2020

Hazard Mitigation Plan
Sudbury, Massachusetts

Town of Sudbury Hazard Mitigation Plan
Sudbury, Massachusetts

Acknowledgements
Charlie Baker – *Governor*

Massachusetts Emergency Management Agency
Samantha Phillips – *Director*

Members of the Sudbury Local Hazard Mitigation Committee

Chief John Whalen - Sudbury Fire Chief

Adam Duchesneau – Director, Planning and Community Development

Beth Suedmeyer - Environmental Planner

William Barletta – Facilities Director

Andrew Lewis – Building Inspector's Office

Tim Choate – Fire Dept.

Scott Nix – Sudbury Police Chief

Dan Nason – DPW Director

William O'Rourke – Deputy Director, DPW

William Murphy – Director, Board of Health

Lori Capone – Sudbury Conservation Agent

Vin Roy – Director, Sudbury Water District

Marie Royea – Citizen/CERT Team

Heather Tecce – Sustainable Sudbury/MEMA Representative

Jeff Zukowski – MEMA Representative

Craig Pereira – Consultant, Horsley Witten Group, Inc.

A TOWN OF SUDBURY RESOLUTION
IN RECOGNITION OF

Sudbury's Hazard Mitigation Plan

WHEREAS, A Town Hazard Mitigation Plan preserves the health, safety, and welfare of the citizens of Sudbury and their property; and

WHEREAS, The 2020 Hazard Mitigation Plan is an update to the Hazard Mitigation Plan last adopted by the Board of Selectman on May 13, 2010; and

WHEREAS, The Town of Sudbury Local Hazard Mitigation Committee, and along with its contractor, the Horsley Witten Group, Inc. composed the plan and held a series of advertised and noticed public meetings from April 2019 through early 2020 on drafting the plan update; and

WHEREAS, Adoption of this plan is a federal requirement for the Town to be eligible for federal hazard mitigation grants as a result of a disaster or major mitigation planning project; and

WHEREAS, FEMA Region 1 has completed its review of the 2020 Town of Sudbury Hazard Mitigation Plan and approved it subject to approval by the Board of Selectmen; and

WHEREAS, Board of Selectmen approval will allow the Town to meet its local hazard mitigation planning requirements pursuant to 44 C.F.R. Section 201 (the Disaster Mitigation Act),

NOW, THEREFORE, BE IT RESOLVED that the Board of Selectmen of the Town of Sudbury do hereby accept and approve the Town of Sudbury 2020 Hazard Mitigation Plan as presented and outlined by the Fire/Emergency Management Department.

IN WITNESS WHEREOF, we have hereunto set our hands and caused the Seal of the Town of Sudbury to be affixed on this _____.

_____
Daniel E. Carty, Chair

_____
Patricia Brown, Vice Chair

_____
Janie Dretler, Member

_____
Jennifer Roberts, Member

_____
William Schineller, Member

_____
Maryanne Bilodeau, Clerk

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Section 1 Introduction

1.1 Overview

Each year in the United States, disasters take the lives of hundreds of people and injure thousands more. Nationwide, taxpayers pay billions of dollars annually to help communities, organizations, businesses, and individuals recover from disasters. These monies only partially reflect the true cost of disasters, because additional expenses to insurance companies and nongovernmental organizations are not reimbursed by tax dollars. Many disasters are predictable, and much of the damage caused by these events can be alleviated or even eliminated.

Hazard mitigation is defined by the Federal Emergency Management Agency (FEMA) as "any sustained action taken to reduce or eliminate long-term risk to human life and property from a hazard event." The results of a three-year, congressionally mandated independent study to assess future savings from mitigation activities provides evidence that mitigation activities are highly cost-effective. On average, each dollar spent on mitigation saves society an average of $4 in avoided future losses in addition to saving lives and preventing injuries (National Institute of Building Science Multi-Hazard Mitigation Council 2005).

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

This plan update was prepared pursuant to the requirements of the Disaster Mitigation Act of 2000 (Public Law 106-390) and the implementing regulations set forth by the Interim Final Rule published in the *Federal Register* on February 26, 2002 (44 CFR §201.6) and finalized on October 31, 2007 (hereafter, these requirements and regulations will be referred to collectively as the Disaster Mitigation Act). While the act emphasized the need for mitigation plans and more coordinated mitigation planning and implementation efforts, the regulations established the requirements that local hazard mitigation plans must meet in order for a local jurisdiction to be eligible for certain federal disaster assistance and hazard mitigation funding under the Robert T. Stafford Disaster Relief and Emergency Act (Public Law 93-288). Because the Town of Sudbury is subject to many kinds of hazards, access to these programs is vital.

Information in this plan update will be used to help guide and coordinate mitigation activities and decisions for local land use policy in the future. Proactive mitigation planning will help reduce the cost of disaster response and recovery to the community and its property owners by protecting critical community facilities, reducing liability exposure, and minimizing overall community impacts and disruption. The Town of Sudbury has been affected by

hazards in the past and is thus committed to reducing future disaster impacts and maintaining eligibility for federal funding.

The Town of Sudbury's 2010 Plan was developed as part of a regional approach conducted by The Metropolitan Area Planning Council (MAPC). This 2020 plan update represents a local jurisdiction plan that will serve as a stand-alone document relative to just the Town of Sudbury (with references to the State Hazard Mitigation Plan for consistency). The Town received a FEMA grant under the Municipal Vulnerability Preparedness (MVP) Program to develop a local hazard mitigation plan (HMP) update.

1.2 What Hazard Mitigation Can Do for the Town of Sudbury

A primary benefit of hazard mitigation is that preventative measures taken now can significantly reduce the cost of post-disaster cleanup tomorrow. In addition, mitigation actions conducted before hazards occur greatly reduces the impact and costs associated with the aftermath of a hazard event. By planning ahead, Sudbury will minimize the economic and social disruption that can result from floods, snowstorms, and hurricanes and other natural disasters.

The adoption and implementation of this plan update will assist Sudbury in remaining eligible to receive assistance from FEMA in both pre- and post-disaster assistance such as: FEMA's Community Rating System (CRS), FEMA's Pre-Disaster Mitigation Program (PDM), Flood Mitigation Assistance (FMA) Program, and FEMA's Post-Disaster Hazard Mitigation Grant Program (HMGP).

1.3 Sudbury's Mission Statement

The purpose of the Sudbury Hazard Mitigation Plan is to preserve the quality of life, property values, natural and historic resources by identifying all potential natural hazards impacting the community and mitigating their effects to reduce loss of life, as well as, losses of economic, natural, and historic resources.

1.4 Goals

The Sudbury Local Hazard Mitigation Committee (LHMC) met to evaluate the existing goals from the 2010 Plan and determined that more broad-brush goals applicable to the entire Town would be more appropriate. The new goals of the Sudbury Hazard Mitigation Plan are to:

1. Protect the public's health, safety and welfare.
2. Reduce property damages caused by hazard impacts.
3. Minimize social distress and economic losses/business disruption.
4. Provide an ongoing forum for the education and awareness of natural hazard mitigation issues, programs, policies, projects and resources.

1.5 Planning Process

A hazard mitigation plan should be considered a living document that must grow and adapt, keeping pace with a community's growth and change. The DMA of 2000 places high priority on the continuation of the planning process after the initial submittal, requiring communities to seek and receive re-approval from FEMA in order to remain eligible for assistance. The evaluation, revision and update process is also a means to create an institutional awareness and involvement in hazard mitigation as part of daily activities.

The Town of Sudbury, with the assistance of the Horsley Witten Group, Inc. (HW) developed this update/stand-alone Hazard Mitigation Plan. The Sudbury LHMC from the 2010 Plan was again, re-energized and enhanced to provide a broad spectrum of local knowledge and experience to complete this 2020 plan update.

