam owners are required to maintain.

Westminster does not own any high hazard dams, but they work closely with the owners of the high hazard dams in town to ensure they are maintaining an EAP that includes specific procedures for each dam in the case of an emergency including assigned responsibilities for town and state departments, as well as other organizations including the American Red Cross. The Plan also includes procedures for evaluation, training, and a list of residents to notify.

Immediate notification of a dam failure is critical to minimize potential loss of life. Populations without access to adequate warning of the event from a warning system are highly vulnerable to dam failure.

7.2 Hurricanes and Tropical Storms

Extent of impact from hurricanes and tropical storms depends on the category of the hurricane and corresponding wind speed. The potential area of impact for Westminster would be widespread. All 4,048 buildings in Westminster are potentially exposed to hurricanes and tropical storms.

The majority of buildings in Westminster are single family homes with wood frame construction, and will experience more damage than concrete or steel structures during hurricane or tropical storm events. Structures built prior to the establishment of the Massachusetts State Building Code, which went into effect on January 1, 1975, are more susceptible to damage from high winds during hurricanes and tropical storms as they were not designed to meet specific wind speeds.

Damage caused by hurricanes and tropical storms may result in residents being displaced from their homes. Falling trees and debris can also lead to injury and loss of life. Economically disadvantaged populations are at a greater risk of impact based on their financial ability to react to an event as well as the construction quality of their home.

7.3 Nor'easter

Impacts from a Nor'easter are similar to those caused by hurricanes and tropical storms. The area of impact would be widespread. In addition to high winds, the town could be impacted by heavy rains and/or snow.

A Nor'easter is typically a longer duration event and as such could potentially impact the town for a number of days or weeks.

Damage caused by Nor'easters may result in residents being displaced from their homes. Falling trees and debris can also lead to injury and loss of life. Economically disadvantaged populations are at a greater risk of impact based on their financial ability to react to an event as well as the construction quality of their home.

7.4 Earthquake

Damage resulting from an earthquake depends on the severity of the event. Most structures in Westminster were not constructed with seismic design features based on the low frequency of major earthquakes occurring in the area.

Westminster's PGA values that have a 2 percent chance of being exceeded in 50 years range between 10 %g to 14%g. This magnitude of earthquake would cause strong shaking and slight damage. If this magnitude of earthquake were to occur in Westminster, an estimated 25% - 75% of the town could potentially be impacted, though the severity would be minor.

Per FEMA's *Understanding You Risks: Identifying Hazards and Estimating Losses,* wood framed construction, without seismic design ranges from 0.7% to 1.6% building damage. Assuming 75% of the town is impacted by an earthquake, this equates to approximately $581,320 - $1,328,732 worth of building damage in Westminster from an earthquake event.

Damage caused to structures during an earthquake may result in residents being displaced from their homes. Economically disadvantaged populations are more susceptible to impacts from an earthquake based on their financial ability to react to an event and the construction quality of their homes. Elderly populations are also more susceptible to earthquakes as they are more likely to need or seek medical attention which may not be available because their route is blocked or impacted.

7.5 Landslide

Westminster does not have many steep slopes in town and landslides are considered low frequency events that may occur once in 50 to 100 years (a 1% to 2% chance of occurring each year).

Areas with clay-rich soils have a higher probability of experiencing a landslide due to the sliding of the soil. The majority of soils in Westminster are sandy loam and loamy sand. Based on soil type and relatively flat topography, landslides are not a hazard of concern in Westminster. Should a landslide occur in Westminster, an estimated 1% of the town would be impacted by the event and damaged would typically be less than $2.5 million.

7.6 Snow & Blizzard

Damage from snowstorms and blizzards is typically a result of snow loads on trees, roofs, and power lines that causes infrastructure to collapse. The extent of damage depends on the severity of the snowstorm or blizzard. It is expected the entire town will be impacted by an event; however impacts from blizzards and snowstorms are primarily public safety issues. Streets can become impassible for vehicles, including emergency vehicles. Snow piles can block line of sight at intersections and result in car accidents.

Table 7-5 summarizes estimated town-wide, worst-case scenario damage expected during snowstorms and blizzards of different severities. Based on previous events, Westminster typically experiences a category 3 or higher snowstorm or blizzard once every 10 years.

Table 7-5: Estimated Damage from Snow/Blizzard Event

Category	Description	Estimated Percent Building Damage	Total Estimated Damage
1	Notable	0.005%	$5,536
2	Significant	0.025%	$27,681
3	Major	0.050%	$55,363
4	Crippling	0.10%	$110,727
5	Extreme	0.20%	$221,455

Elderly and disabled populations are more susceptible to snowstorm or blizzard impacts as they are more likely to need or seek medical attention which may not be available because their route is impacted. Elderly people are also more likely to risk injury or death from overexertion clearing snow, or hypothermia due to power loss and the resultant impact on heating their house.

Economically disadvantaged populations are also more susceptible to experiencing hypothermia during snowstorms and blizzards based on the construction quality of their home and their home's ability to withstand cold temperatures.

7.7 Ice Storms

Like snowstorms and blizzards, damage from ice storms depends on the severity of the event. Ice buildup can cause tree branches to fall, power outages, and block roadways. Westminster experienced an Ice Storms in December of 2008 and October of 2011 that caused significant damage. Although data regarding the financial impact to Westminster is not available for those storms, significant damage to both Town-owned infrastructure and private property was experienced. A severe ice storm, with ice buildup of greater than ¼" would affect the entire town and damage could range from structure damage of $110,727 (1% damage to 10% of buildings in town) to $1.38 million (5% damage to 25% of buildings in town).

Elderly populations are more susceptible to ice storms as they are more likely to risk injury or death from falls and overexertion clearing ice.

Economically disadvantaged populations are also more susceptible to impacts during ice storms based on the construction quality of their home and potential for ice dams to build up and damage their homes.

7.8 Fire Related Hazards

Damage resulting from wildland fires and urban fires can vary greatly depending on the severity and extent of the fire.

Westminster does not have a major urban area and estimated amount of damage from an urban fire would be less than $1.0 million based on previous occurrences.

There is a higher risk of health impacts from a fire to people over 65 and children. First responders are also at risk to injury or death from the initial fire, as well as long-term affects relating to smoke inhalation.

7.9 Thunderstorms

Damage caused by high winds and hail during thunderstorms may result in falling tree limbs and debris that can lead to injury and loss of life. Power outages and road blockages can also occur during thunderstorms. Buildings surrounded by trees, especially older unhealthy trees, are more likely to be impacted from high winds during thunderstorms. Damage to buildings is estimated at less than $50,000 per storm event. However, 10 to 15 storm events can occur per year and result in structure damage totaling $750,000 for the year.

Economically disadvantaged populations and populations without access to shelters are more susceptible to impacts from thunderstorms. These populations may lack the financial ability to react to a thunderstorm and are more likely to be exposed to high winds and lightning strikes.

7.10 Tornadoes

The majority of damage associated with tornadoes is due to high winds. Impact of a tornado depends greatly on the severity of the event. However, damage would be limited because a tornado's path is relatively narrow. Location of a tornado significantly impacts the extent of damage. If a tornado were to occur downtown, it would likely cause much more damage than if it occurred in a more sparsely developed location.

FEMA's *Understanding You Risks: Identifying Hazards and Estimating Losses,* Westminster is located in the Zone II wind zone, with a design wind speed of 160 mph and is also located in a hurricane susceptible region.

The last time a tornado touched down in Westminster was in 1981. It was a F3 tornado and caused three injuries and approximately $25,000 worth of damage.

Impact from a tornado in town would be limited and is estimated to affect 10% of buildings in town. **Table 7-6** below provides a worst-case estimate for each potential storm, assuming 10% of the town is impacted.

Table 7-6: Estimated Damage from Tornado Event

Tornado Category	Typical Damage	% Building damaged	Estimated Damage Cost
EF0	Light damage, tree branches broken, chimneys damaged, shallow-rooted trees toppled	0.5%	$521,400
EF1	Moderate damage, windows broken, roof surfaces peeled off, some tree trunks snapped, unanchored manufactured home over turned, attached garages may be destroyed	1%	$1,042,820
EF2	Considerable damage, roof structures damaged, manufactured homes destroyed, debris becomes airborne, large trees snapped or uprooted	3%	$3,128,450
EF3	Severe damage, roofs and some walls torn from structures, some small buildings destroyed, non-reinforced masonry buildings destroyed, most trees uprooted	5%	$5,214,100
EF4	Devastating damage, well-constructed homes destroyed, some structures lifted from foundations and blown some distance, cars blown some distance, large debris becomes airborne	10%	$10,428,150
EF5	Incredible damage, strong frame homes lifted from foundations, reinforced concrete structures damaged, automobile-size debris becomes airborne, trees completely debarked	15%	$15,642,230