Members of the Sudbury LHMC include:

- Chief John Whalen - Sudbury Fire Chief
- Adam Duchesneau – Director, Planning and Community Development
- Beth Suedmeyer - Environmental Planner
- William Barletta – Facilities Director
- Andrew Lewis – Building Inspector's Office
- Tim Choate – Fire Dept.
- Scott Nix – Sudbury Police Chief
- Dan Nason – DPW Director
- Lori Capone – Sudbury Conservation Agent
- Vin Roy – Director, Sudbury Water District
- Marie Royea – Citizen/CERT Team
- Heather Tecce – Sustainable Sudbury/MEMA Representative
- Jeff Zukowski – MEMA Representative
- Craig Pereira – Consultant, Horsley Witten Group, Inc.

The Horsley Witten Group, Inc. conducted a series of meetings from April 2, 2019 through December 2019 with the Sudbury LHMC, municipal officials, the community, and representatives of MEMA. The public workshops were held in an open public forum and in accordance with M.A.G.L. c. 30A, Sections 18 - 25 in complying with the requirements of the Federal Disaster Mitigation Act of 2000 (DMA 2000).

A project webpage was designed and hosted on the Town's municipal website to announce the project, inform and engage the community before, during and after plan development, and to serve as a repository of project documents, presentations, and summaries. A PDF of the project webpage layout is included in Appendix B.

A series of Municipal Interviews (in-person, telephone and email correspondence) were conducted early in the update process (as part of the

MVP process) for the development of the 2010 Plan Report Card (Table 1-1), identification of accomplishments since the 2010 Plan, and preliminary identification of mitigation measures for consideration in the plan update.

In-Person Interviews:

- Chief John Whalen - Sudbury Fire Chief
- Adam Duchesneau – Director, Planning and Community Development
- William Barletta – Facilities Director
- Scott Nix – Sudbury Police Chief
- Vin Roy – Director, Sudbury Water District
- Bill Murphy – Board of Health
- Bill O'Rourke - DPW

Table 1-1
2010 Plan Report Card (2020 Update) Sudbury, Massachusetts

Mitigation Measure	*Location*	*Ownership*	*Natural Hazard*	*Primary Problem/Effect*	*Mitigation Objective*	*Risk H-Historical P- Potential*	*2020 Status*
High Priority Mitigation Measures							
Enhance Flood Plain Bylaw enforcement assistance (2010 Plan Mitigation Action #1)	1030 Concord Road	Private	Flooding	Private property damage	Reduced damages/cost for property owner	H and P	Not Completed… pending funding at 2019 Town Meeting
Revise wetlands bylaw to provide better wildlife habitat protection and comply with new DEP Stormwater regulations (2010 Plan Mitigation Action #2)	Townwide	Public and Private	Flooding	Public and Private property damage	Reduced damages/costs for property owners; retrofit of structures to current standards; public education/safety	H and P	Completed… ongoing. Move to Capability Assessment
Increase Town emergency response to imminent storms and during winter storms. (2010 Plan Mitigation Action #3)	Townwide	Public and Private	All Hazards	Damage to public/private property; compromised emergency response/public safety	Reduced damages/costs for public/private property owners; public safety	H and P	Completed
Elevate the grade of Concord Road two feet (between Lincoln Road to Old Sudbury Rd.) (2010 Plan Mitigation Action #4)	FEMA Flood Zone	Public and Private	Flooding	Private property damage; environmental contamination	Reduced damages/costs for property owners; Minimize environmental; public safety	H and P	Not Completed… carry forward

Table 1-1
2010 Plan Report Card (2020 Update) Sudbury, Massachusetts

Mitigation Measure	*Location*	*Ownership*	*Natural Hazard*	*Primary Problem/Effect*	*Mitigation Objective*	*Risk H-Historical P- Potential*	*2020 Status*
Elevate Concord Rd. two feet (eastern end of Concord Rd.) (2010 Plan Mitigation Action #5)	FEMA Flood Zone	Public and Private	Flooding	Private property damage; environmental contamination	Reduced damages/costs for property owners; Minimize environmental; public safety	H and P	Not Completed… carry forward
Remove beaver dam and conduct beaver trapping/removal as needed (2010 Plan Mitigation Action #6)	FEMA Flood Zone	Public and Private	Flooding	Damage to private property	Reduced damages/costs to private property; public safety	H and P	Completed
Develop inspection/maintenance plans: Carding Mill and Stearns Mill Dams (2010 Plan Mitigation Action #7)	Carding Mill/Stearns Mill Dams	Public and Private	Flooding	Damage to public/private property and infrastructure	Reduced damages/costs to public/private property	H and P	Completed
Establish a regular tree inventory and maintenance plan (2010 Plan Mitigation Action #8)	Townwide	Public and Private	Snow/Blizzard/Ice, Wind-related events	Damage to public/private property; compromised public safety	Reduced damages/costs to public/private property; public safety	H and P	Not Completed… carry forward
Establish microwave link communications system with repeater at Nobscot Mountain (2010 Plan Mitigation Action #9)	Nobscot Mountain	Public and Private	All Hazards	Compromised emergency response/public safety	Improved emergency response; public safety	H and P	Completed

Table 1-1
2010 Plan Report Card (2020 Update) Sudbury, Massachusetts

Mitigation Measure	*Location*	*Ownership*	*Natural Hazard*	*Primary Problem/Effect*	*Mitigation Objective*	*Risk H-Historical P- Potential*	*2020 Status*
Establish a municipal HAM radio station and provide training/licensing for operators (2010 Plan Mitigation Action #10)	Townwide	Public and Private	All Hazards	Compromised emergency response/public safety	Improved emergency response; public safety	H and P	Not Completed… remove
Build a municipal Emergency Operations Center as part of the redesign of Fire dept. or new Police Station (2010 Plan Mitigation Action #11)	Townwide	Public and Private	All Hazards	Compromised emergency response/public safety	Improved emergency response; public safety	H and P	Completed
Reconfigure generators at Lincoln-Sudbury High School to include heating capability (2010 Plan Mitigation Action #12)	Lincoln-Sudbury High School	Public	All Hazards	Economic/social hardship; Loss of life/property	Expedited coordination with the City; public safety	H and P	Not Completed… carry forward
Install a large-capacity , multi-fuel generator at the Curtis Middle School (2010 Plan Mitigation Action #13)	Curtis Middle School	Public	All Hazards	Limited sheltering capability	Enhanced sheltering capacity; public safety	H and P	Not Completed… carry forward

Table 1-1
2010 Plan Report Card (2020 Update) Sudbury, Massachusetts

Mitigation Measure	*Location*	*Ownership*	*Natural Hazard*	*Primary Problem/Effect*	*Mitigation Objective*	*Risk H-Historical P- Potential*	*2020 Status*
Acquire a large, mobile, diesel generator for the Fire Dept. (2010 Plan Mitigation Action #14)	Townwide	Public	All Hazards	Limited emergency response capability	Enhanced response capacity; public safety	H and P	Completed
Measures to Ensure Compliance with NFIP							
Adopt new regulations for the Water Resource Protection District Bylaw (2010 Plan Mitigation Action #15)	Townwide	Public and Private	All Hazards	Environmental contamination	Minimized environmental; public safety	H and P	Not Completed… carry forward
Develop/Adopt new Stormwater Bylaw in conjunction with MAPC (2010 Plan Mitigation Action #16)	Townwide	Public and Private	Flooding	Environmental contamination	Minimized environmental contamination; public safety	H and P	Completed
Develop/Adopt new Earth Removal Bylaw (2010 Plan Mitigation Action #17)	Townwide	Public and Private	Flooding	Damage to public/private property; compromised public safety	Reduced damages/costs to public/private property; public safety	H and P	Not Completed… carry forward
Acquire wetlands parcels in the Sudbury River floodplain (2010 Plan Mitigation Action #18)	FEMA Flood Zone	Public and Private	Flooding	Damage to public/private property; compromised public safety	Reduced damages/costs to public/private property; public safety	H and P	Completed… ongoing. Move to Capability Assessment
Increase funding for preventative practices on drainage infrastructure (2010 Plan Mitigation Action #19)	Townwide	Public/Private	Flooding	Damage to public/private property; Environmental contamination	Reduced damages/costs to public/private property; Minimized environmental contamination	H and P	Not Completed… carry forward