Elderly populations are more susceptible to tornadoes as they are more likely to need or seek medical attention during an event which might not be available. People living in manufactured or mobile homes are also at a greater risk of impact, particularly if the manufactured home is not anchored.

7.11 Drought

Drought conditions can reduce the town's ability to fight a fire and cause a shortage of water for consumption. Westminster relies heavily on groundwater for its residents and therefore is more vulnerable to drought.

Populations more vulnerable to drought are those that rely on groundwater and surface water for drinking water. Droughts can also cause minor to significant damage to crops and pastures which can have significant financial consequences.

Minimal or no loss of structures is expected due to drought.

7.12 Extreme Temperatures

Weather reports can provide advanced warning of extreme heat or cold events and the anticipated severity. This forewarning can provide the opportunity for people to plan and prepare. Populations without access to advanced warning are more vulnerable to extreme temperatures because they do not have the time to prepare for the event.

The homeless population is the most vulnerable to extreme heat and cold, due to lack of shelter and protection. Economically disadvantaged populations are also more vulnerable to extreme temperatures as they potentially lack appropriate heating and cooling systems. In addition, homes without proper insulation do not provide adequate protection from extreme heat and cold.

Elderly populations are also vulnerable to extreme temperatures due to their age, health conditions, and lack of mobility to access shelters if needed.

Minimal or no loss of structures is expected due to extreme temperatures.

8.0 Climate Change

Modeling analysis by the Northeast Climate Adaptation Science Center at the University of Massachusetts, Amherst indicates temperatures are increasing, precipitation patterns are changing, sea level is rising, and extreme weather events are becoming more frequent in Massachusetts. **Table 8-1** and **Table 8-2** below show climate observation for Worcester County from the 1960s to the 2000s and climate projections for the 2050s and 2090s.

Table 8-1: Worcester County Climate Change – Precipitation[22]

Season	Climate Observations					Climate Projections	
	1960s	1970s	1980s	1990s	2000s	2050s	2090s
Consecutive Dry Days							
Annual	19.4	16.8	17.3	18	18.1	18.47	18.49
Fall	17.1	14.2	12.6	12.5	12.1	14.29	14.63
Spring	13.3	12.1	11	11.1	12.2	11.46	11.24
Summer	11.6	12.9	14.1	13.9	12.3	14.05	14.43
Winter	11.1	10.1	11.4	9.9	12.5	11.30	11.22
Days with Precipitation > 1"							
Annual	6.3	8.2	7.3	8.1	8.4	9.63	10.31
Fall	2.3	2.3	1.7	2.8	2.6	2.66	2.69
Spring	1.9	1.5	2.1	1.3	3.2	2.27	2.58
Summer	0.7	2.1	2	1.9	2	2.24	2.19
Winter	1.2	2.6	1.4	2	0.7	2.48	2.86
Total Precipitation (inches)							
Annual	40.5	48.5	45.3	47.1	49.7	50.42	50.89
Fall	11	12.3	11.5	12.6	12.9	12.66	12.53
Spring	10.2	11.5	12.1	11.8	15.2	13.02	13.57
Summer	8	11.2	11.8	10	10.9	11.59	11.43
Winter	10.7	14.3	10	12.6	10.5	13.02	14.15

Table 8-2: Worcester County Climate Change – Temperature[23]

Season	Climate Observations					Climate Projections	
	1960s	1970s	1980s	1990s	2000s	2050s	2090s
Average Temperature (°F)							
Annual	49.7	50.2	49.9	51.3	50.7	54.97	57.45
Fall	53.2	52.9	52.7	53.5	54	57.67	60.14
Spring	46.7	47.6	47.5	47.9	47.5	51.65	54.04
Summer	69.4	70	69.6	71	70.6	74.57	77.29
Winter	29.4	29.7	30.1	31.9	30.6	35.55	38.01
Days Below 32° F							
Annual	124.1	124.1	122.8	113.2	119.1	86.94	69.36