Table 1-1
2010 Plan Report Card (2020 Update) Sudbury, Massachusetts

Mitigation Measure	*Location*	*Ownership*	*Natural Hazard*	*Primary Problem/Effect*	*Mitigation Objective*	*Risk H-Historical P- Potential*	*2020 Status*
Medium Priority Mitigation Measures							
Continue ongoing education for town residents on stormwater and wetland resources (2010 Plan Mitigation Action #20)	Townwide	Public/Private	Flooding	Damage to public/private property; Environmental contamination	Reduced damages/costs to public/private property; Minimized environmental contamination	H and P	Completed… ongoing. Move to Capability Assessment
Complete repairs and develop Operations and Management Plan for Pantry Brook Dam (2010 Plan Mitigation Action #21)	Pantry Brook Dam	Public	Flooding	Damage to public/private property	Reduced damages/costs to public/private property	H and P	Not Completed… carry forward
Elevate Concord Rd. near Nashawtuc Country Club (2010 Plan Mitigation Action #22)	Concord Rd. near Nashawtuc Country Club	Public/Private	Flooding	Damage to public/private property	Reduced damages/costs to public/private property	H and P	Not Completed… carry forward
Upgrade older drainage systems in town (2010 Plan Mitigation Action #23)	Townwide	Public	Flooding	Damage to public/private property; Environmental contamination	Reduced damages/costs to public/private property; Minimized environmental contamination	H and P	Not Completed… carry forward
Beaver dam removal, beaver trapping/removal as needed (2010 Plan Mitigation Action #24)	Maynard Rd., Water Row, Concord Rd., Moore Rd.	Public/Private	Flooding	Damage to private property	Reduced damages/costs to private property; public safety	H and P	Completed… ongoing. Move to Capability Assessment

Table 1-1
2010 Plan Report Card (2020 Update) Sudbury, Massachusetts

Mitigation Measure	*Location*	*Ownership*	*Natural Hazard*	*Primary Problem/Effect*	*Mitigation Objective*	*Risk H-Historical P- Potential*	*2020 Status*
Establish more frequent maintenance schedules for town-owned drainage facilities (2010 Plan Mitigation Action #25)	Townwide	Public	Flooding	Damage to public /private property; Environmental contamination	Reduced damages/costs to public/private property; Minimized environmental contamination	H and P	Completed… ongoing. Move to Capability Assessment
Acquire Soft Suction pond water drafting system (2010 Plan Mitigation Action #26)	Townwide	Public	Wildfire	Limited emergency response capability; Damage to public/private property; Loss of life/property	Enhanced response capacity; Reduced damages/costs to public/private property; Public safety	H and P	Completed
Devote more resources to privately-owned drainage facilities (2010 Plan Mitigation Action #27)	Townwide	Private	Flooding	Damage to private property; Environmental contamination	Reduced damages/costs to private property; Minimized environmental contamination	H and P	Not Completed… carry forward
Relocate overhead electrical/cable utility lines underground (2010 Plan Mitigation Action #28)	Townwide	Private	All Hazards	Economic/social hardship; interruption of essential/lifeline systems	Reduced social hardships; Continuity of essential/lifeline systems	H and P	Not Completed… carry forward
Conduct feasibility study to investigate options for all public buildings to be earthquake proof (2010 Plan Mitigation Action #29)	Townwide	Public	Earthquakes	Damage to public property; Loss of life/property	Reduced damages/costs to public property; Public safety	H and P	Not Completed… carry forward

Table 1-1
2010 Plan Report Card (2020 Update) Sudbury, Massachusetts

Mitigation Measure	*Location*	*Ownership*	*Natural Hazard*	*Primary Problem/Effect*	*Mitigation Objective*	*Risk H-Historical P- Potential*	*2020 Status*
Add manpower to the Fire Dept. and provide homeowner education on fire prevention using building/landscaping best management practices (2010 Plan Mitigation Action #30)	Townwide	Public/Private	Wildfire/Fire	Limited emergency response capability; Damage to public/private property; Loss of life/property	Enhanced response capacity; Reduced damages/costs to public/private property; Public safety	H and P	Completed… ongoing. Move to Capability Assessment
Beaver dam removal, beaver trapping/removal as needed (2010 Plan Mitigation Action #30)	Hickory Rd.	Public/Private	Flooding	Damage to private property	Reduced damages/costs to private property; public safety	H and P	Completed… ongoing. Move to Capability Assessment
Low Priority Mitigation Measures							
Increase outreach and education on subsidence, erosion, stormwater and BMPs to landscapers and contractors (2010 Plan Mitigation Action #32)	Townwide	Public/Private	Flooding	Damage to public /private property; Environmental contamination	Reduced damages/costs to public/private property; Minimized environmental contamination	H and P	Completed… ongoing. Move to Capability Assessment

The Sudbury LHMC first met on April 19, 2019 to kick off three projects: the MVP project; the HMP update; and, the policy/regulatory review project. As each project builds upon the next, it was important to ground truth schedules, outreach and deliverables. For the hazard mitigation component of this meeting, the LHMC confirmed its membership, reviewed the project scope and revised schedule, discussed project coordination, reviewed proposed revisions to the plan update's mitigation measures layout (utilization of hazard mitigation categories) and identification of risks content (to include climate change), and discussed the logistics for the first Public Workshop. A complete set of meeting materials is included in Appendix B.

The first Public Workshop was held May 30, 2019 at the Sudbury Grange in the Meeting Room. This workshop was a joint meeting for the MVP and HMP projects. Announcements were posted on the project webpage, and emailed to Sudbury Boards, Commissions and interested citizens, copies have been included in Appendix B. The presentation included an overview of the mitigation process, goals and measures, followed by a review of the 2010 Risk Assessment Matrix Report Card, and preliminary revisions to the plan update (based on personal interviews with municipal officials, boards, and commissions). The Workshop agenda, PowerPoint Presentation and Sign-In Sheet are included in Appendix B.

The Sudbury LHMC met for a second time on September 5, 2019 to discuss elements of Section 1 Introduction, including the update's mission statement and goals. Next, a discussion of Section 2 Risk Assessment elements, including a GIS mapping update, development trends since the 2010 plan, NFIP property data update and FEMA grant assistance since the 2010 plan. The meeting concluded with an overview of Section 4 Mitigation Strategy to inform the LHMC what they needed to consider for the upcoming meeting. A complete set of meeting materials is included in Appendix B.

The Sudbury LHMC met for a third time on October 30, 2019 to conduct a follow up to content needed for the update, review the updated risk maps and economic vulnerability analyses, complete the actions for continued NFIP compliance table and hear a report out of the online survey findings. A review of the preliminary mitigation actions for consideration included carry over actions from the 2010 plan, actions identified out of the MVP and policy/regulatory review processes, and contributions from the LHMC. A complete set of meeting materials is included in Appendix B.

The Sudbury LHMC met for a fourth time on December 4, 2019 to conduct the Benefit Cost Analysis (BCA review). The Project Consultant reviewed the draft 2020 Mitigation Actions (Table 4-1) which identified those actions: Ongoing – initially addressed but requires ongoing maintenance/attention, therefore, carried forward from the 2010 plan; Not addressed/partially addressed - revised from the 2010 plan; and, New - completely new action items. The Sudbury LHMC completed the BCA review to prioritize/rank the action items, assigned time

frames and responsible parties, and agreed on the proposed methodology/schedule for plan maintenance and plan update (based on FEMA requirements). A complete set of meeting materials is included in Appendix B.

The second Public Workshop was held January 29, 2020 at the Sudbury Town Hall. Announcements were posted on the project webpage, and emailed to Sudbury Boards, Commissions and interested citizens, copies have been included in Appendix B. The presentation included list of accomplishments to date, overview of preliminary mitigation actions, questions from the audience, and identification of next steps. The Workshop agenda, PowerPoint Presentation and Sign-In Sheet are included in Appendix B.

Online Survey

The survey link was opened and available mid-August 2019 through the end of September 2019 and included a total of 90 responses. A brief summary of responses collected is included below. The full Survey Summary is included in Appendix B.

- Most residents/businesses have experienced winter, wind, and temperature-related hazard events in the past 20 years;
- Just over half (54%) of respondents feel they are adequately prepared to deal with a natural hazard event, with most getting their information from local news/social media (76%) and/or personal experience (72%) with one or more natural hazards;
- Most respondents are 'Very Concerned' with winter (39%) and wind-related hazards (29%%), followed by temperature-related hazards (16%);
- 83% of respondents know for sure whether or not their property is located in/near a FEMA –designated floodplain;
- Just over (67%) of respondents are interested in making their home, business or neighborhood more resilient, with 66% willing to spend their own money to do so; and
- The top four choices to reduce damage/destruction of natural hazards in Sudbury include:
    - Work to improve utility resilience: electric; communications; water/wastewater facilities (79%)
    - Retrofit public infrastructure, such as elevating roadways and improving drainage systems (60%)
    - Inform property owners of ways they can reduce the damage caused by natural events (55%)
    - Replace inadequate/vulnerable bridges and inform property owners of ways they can reduce the damage caused by natural events (49%).

With this information, the project consultant prepared the draft Hazard Mitigation Plan update which was available for public comment from February 3, 2020 through February 28, 2020 (online, on the Town's website and hard copies

available at the Town Hall (see Appendix C for Notice of Availability of draft) with ___ comments returned.

This plan update was also forwarded to the neighboring communities of: Framingham, Nathaniel Eames - Associate Planner; Wayland, Sarkis Sarkisian – Town Planner; Acton, Roland Bartl - Director of Planning and Land Management; Concord, Jennifer Burney – Director of Planning and Land Use; Marlborough, Arthur Vigeant – Mayor; Hudson, Jack Hunter – Director Planning and Community Development; Stow, Jesse Steadman – Town Planner; and Maynard, Bill Nemser – Town Planner. All received notice of the draft update availability on the Town of Sudbury's website, with _____ returning any comments. The draft was submitted to the Sudbury Board of Selectmen for approval to forward on up to MEMA, then forwarded to MEMA for consideration. It is the intention of the Sudbury LHMC that the Hazard Mitigation Plan update be an available and pertinent source of information to a wide variety of individuals and interests. The plan update also has a specific and pragmatic function. By identifying and prioritizing local mitigation needs, the plan update has already served, and will continue to serve, as a basis for amendments to local policies and regulations.

State authorities will incorporate information compiled in this document into the State Hazard Mitigation Plan, to strengthen the statewide knowledge and idea-base for mitigation planning. A well-prepared and locally adopted plan can demonstrate understanding and commitment, two important variables when vying for limited, high-demand resources.

1.6 Environmental Setting

Sudbury is a charming community located approximately twenty miles west of Boston, along the major highways of Route 20 in the south and Route 117 in the north and bisected by Route 27. Rooted deeply in history, Sudbury is known for Longfellow's Inn, including The Redstone Schoolhouse where Mary brought her little lamb, the Grist Mill and the Martha Mary Chapel. The town is also noted for its excellent domestic underground water supply, excellent schools and well managed government. Sudbury is one of the older towns in the New England area, being incorporated in 1639, and it has one of the oldest and longest-running open meeting forms of government.[1]

The Town is governed by a Board of Selectmen with a Town Manager. The Town operates under the representative Town Meeting format.

[1] http://www.mass.gov/dhcd/iprofile/288.pdf

1.7 History of Disaster Declarations

Since 1953, FEMA Region 1 (the New England States) has endured more than 150 federal emergency (EM) and major disaster declarations (DR), 28 of which impacted Massachusetts. The following information (Table 1-2 below) gives an overview of the most significant past federal emergency and major disaster declarations for Massachusetts (and in particular Middlesex County, and including Sudbury):

Table 1-2 Significant Federal Emergency and Major Disaster Declarations, Middlesex County

ID Number	Type	Date
DR-751	Hurricane Gloria	September 1985
DR-790	Severe Storms/Flooding	April 1987
DR-914	Hurricane Bob	August 1991
DR-920	Severe Coastal Storm	October 1991
DR-975	Winter Coastal Storm	December 1992
EM-3103	Blizzard/High Winds	March 1993
DR-1090	January Blizzard	January 1996
DR-1142	Severe Storm/Flooding	October 1996
DR-1224	Heavy Rain/Flooding	June 1998
EM-3153	Fire	December 1999
EM-3165	Snowstorm	March 2001
DR-1364	Severe Storms/Flooding	April 2001
EM-3175	Snowstorm	March 2003
EM-3191	Snow	January 2004
DR-1512	Flooding	April 2004
EM-3201	Snow	February 2005
EM-3252	Hurricane Katrina Evacuation	September 2005
DR 1614	Severe Storms/Flooding	May 2006
DR-1701	Severe Storms/Flooding	April 2007
EM-3296	Sever Winter Storm	December 2008
DR-1813	Severe Winter Storm/Flooding	January 2009
DR-1895	Severe Storms/Flooding	March 2010
EM-3312	Water Main Break	May 2010
EM-3315	Hurricane Earl	September 2010
EM-3330	Hurricane Irene	August 2011
EM-3343	Severe Storm	November 2011
EM-3350	Hurricane Sandy	October 2012
DR-4097	Hurricane Sandy	October 2012
DR-4110	Severe Winter Storm/Snow/Flooding	February 2013
DR-4214	Severe Winter Storm/Snow/Flooding	January 2015
DR-4372	Severe Winter Storm/Flooding	March 2018

DR-4379	Severe Winter Storm/Snow	March 2018

Sources: 2018 State Hazard Mitigation and Climate Adaptation Plan, Commonwealth of Massachusetts, *NOAA National Climatic Data Center,* www.ncdc.noaa.gov.

1.8 Recent Disaster Declarations

The communities of Middlesex County (including Sudbury) have experienced significant losses during several recent storms that have warranted FEMA to declare these storms as disasters. The following are descriptions of each of the recent storms (since the 2010 Plan) that have been declared as disasters by FEMA and which have affected the Town of Sudbury.

1.8.1 Hurricane Storm Irene – August 2011 (FEMA EM-3330)

Hurricane Irene formed east of the Caribbean Island of Dominica, part of the Lesser Antilles region, on the afternoon of August 20, 2011. Irene moved through the Caribbean and up the east coast of the United States making landfall twice. She first made landfall as a Category 1 Hurricane near Cape Lookout, North Carolina around 7:30 am on August 27th, then moved offshore again during the evening. She then made a 2nd landfall, again as a Category 1 Hurricane at 5:40 am on August 28th near Little Egg Inlet in New Jersey. She moved over New York City and then into southeastern New York State and Connecticut as a Tropical Storm a few hours later. By the end of the evening of the 28th, Irene was crossing the U.S./Canada border having produced significant amounts of rain, storm surge, inland and coastal flooding, and wind damage across southern New England and much of the east coast of the United States.