[22] Resilient MA, Climate Change Clearinghouse for the Commonwealth, http://resilientma.org/
[23] Resilient MA, Climate Change Clearinghouse for the Commonwealth, http://resilientma.org/

Fall	16	18.1	17	15.3	14.2	8.33	6.11
Spring	29	29.2	26.8	26.1	27.5	16.19	11.82
Summer	0	0	0	0	0	0	0
Winter	78.5	77.1	78.1	72.7	76.7	62.59	52.66
Days Above 90° F							
Annual	4	5.3	7.7	7.9	7.7	24.45	41.81
Fall	0.4	0.4	0.6	0	0.1	1.95	4.73
Spring	0.2	0.4	0.3	0.5	0.8	0.85	1.61
Summer	3.4	4.5	6.8	7.4	6.9	21.67	35.12
Winter	0	0	0	0	0	0	0

As shown in **Table 8-1** above, total precipitation is projected to increase and the number of greater intensity rain events are projected to increase as well. The greatest increase in precipitation is expected to occur during winter months and the greatest increase in consecutive dry days is projected to be during the fall and summer months.

As shown in **Table 8-2** above, average annual temperatures in Worcester County are expected to increase by 8% by 2050s and 13% by 2090s. The number of days with temperatures below freezing are projected to decrease by 27% by 2050s and 42% by 2090s. The greatest decrease in days below freezing will occur in the fall and spring months. The number of days with temperatures above 90° F are projected to be 3 times higher than today by 2050s and 5 times higher than today by 2090s.

Projected climate changes will affect natural hazards and their impact on the community. In most cases, climate change will increase severity, duration, or frequency of a hazard event.

Changes in precipitation including increased rainfall intensity and frequency and number of consecutive days will increase the frequency of inland flooding. Soils become saturated, and less rainfall is infiltrated into the ground. Water levels in rivers rise and drainage systems become overwhelmed. Changes in precipitation can also lead to an increase of frequency and intensity of droughts, particularly in the summer and fall months.

Rising temperatures annually, and especially during the summer months can lead to periods of utility failure, as air conditioner use increases. Vulnerable populations like the elderly and homeless are also at a greater risk for health impacts as they may lack access to adequate cooling. Risk of wildfires also increases as the number of days greater than 90° F are expected to increase significantly. Coupled with changes in precipitation, there may also be less available water to fight the wildfires.

The frequency and magnitude of extreme weather events is projected to increase. Warmer oceans can provide more energy for storms and warmer air can hold more water vapor, increasing the rate of rainfall. When moisture heavy air meets a cold front, an increase in frequency and magnitude of snow events is also predicted.

9.0 EXISTING MITIGATION MEASURES

Table 9-1 below describes existing mitigation measures in place in Westminster. It includes a brief description of each measure as well as an evaluation of its effectiveness and of any need for modifications.

Table 9-1: Existing Mitigation Measures

Existing Measure	Description	Area Covered	Implementing Department/Agency	Improvement or Changes Needed
Stormwater Management Standards	State Regulation under the Wetlands Protection Act to regulate stormwater and other point source discharge	Town-Wide	Enforced by the Westminster Conservation Commission (Wetlands Protection Act) staffed by the municipal Conservation Agent and Westminster Planning Board (Subdivision Control Law and site plan review) staffed by the municipal Town Planner.	Planning Board will be proposing a town-wide stormwater management bylaw for the annual Town Meeting in May 2020 that will govern land disturbances over an acre. Following the Town Meeting, the Planning Board will be adopting new regulations for stormwater management and adding new stormwater management provisions to its existing regulations: earth removal and placement of fill regulations, subdivision regulations and site plan review regulations. Storm water management standards are and continue to be enforced. No improvements or changes needed.
Low Impact Development	General Bylaw	Town – Wide	Westminster Planning Board staffed by the municipal Town Planner.	The Planning Board is proposing some revisions to the existing town-wide LID bylaw at the Annual Town Meeting in May. Following the Town Meeting, the Planning Board will adopt a set of LID regulations governing land disturbances between 10,000 square feet up to an acre. General Bylaw and enforcement remain in effect. No improvements or changes needed.
Wetlands Protection Act (local)	Local bylaw establishing 30-foot no disturb area of associated wetlands	Wetland resource areas	Enforced by the Conservation Commission	
Wetlands Protection Act (state)	State law regulating development and activity within wetland buffer zone	100-foot state buffer around wetland area; 200 foot buffer around river front areas.	Enforced by the Westminster Conservation Commission staffed by the municipal Conservation Agent.	No improvements or changes needed.
100 Year Flood Zone	Federal law requiring elevation above 100- year flood level of new and substantially improved residential structures in floodplain	100-year floodplain as shown on Flood Insurance Rate Map dated July 19, 1982.	Enforced by the Building Inspector (municipal staff) and Westminster Conservation Commission staffed by the municipal Conservation Agent.	Update Insurance Flood Rate Maps FEMA is in the process of doing this and have shared with the town drafts of the new FIRM maps.