The collective effects of Tropical Storm Irene on August 28th, resulted in 1 fatality, 0 injuries, and $127.3M in property damage in the following counties: Barnstable, Cumberland, Essex, Franklin, Hampden, Hampshire, Middlesex, Nantucket, Norfolk, Plymouth, Suffolk, and Worcester (all in MA), Hartford, Tolland, and Windham (all in CT), Cheshire and Hillsborough (all in NH), and Providence, Kent, Washington, and Newport (all in RI).[2]

1.8.2 Hurricane Sandy - October 2012 (FEMA DR-4097)

Sandy, a hybrid storm with both tropical and extra-tropical characteristics, brought high winds and coastal flooding to southern New England. Easterly winds gusted to 50 to 60 mph for interior southern New England; 55 to 65 mph along the eastern Massachusetts coast and along the I-95 corridor in southeast Massachusetts and Rhode Island; and 70 to 80 mph along the southeast Massachusetts and Rhode Island coasts. A few higher gusts occurred along the Rhode Island coast. A severe thunderstorm embedded in an outer band associated with Sandy produced wind gusts to 90 mph and concentrated damage in Wareham early Tuesday evening, a day after the center of Sandy had

[2] National Climatic Data Center, www.ncdc.noaa.gov

moved into New Jersey. In general, moderate coastal flooding occurred along the Massachusetts coastline, and major coastal flooding impacted the Rhode Island coastline. The storm surge was generally 2.5 to 4.5 feet along the east coast of Massachusetts, but peaked late Monday afternoon in between high tide cycles. Seas built to between 20 and 25 feet Monday afternoon and evening just off the Massachusetts east coast. Along the south coast, the storm surge was 4 to 6 feet and seas from 30 to a little over 35 feet were observed in the outer coastal waters. The very large waves on top of the storm surge caused destructive coastal flooding along stretches of the Rhode Island exposed south coast.

Sandy grew into a hurricane over the southwest Caribbean and then headed north across Jamaica, Cuba, and the Bahamas. As Sandy headed north of the Bahamas, the storm interacted with a vigorous weather system moving west to east across the United States and began to take on a hybrid structure. Strong high pressure over southeast Canada helped with the expansion of the strong winds well north of the center of Sandy. In essence, Sandy retained the structure of a hurricane near its center (until shortly before landfall) while taking on more of an extra-tropical cyclone configuration well away from the center. Sandy's track was unusual. The storm headed northeast and then north across the western Atlantic and then sharply turned to the west to make landfall near Atlantic City, NJ during Monday evening. Sandy subsequently weakened and moved west across southern Pennsylvania on Tuesday before turning north and heading across western New York state into Quebec during Tuesday night and Wednesday.[3]

1.8.3 Severe Winter Storm/Snow/Flooding – February 2013 (FEMA DR-4110)

An historic winter storm deposited tremendous amounts of snow over all of southern New England, mainly from the mid-afternoon on Friday, February 8 and lasting into the daylight hours of Saturday, February 9. What made this an amazing storm was the widespread coverage of heavy snowfall. Most locations received 2 to 2.5 feet of snow. A stationary band of even heavier snowfall persisted from southwest NH through central MA and on to the southwest across central and western CT. In those areas, reports averaged closer to 2.5 to 3 feet. Along the southeast MA coast, average amounts ranged from 1 to 2 feet. Only on Martha's Vineyard and Nantucket were snowfall totals less than 1 foot (6 to 12 inches). Isolated thunderstorms were common across the entire region during the height of the storm.

A low pressure system advancing from the Great Lakes region combined forces with a very moist low pressure system moving northeast from the Gulf Coast states. Explosive deepening took place Friday evening, February 8, as a low center moved from the North Carolina coast to south of Nantucket. Strong high pressure to the north of New England helped ensure that cold air remained in

[3] Ibid.

place over the area. Snowfall gained intensity during the afternoon, but during the night, 2 to 3 inch per hour amounts were common throughout the region. The band of heaviest snowfall, with 3 to 5 inches per hour for several hours, extended from southwest NH to central and western CT. The precipitation started as mainly snow, although a brief period of rain at the onset was common on the Islands. Snow ended in the morning in western and central MA, southwest NH, most of CT and RI, and in the early afternoon across eastern MA. It lingered during the whole afternoon over Cape Cod and Nantucket, aided by some ocean-effect bands of snowfall.

1.8.4 Severe Winter Storm/Snow/Flooding – January 2015 (FEMA DR-4214)

An historic winter storm brought heavy snow to southern New England with blizzard conditions to much of Rhode Island and Massachusetts, beginning during the day on Monday, January 26, 2015 and lasting into the early morning hours of Tuesday, January 27th. The highest snowfall totals, averaging two to three feet, extended from extreme northeast Connecticut and northwest Rhode Island into much of central and northeast Massachusetts, including greater Boston. Much of southeast Massachusetts and the rest of Rhode Island received one to two feet of snow. Totals dropped off dramatically west of the Connecticut River Valley where totals of 4 to 8 inches were observed.

The storm was well-forecast, with Blizzard Watches and Winter Storm Watches issued 2 days before the snow began. Low pressure tracked northeast from the Carolinas and strengthened rapidly as it slowly passed southeast of Nantucket on Monday evening, January 26. All of the precipitation fell as snow with this storm. At its peak, snowfall rates of 2 to 3 inches per hour were common.

Daily snowfall records were set for January 27th in Boston (22.1 inches, previous record 8.8 inches in 2011), Worcester (31.9 inches, previous record 11.0 inches in 2011), and Providence (16.0 inches, previous record 6.7 inches in 2011). In Providence, the total of 19.1 inches was the fourth highest on record (dating back to 1904), while in Boston the total of 24.6 inches was the sixth highest on record (dating back to 1872).

The Blizzard of January 2015 produced very strong winds late Monday into Tuesday near the Massachusetts and Rhode Island coasts where gusts of 50 to 65 mph were common.

1.8.5 Severe Winter Storm/Snow – March 2018 (FEMA DR-4372)

Low pressure moving out of the Ohio Valley passed south of Southern New England on the 2nd and moved out to sea on the 3rd. This storm brought heavy snow to northwest Massachusetts, heavy rain and strong winds to central and eastern Massachusetts, and coastal flooding to the coastline. Moderate to major coastal flooding took place over three tide cycles due to astronomically high tides

and a persistent northeast wind. This built a storm surge of two to four feet along the Massachusetts East Coast.[4]

1.8.6 Severe Winter Storm/Flooding – March 2018 (FEMA DR-4379)

Low pressure along the Carolina coast March 12 moved up the coast and passed offshore of Southern New England on March 13, moving off through the Maritimes on March 14. The storm brought snow accumulations of one to two feet across Eastern Massachusetts and wind gusts of seventy to eighty miles per hour to Cape Cod and the Islands. Blizzard conditions were observed at Boston's Logan International Airport, Marshfield, Plymouth, Hyannis, and Martha's Vineyard.[5]

[4] Ibid.
[5] Ibid.

Section 2 Risk Assessment

2.1 Introduction

Identifying potential hazards is the first step in any effort to reduce community vulnerability. The subsequent identification of the risk and vulnerability for a community are the primary factors in determining how best to allocate finite resources to address what mitigation might take place. The FEMA document titled Plan Review Guide, dated October 1, 2011 was used in developing this strategy plan as a basic template to identify the various natural hazard types. The hazard identification and analysis involves all of those hazards that potentially threaten the Town of Sudbury.