Town Zoning Bylaw Flood Plain District	Local bylaw enhancing federal/state laws and regulating any development in the flood plain district	100-year floodplain as shown on Flood Insurance Rate Map dated July 19, 1982.	Enforced by the municipal Building Inspector and Conservation Commission staffed by the municipal Conservation Agent	Update Insurance Flood Rate Maps FEMA is in the process of doing this and have shared with the town drafts of the new FIRM maps.
Maintenance of municipal storm water drainage system	Regular cleaning of catch basins, storm drains, and culverts	Town-Wide	Directed by the Department of Public Works municipal staff.	Additional Personnel and Equipment Needed
Maintenance of public water bodies (ponds, streams, brooks, wetlands)	Periodic cleaning of waterways undertaken, e.g., remove trash, debris	Town-Wide	Undertaken by the Department of Public Works with guidance from Westminster Conservation Commission staffed by the municipal Conservation Agent.	Maintenance continues. No improvements or changes needed.
Inspection of major dams	Periodic inspections of the structural integrity of the dam	Major Dams	Directed by the Massachusetts Department of Conservation and Recreation, Office of Dam Safety.	Update Dam failure studies for the dams rated as high hazard
State Building Code	State Law related to design loads to include wind effects	Town-Wide	Enforced by Building Department municipal staff.	Continued enforcement remains in place. No improvements or changes needed.
National Grid's Tree Maintenance Program	Regular inspection and tree maintenance to cut branches threatening power lines and overhead utilities	Town-Wide	National Grid staff (Electric Company).	Tree maintenance continues. No improvements or changes needed.
Limited Brush Clearing	Provide access to Emergency Service vehicles	Town-Wide	Department of Public Works municipal staff.	Limited brush clearing continues. Identify additional Areas with Potential for Brushfires
Residential Parking Bans	Parking Bans to Enable Snow Removal Effectively from Residential Streets	Town-Wide	Department of Public Works municipal staff.	Residential parking bans remain in effect but additional personnel and equipment needed for enforcement

Clearing Snow from Major Arterial Routes	Ensure Access to Emergency Service vehicles	Town-Wide	Department of Public Works municipal staff.	Snow clearing continues but additional personnel and equipment needed.

10.0 Hazard Mitigation Strategy

10.1 Hazard Mitigation Goals

The Westminster Hazard Mitigation Planning Team identified the following hazard mitigation goals:

- Reduce the loss of life, property, infrastructure, and cultural resources from natural disasters;
- Identify and prioritize structural mitigation projects based on feasibility and cost effectiveness;
- Maintain adequate access to public utilities during and after a hazard event;
- Improve public education to inform residents of available resources during and after a hazard event;
- Increase awareness of hazard mitigation benefits to the public and enhance existing mitigation strategies

The planning team developed a list of mitigation strategies and prioritized them based on the strategy described below.

10.2 Impact

The planning team analyzed mitigation impact of each proposed action, regardless of cost and other constraints. The goal was to determine if cost were a non-issue, which actions would have the most benefit. Impacts were categorized as high, medium, or low based on the following parameters:

- **High Impact** – actions that help mitigate several hazards, substantially reduce loss of life and property, and/or aid a relatively large portion of the community.
- **Medium Impact** – actions that help mitigate multiple hazards, somewhat reduce loss of life and property, and/or aid a sizeable portion of the community.
- **Low Impact** – actions that help mitigate a single hazard, lead to little or no reduction in loss of life and property, and/or aid a highly localized area.

10.3 Priority

After ranking each mitigation action based on its potential impact, other factors were considered such as cost and cost effectiveness, project timing, political and public support, and the local administrative capabilities.

- **High Priority** – actions that have obvious impacts that clearly justify costs and can be funded to a large degree, can be completed in an appropriate timeframe, can be administrated efficiently and are supported locally.
- **Medium Priority** – actions that have some clear impacts that generally justify costs and generally can be funded, can be completed in an appropriate timeframe, can be administrated effectively, and are locally supported
- **Low Priority** – actions that have low impacts that do not necessarily justify costs and may have difficulty being funded, completed in an appropriate timeframe, administrated effectively, and locally supported.

10.4 Estimated Costs

A rough cost estimate was developed for each mitigation action based on available third-party or in-house estimates and past experiences. Cost estimates include construction, engineering, and Town staff time as appropriate. In cases where detailed and current estimates were not generally available, costs were summarized within the following ranges:

- **Low** – less than $50,000
- **Medium** – between $50,000 and $100,000
- **High** – more than $100,000

10.5 Type of Mitigation Actions

Proposed mitigation actions were separated into four categories to help facilitate the planning team's discussions[24].

- **Local Plans and Regulations** – policies, codes, or regulations that influence the way land and buildings are developed and built.
- **Structural Projects** – construction projects including infrastructure improvements to mitigate impacts or threats from identified natural hazards. Projects can apply to public or private structures.
- **Natural Systems Protection** – actions that minimize damage and losses while preserving or restoring functions of natural systems.
- **Education and Awareness Programs** – actions that inform and educate citizens, elected officials, and property owners about hazards and potential ways to mitigation them.

10.6 Proposed Mitigation Actions

Table 10-1 below describes proposed mitigation actions in place in Westminster. It includes a brief description of each measure as well as an evaluation of the potential impact, cost, and priority. The table also identifies the department responsible for coordinating efforts associated with that action.

[24] Local Mitigation Planning Handbook, FEMA, March 2013

Table 10-1: Westminster Mitigation Actions

Mitigation Action/ Description	Type of Action	Responsible Department	Impact	Cost	Priority	Potential Funding Sources	Timeline
Water Supply Infrastructure: Annual water conservation/ education communication with public. Public education about private wells (deep wells). Conservation outreach with Public Water Supply well. Education on low impact development, low water plants etc. Town to investigate ways of monitoring water usage.	Public Outreach /Education	DPW and Westminster	High	Low	High	Local	1-2 years
Electrical System: State Rd West Substation most affected during flood event - Monitor potential flooding events. Planning event with National Grid to discuss backup/rerouting capabilities. National Grid to continue tree trimming, line replacement, pole height, to protect against storms. Town to provide backup generators at public buildings. Generator at DPW to maintain SCADA system and backup emergency communications.	Utility Coordination/ Tree Trimming/ Generator Installation	DPW	High	Medium	High	Local, State, Federal	5-10 years
Wetlands Protection Act (local)	Local Plans and Regulations	Conservation Commission	High	Low	Medium	Local	3-5 years
100-Year Flood Zone	Local Plans and Regulations	Planning/ Conservation Commission	Medium	Medium	High	Local, State	Ongoing
Maintenance of municipal stormwater drainage system	Structural Projects	DPW	Medium	Low	High	Local, State	Ongoing
Update dam failure studies for the dams rated as high hazard	Local Plans and Regulations/ Structural Projects	Conservation Commission	Low	Medium	High	Local, State	Ongoing
Brush Clearing	Structural Projects	DPW	High	High	High	Local	Ongoing

Mitigation Action/ Description	Type of Action	Responsible Department	Impact	Cost	Priority	Potential Funding Sources	Timeline
Residential Parking Bans: Additional Personnel/Equipment	Local Plans and Regulations	DPW	Low	Low	Medium	Local	Ongoing
Snow Clearing from Major Arterial Routes: Additional Personnel/Equipment	Local Plans and Regulations	DPW	Low	Low	Medium	Local	Ongoing
Invasive Species, Beaver Control Program	Structural Projects	DPW	High	High	High	Local	Ongoing

11.0 Plan Adoption, Implementation, and Maintenance

11.1 Plan Adoption

A public meeting will be held after the public comment period as part of the Public Works Commission meeting to present the planning process to date as well as solicit comments from the public on the draft Hazard Mitigation Plan.