By collecting and analyzing information for each potential hazard that may affect Sudbury, several determinations have been made:

- Which hazards merit special attention
- What actions might be taken to reduce the impact(s) of those hazards
- What resources are likely to be needed

2.2 Hazard Identification

The Sudbury LHMC evaluated each of the hazard types that may affect Sudbury, with the addition of Climate Change. For the purposes of the 2020 plan update, and for consistency with the State Hazard Mitigation Plan, the Sudbury LHMC decided to organize natural hazards into the following categories and listed in order of frequency and impact, beginning at the top of the list with the most frequently occurring natural hazards:

- Flood-Related Hazards
- Winter-Related Hazards
- Wind-Related Hazards
- Geologic-Related Hazards
- Drought/Extreme Heat-Related Hazards
- Urban Fire/Wildfire-Related Hazards
- Invasive Species-Related Hazards

The Horsley Witten Group, Inc. created new updated Town-wide Geographical Information Systems (GIS) mapping with Location Map (Map 1-1), Flood Hazard Areas Map (Map 2-1), Earthquakes/Landslides Map (Map 2-2), Hurricanes/Tornadoes Map (Map 2-3), Average Annual Snowfall Map (Map 2-4), Critical Facilities separated into quadrants for readability (Maps 2-5.1 through 2-5.4, and Table A-1 Critical Facilities - Sudbury), and Traffic Control Points/Evacuation Routes (Map 2-6).

2.3 Hazard Profiles: Location, History and Probability of Future Occurrence

In assessing the hazards to a community, both the risk and the vulnerability must be taken into account. A hazard is the actual event that poses the danger to the community, (e.g. the hurricane, tornado, earthquake, etc. that threatens the Town). The term "risk" refers to the predicted impact that a hazard would have on people, services, specific facilities and structures in the community. The term "vulnerability" refers to the characteristics of the society or environment affected by the event that resulted in the costs from damages (Heinz Center Report, 1999, p. 105). The vulnerability of an area refers to its susceptibility to a hazard. The areas of the town affected by extreme natural events are identified by the hazard risk assessment. In determining the risk and vulnerability of the town, the likelihood, frequency and magnitude of damage from identified hazards are assessed.

In developing the Risk Assessment, the Sudbury LHMC defined the risks that the Town could face and followed up with an assessment of the vulnerability of the at-risk areas, and the implications of experiencing natural disasters (e.g., loss of life, damage to the natural environment, property damage, and economic losses). Risk assessment is the determination of the likelihood of adverse impacts associated with specific natural hazards, and vulnerability assessment is concerned with the qualitative or quantitative examination of the exposure of some societal component (i.e. economy, environment). The result of this process was the preparation of a Risk Assessment Matrix (Table 2.1 Risk Assessment Matrix 2020 Update) that lists the vulnerable areas and the primary effects from an event on these areas. The matrix was then used to establish mitigation benefits and develop mitigation strategies (Section 4).

Hazard Index

The Sudbury LHMC evaluated each of the flood, winter, wind, fire and geologic-related hazards and collectively determined the likelihood of occurrence, locations affected, and potential impacts of each. This information was used to establish a Hazard Index (HI) value (HI=1 being lowest impact and HI=10 being highest impact) for each of the types of natural hazards and is presented in Table 2-2. The highest hazard index values were assigned to those natural hazards that were deemed to have the highest level of impact to the community. These hazards include flood-related hazards such as inland/urban flooding/heavy rain (HI=7), winter-related hazards such as snow/nor'easter/blizzards (HI=7), and wind-related hazards such as hurricanes (HI=7).

The Hazard Index for this 2020 plan update utilizes language used in the FEMA State and Local Mitigation Planning How-to-Guide Series for frequency and severity categorization:

Criteria for Frequency Categorization:

Very low frequency: events that occur less frequently than once in 1,000 years (less than 0.1% per year).
Low frequency: events that occur from once in 100 years to once in 1,000 years (0.1% to 1% per year).
Medium frequency: events that occur from once in 10 years to once in 100 years (1% to 10% per year).
High frequency: events that occur more frequently than once in 10 years (greater than 10% per year).

The criteria used for severity categorization, based on past hazard events includes:

Criteria for Severity Categorization (based on past hazard events):

Minor: Limited and scattered property damage; no damage to public infrastructure; contained geographic area; essential services not interrupted; no injuries or fatalities.
Serious: Scattered major property damage; some minor infrastructure damage; wider geographic area; essential services are briefly interrupted; some injuries/fatalities.
Extensive: Consistent major property damage; major damage to public infrastructure; essential services are interrupted for several hours to several days; many injuries and fatalities.
Catastrophic: Property and public infrastructure destroyed; essential services stopped; thousands of injuries and fatalities.

Table 2-1
2020 Risk Assessment Matrix, Town of Sudbury

Vulnerable Area	Location	Ownership	Natural Hazard	Primary Problems/Effects	Mitigation Benefits	Risk H-Historical P- Potential
Local Roads Subject to Flooding	Town-wide	Public and Private	Riverine/Flash Flooding; Heavy Rain/Inland and Urban Flooding; Blizzards/Heavy Snow/Nor' Easters; Hurricanes;Earthquakes	Disruption of arterial traffic flow; Disruption of evacuation routes; Damage to private property; Cost of cleanup	Improved public safety; Maintain viable evacuation routes; Reduced damages to private property; Minimized cleanup costs	H and P
Dams	Carding Mill Dam; Stearns Mill Pond Dam	Public	Hurricane/Flood	Downstream property damage; Eonomic hardship	Reduced damages to private property; Minimized economic impacts	P
Communications	Town-wide	Public and Private	All Hazards	Public safety before/during/after an event; Limited emergency response	Improved public safety; Enhanced emergency response	P
Wetlands/Resource Areas	Town-wide	Public and Private	Riverine/Flash Flooding; Heavy Rain/Inland and Urban Flooding; Dam Failure	Damage to public/private property; Loss of resource habitat; Cost of cleanup	Mainatin resource areas; Reduced damages to private property; Minimized cleanup costs	H and P
Emergency Response	Town-wide	Public and Private	All Hazards	Public safety before/during/after an event; Limited emergency response	Improved public safety; Enhanced emergency response	P
Site Disturbance	Town-wide	Public and Private	Riverine/Flash Flooding; Heavy Rain/Inland and Urban Flooding; Hurricanes	Damage to public/private property; Loss of resource habitat; Erosion	Mainatin resource areas; Reduced damages to private property; Minimize erosion/site disturbance	H and P
Fire Management/ Response	Town-wide	Public and Private	Wildfires	Public safety; Damages to public/private property	Public safety; Prevent/minimize economic and social damage	H and P
Municipally-owned Structures	Town-wide	Public	Earthquakes	Economic and social hardship; Loss of life/property; Public safety	Public safety; Minimize economic/social damages	P

Table 2-2 Hazard Index Sudbury, Massachusetts

Natural Hazard	*Frequency (i.e. Very Low, Low, Medium, High)*	*Location (i.e. small/local, medium/regional, large/multiple communities)*	*Severity (i.e. minor, serious, extensive, catastrophic)*	*Hazrd Index (i.e. ranked by combining frequency and severity; 10 - high, 1 - low)*
Flood-Related Hazards				
- Riverine/Flash Flooding	Low	Medium/Regional	Serious	3
- Inland/Urban Flooding/Heavy Rain	High	Medium/Regional	Extensive	7
- Climate Change	Medium	Large/Multiple	Serious	5
- Dam Failures	Low	Small/Local	Serious	4
Winter-Related Hazards				
- Blizzards/Snow/Nor' easter	High	Large/Multiple	Extensive	7
- Ice	Low	Medium/Regional	Serious	4
- Extreme Cold	Low	Medium/Regional	Serious	4
Wind-Related Hazards				
- Hurricanes	High	Large/Multiple	Extensive	7
- Tornadoes*/High Winds	High	Medium/Regional	Serious	6
- Lightning/Thunderstorms	High	Local	Minor	5
- Hail	High	Local	Minor	5
Geologic-Related Hazards				
- Earthquakes	Low	Medium/Regional	Extensive	5
- Landslides	Low	Local	Minor	3
Drought				
- Drought	High	Medium/Regional	Serious	6
- Extreme Heat	Low	Medium/Regional	Serious	4
Urban Fire/Wildfire				
- Urban Fire/Wildfire	Medium	Small/Local	Minor	4
Invasive Species				
- Multiple	Low	Small/Local	Minor	1

* Tornadoes not a major issue for Sudbury

For the purposes of this 2020 update, based on the Hazard Index, the Sudbury LHMC determined that the Town is most at risk to the following hazards (and has advanced the assessment of the vulnerability of the at-risk areas, and the implications of experiencing these natural disasters):

- ✓ Riverine/Flash Flooding
- ✓ Heavy Rain/Inland and Urban Flooding
- ✓ Climate Change
- ✓ Dam Failure
- ✓ Blizzards/Heavy Snow/Winter Weather/Nor'easters
- ✓ Ice Storms
- ✓ Extreme Cold
- ✓ Hurricanes
- ✓ Tornadoes/High Winds
- ✓ Lightning/Thunderstorms
- ✓ Hail
- ✓ Earthquakes
- ✓ Landslides
- ✓ Drought
- ✓ Extreme Heat
- ✓ Urban Fire/Wildfires
- ✓ Invasive Species

The Sudbury LHMC formed the consensus that: flood-related hazards such as flooding/heavy rain; winter-related hazards such as snow/nor'easters; and, wind-related hazards such as hurricanes and strong winds, are the major causes of risk to the community.

It should be noted that the above hazards are not a complete listing of hazards that may impact Sudbury. The Sudbury LHMC agreed that this listing accurately represents those hazards that impact the Town most frequently and have the potential to cause fatalities, injuries, property and infrastructure damage, agricultural loss, damage to the environment, interruption of business, or other types of harm of loss. The following hazards will not be addressed in this 2020 plan update:

- Sea Level Rise
- Avalanche
- Expansive Soils
- Land Subsidence
- Volcanoes
- Tsunamis

These hazards were considered and discussed during LHMC meetings, where it was determined these hazards would not be considered for the following reasons:

- Lack of frequency in which they occur;
- The minimal probability of their occurrence; and/or
- The lack of resources to devote any amount of time to further research the likelihood or potential occurrence or impact.

The hazard-specific tables that follow after each section represent the various significant natural hazard events that have occurred in and around the Town of Sudbury, utilizing National Oceanic and Atmospheric Administration's (NOAA) National Climatic Data Center (http://www.ncdc.noaa.gov/). All events are county wide (Middlesex), unless otherwise noted.

Climate Change

Climate change is one of the most pressing issues of our time and its effects are increasingly impacting Massachusetts. Since climate change has both direct and indirect impacts on the range of natural hazards that Sudbury is vulnerable to, the LHMC determined it was most appropriate to include a 'climate change impacts on' section to each natural hazard profiled in this plan.

Municipal Vulnerability Preparedness Program

In 2019, the Town of Sudbury also completed the Municipal Vulnerability Preparedness (MVP) program through a planning grant provided by the Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs. The goal of the planning grant was to identify hazards that Sudbury daces that are being exacerbated by climate change, and to prioritize actions the Town can take to prepare for identified hazards. The Town became an MVP-Designated community in August of 2019.

The Commonwealth of Massachusetts has established a Massachusetts-specific climate data clearing house, resilientma.org, to easily enable municipalities and stakeholders to access regional data for use in climate preparedness planning. Overall, an emphasis on future projections for temperature and precipitation served as the two primary focus areas under this program. Similar to the approach with incorporating climate change into this plan, projections for temperature and precipitation have also been incorporated into the appropriate hazard profiles in this plan.

2.3.1 Flood-Related Hazards

Flooding is the accumulation of water within a water body and the overflow of excess water onto adjacent floodplain lands (FEMA, Multi Hazard Identification and Risk Assessment, 1997). The floodplain is the land adjoining the river/stream channel, ocean or other watercourse or water body that is susceptible to flooding.

Flooding results from: large-scale weather systems generating prolonged rainfall; on-shore winds; locally intense thunderstorms; dam failures; or significant snow melt. Floods are capable of undermining buildings and bridges, eroding shorelines and stream banks, uprooting trees, washing out access roads, and causing loss of life and injuries. Also, flash floods (characterized by rapid onset and high velocity waters) carry large amounts of debris that further exacerbate conditions.

Under the NFIP, FEMA is required to develop flood risk data for use in both insurance rating and floodplain management. FEMA develops this data through Flood Insurance Studies (FIS). Detailed analyses are used to generate flood risk data only for developed or developing areas of communities. For undeveloped areas FEMA uses approximate analyses to generate flood risk data. Flood hazard areas are identified in the FEMA FIRMs. Flood hazard areas are divided into zones (V, X, AO, etc.) depending on the severity and type of flood threat. These zones are those areas subject to inundation (shallow or deep) by a flood (and/or velocity wave action) that has a 1 percent chance of occurring during any given year.

Floodplains in Sudbury include 'AE' and 'X' Zones, Map 2-1 'Flood Hazard Areas' (Appendix A). 'AE' Zones are areas that would be inundated by the 100-year flood. The 100-year flood is a regulatory standard used by federal agencies and most states to administer floodplain management programs and is also used by the NFIP as the basis for insurance requirements nationwide. 'X' Zones are areas that would be inundated by the 500-year flood.

Table 2-3 below represents the various significant flood-related hazard events that have occurred in and around the Town of Sudbury over time, utilizing NOAA's National Climatic Data Center (http://www.ncdc.noaa.gov/). All events are county wide (Middlesex County), unless otherwise noted.

Table 2-3 Significant Flood-Related Events, Middlesex County

Hazard Type	Date	Level/ Description	Damages	Notes
Flash Flood				
	7/6/2005		$20,000	Lanes on Route 9/Route 126 closed
Inland/Urban Flood/Heavy Rain				
	7/13/1996			
	9/18/1996			
	8/3/1997			
	11/1/1997			
	1/23/1998	2.58"		
	2/18/1998			
	2/23/1998	2"+		
	3/8/1998			
	5/9/1998			

	6/13/1998		$13 million	
	9/16/1999			
	10/15/2005		$125,000	
	5/13/2006		$5,000,000	
	8/10/2008		$40,000	In Sudbury, Maynard Road was flooded with two feet of water stranding several cars. Numerous other side roads also were flooded making them impassable.
	9/6/2008		$15,000	Heavy rain associated with Tropical Storm Hanna ranged from 2.28 inches to 3.64 inches.
	12/12/2008		$20,000	
	3/14/2010		$26,430,000	Each of the seven gaged mainstem rivers in Middlesex County rose above flood stage. In addition, many streets were closed due to flooding in Sudbury.
	3/29/2010		$8,810,000	Four to seven inches of rain fell across Middlesex County resulting in each of the seven gaged mainstem rivers in Middlesex County to rise above flood stage. The Assabet River at Maynard and the Sudbury River at Saxonville both reached major flood with the Sudbury River setting a new flood of record.
	4/1/2010			
	8/28/2011		$5,000	
	10/14/2011			Route 129 flooded resulting in minor traffic problems.
	6/8/2012			
	6/23/2012		$15,000	
	7/18/2012		$5,000	
	10/29/2012			
	6/7/2013			Two to five inches of rain fell across Middlesex County.
	7/1/2013			
	7/23/2013			
	9/1/2013		$10,000	Route 9 was flooded in both directions at Route 126, making Route 9 impassable.
	3/30/2014		$35,000	
	7/27/2014			
	8/31/2014			
	10/22/2014		$20,000	

	10/23/2014			
	12/9/2014		$30,000	
	5/31/2015			Sudbury Road in Concord was flooded at Heath's Bridge. A car was stranded in flood waters on Bent Road in Sudbury.
	8/4/2015			
	8/15/2015		$75,000	Parts of Route 9 were flooded with four to five feet of water.
	9/30/2015			
	4/6/2017			Media reported that the Concord River in Billerica had risen above its banks.
	6/27/2017		$1,000	
	7/12/2017		$1,000,000	
	8/2/2017		$5,000	
	10/25/2017			
	10/25/2017			
	10/30/2017			
	1/12/2018			
	1/13/2018			
	4/16/2018			
	6/25/2018			Sudbury Road near East Bridge in Concord was reported to be flooded with two feet of standing water.
	8/8/2018		$30,000	
	8/12/2018		$15,000	
	8/17/2018			
	10/29/2018			
	11/3/2018			
	11/10/2018			

Source: NOAA National Climatic Data Center, www.ncdc.noaa.gov.
Data current through March 2019.