The draft plan was posted on the Town's website for additional public review and input.

The draft plan was submitted to MEMA and FEMA on June 30, 2021 for review. The Westminster Hazard Mitigation Plan will be adopted by the Town Manager upon receiving final approval from MEMA and FEMA.

11.2 Plan Implementation and Integration

Plan implementation will begin upon formal adoption by the Town Manager and approval by MEMA and FEMA. The Town departments identified in **Section 10** of the plan will be notified of their responsibilities following plan approval and the Hazard Mitigation Planning Team will oversee plan implementation. At a minimum, the plan will be reviewed and discussed with the following departments:

- Fire/Emergency Management
- Police Department
- Public Works
- Conservation Commission
- Planning

The plan will be posted on the town's website with sensitive information that would be inappropriate for posting redacted. A mechanism for providing feedback from the public will also be provided, such as an email address for the public to send comments. This will also allow for feedback from businesses and other large institutions in town.

Appropriate sections of the plan will be integrated into other town plans and policies as they are updated and reviewed, including the Open Space Plan, Capital Improvement Plan, and Master Plan.

11.3 Plan Maintenance

The DPW, with assistance of the Hazard Mitigation Planning Team shall monitor, evaluate and update the plan.

A scheduled annual review of the plan by the Planning Team will be conducted. The Team will review the hazard measures that have been implemented to date and determine the impact of these measures. The review will include site visits to appropriate locations as necessary. Mitigation actions that have not been implemented will be reviewed to determine if they will still be effective to minimize risk from natural hazards or if they are no longer an appropriate action to take. Additionally, the Team will determine any new options to include in an update of the plan.

Evaluation of the Hazard Mitigation Plan in its entirety will be conducted on a five-year basis in accordance with the Disaster Mitigation Act of 2002. The DPW will oversee the Hazard Mitigation Planning Team's involvement in the review and updating process. Status and prioritization of mitigation actions will be reviewed and updated accordingly as well.

The public will have opportunities to submit feedback and solicit comments from the Town regarding the plan. The public will be notified of any changes made to the plan and copies of the revised plan will be made available to the public online.

APPENDIX A

- Hazard Mitigation Planning Team Meeting Agendas and Sign-In Sheet

Agenda

- Program Overview
- Workshop Overview
- Discussion of Hazard Mitigation Plan
- Science and Resources Information
- Introduction to Small Team Exercise #1
- Reporting Small Team Findings #1
- Small Team Exercise #2
- Reporting Small Team Findings #2
- Summary Discussion

DATE: 3/16/2021

List of Participants

Participant	Department
ML Altobelli	Agricultural Committee
Heather Billings	Crocker Pond Committee
Kyle Butterfield	Fire Chief
John Deline	Deputy Commissioner of Water Supply (Fitchburg)
Robert Francis	Local Business Owner, Resident and Private Dam Owner
Patrick Haley	Assistant Director of DPW
Joshua Hall	DPW Director
Mark Hawke	Town Administrator
Ned LaFortune	Local Business Owner and Resident
Stephanie Lahtinen	Assistant to Town Administrator
Ralph LeBlanc	Chief of Police
Ann Loree	Health Agent
Lee Pelletier	Wyman Lake Association
Stephen Wallace	Town Planner
Jon Wyman	Chair of Planning Board

Name	BETA Group Title
Andrew Dennehy, P.E.	Senior Associate
Mary Beth Irwin	Staff Engineer
Katelyn Burke	Engineering Designer

APPENDIX B

- Critical Facilities Map

Town of Westminster, Massachusetts

Hazard Mitigation Plan
Critical Facilities Map DRAFT

APPENDIX C

- FEMA Flood Zones Map

Town of Westminster, Massachusetts

Hazard Mitigation Plan
FEMA Flood Zones Map
DRAFT

APPENDIX D

- FEMA Flood Zones Map Overlaid with Critical Facilities

Town of Westminster, Massachusetts

Hazard Mitigation Plan
FEMA Flood Zones with Critical Facilities Map
DRAFT