Riverine/Flash Flooding

Riverine or inland flooding often occurs after heavy rain, particularly in areas of the state with high water tables. These areas are also particularly susceptible to flash flooding caused by rapid runoff occurring after heavy precipitation events, and in combination with spring snowmelt. Frozen ground conditions can also contribute to low rainfall infiltration and high runoff events that sometimes result in river flooding.

Flood magnitude increases with increasing recurrence interval. The Town of Sudbury can be uniformly affected by riverine/flash flooding events, dependent upon the location (amount of impervious surfaces within the area), existing/incoming weather conditions, and time of year (frozen ground conditions

exacerbate flooding). Based on the low frequency and serious severity of riverine/flash flooding events (one significant event in total) which caused numerous business and infrastructure closures since the last plan update, as reported by the National Climatic Data Center and indicated in Table 2-3, the Town is considered at low risk for future riverine/flash flooding events.

Climate Change Impacts on Riverine/Flash Flooding
Riverine flooding will likely be exacerbated by increased storm intensity, as well as by increased precipitation. The Intergovernmental Panel on Climate Change (IPCC) identifies inland flooding in some urban regions as a "key risk" in North America, which may result disrupt people's livelihood and result in severe health risks. It is also important to note that riverine flooding and coastal flooding due to SRL can have a coupling effect. Rising seas can set a new flood stage in riverine systems, thus increasing flood risk in inland areas adjacent to rivers.

Heavy Rain/Inland and Urban Flooding
Heavy rains that cause inland and urban flooding are often exacerbated by stormwater-related issues. Thunderstorms, winter storms, coastal storms and nor'easters, and hurricanes all contribute to interior flood related hazards due to the large amounts of precipitation associated with them. Development often compounds the magnitude and frequency of urban flooding by increasing impervious surfaces, also increasing the rate of drainage collection, reducing the carrying capacity of the land, and often overwhelming sewer system infrastructure. The primary cause of inland/urban flooding in Sudbury remains the numerous inadequately sized and unmaintained culverts located throughout low-lying elevations. Based on the high frequency, yet extensive severity of heavy rain and inland/urban flooding events since the last plan, as reported by the National Climatic Data Center and indicated in Table 2-3, the Town is considered at high risk for future heavy rain/inland and urban flooding events.

Climate Change Impacts on Heavy Rain/Inland and Urban Flooding
Heavy precipitation events are becoming more frequent and intense. Whether a hurricane, tropical storm, or extra-tropical storm (e.g. a nor'easter), there has been a global increase in both the frequency and the intensity of heavy precipitation events. This trend is consistent with physical responses to a warming climate, such as an increased amount of moisture in the atmosphere.

MVP Climate Change Projections on Heavy Rain
The average annual precipitation in Sudbury is projected to increase up to 13% by 2050, and 18% by 2100. The largest increases in precipitation are projected to occur during winter months. Table 2-4 below includes precipitation projections beginning with a Baseline (1971 – 2000) through the end of the century (2090s) for the Sudbury/Assabet/Concord Watershed.

Table 2-4 Precipitation Projections, Sudbury/Assabet/Concord Watershed

Climate Parameter	Baseline (1970 - 2000)	Mid-Century (2050s)	End of Century (2090s)
Total Precipitation (inches):			
Annual	45.4	50.0 - 51.5	46.6 - 53.4
Winter	11.2	11.3 - 13.8	11.6 - 15.3
Spring	11.6	11.6 - 13.7	11.8 - 14.2
Summer	10.8	10.3 - 13.0	9.7 - 14.0
Fall	12.0	10.7 - 13.7	10.5 - 13.4
Annual Days with Precipitation over 1 inch	7.0	8.0 - 10.0	8.0 - 11.0
Annual Days with Precipitation over 2 inches	1.0	1.0 - 2.0	1.0 - 2.0
Annual Days with Precipitation over 4 inches	0.0	0 - 0	0 - 0

Source: MVP Program, www.resilientma.org.

Dam Failure

A dam is any artificial barrier with the ability to impound water, wastewater, or any liquid-borne material for the purpose of storage or water control. Dam failure can be a catastrophic type of failure characterized by the sudden, immediate, and uncontrolled release of impounded water, or the likelihood of such an uncontrolled release with secondary impacts to downstream structures within the inundation zone.

There are three inventoried dams located within the Town of Sudbury, two are owned by the Town (Carding Mill Pond Dam and Stearns Mill Pond Dam) and the third is privately owned, Table 2-4. A fourth dam, Willis Pond Dam is located in Sudbury, however it is considered a non-jurisdictional structure according to the MA Office of Dam Safety. Finally, Pantry Brook Dam, owned by the Division of Fish and Wildlife is also located in Sudbury, however it does not meet the criteria to be considered a dam (by the Commonwealth) and is thus, also considered a non-jurisdictional structure.

Inventoried dams are classified by the hazard, which relates to the probable consequences of failure or mis-operation of the dam; it does not relate to the current condition or the likelihood of failure of the dam. A three-tiered hazard classification rates each dam based upon the probable consequences of failure or miss operation of the dam. This system includes:

- **High Hazard** – means a dam where failure or miss operation will result in a probable loss of human life.
- **Significant Hazard** – means a dam where failure or miss operation results in no probable loss of human life but can cause major economic loss, disruption of lifeline facilities, or impact other concerns detrimental

to the public's health, safety, or welfare. Examples of major economic loss include but are not limited to washout of a state of federal highway, washout of two or more municipal roads, loss of vehicular access to residences (e.g. a dead-end road whereby emergency personnel could no longer access residences beyond the washout area), or damage to a few structures.

- **Low Hazard** – means a dam where failure or miss operation results in no probable loss of human life and low economic losses.

On February 10, 2017 Massachusetts Dam Safety Regulations were modified to require owners of significant hazard dams to prepare Emergency Action Plans (EAP) for their dams. This requirement became effective on February 10, 2017 when the Department of Conservation & Recreation (DCR), Office of Dam Safety (ODS) promulgated regulatory changes mandated by amended General Laws Part 1-Title II, Chapter 21, Section 65 (b)-Emergency Action Plans for high and significant hazard dams.

Table 2-5 Inventoried Dams in Sudbury, MA

Name	MA ID #	Ownership	Hazard
Dams			
Grist Mill Pond Dam	01109	Wayside Inn	Low
Carding Mill Pond Dam	00742	Town of Sudbury	Significant
Stearns Mill Pond Dam	01132	Town of Sudbury	Significant

Source: MA Office of Dam Safety

Grist Mill Pond Dam

Grist Mill Dam impounds the Grist Mill Pond, an 8-acre pond used for recreation. The dam was constructed in approximately 1800. The most recent Phase 1 Inspection Report is dated July 24, 2019. The dam's concrete spillway and concrete core were reconstructed in 2003. The dam is considered to be a low downstream hazard risk, and thus, an EAP is not required. The water level behind the dam is often reduced by the town prior to storm events or overtopping occurs. The dam is privately owned by the Wayside Inn. There is not an Operations and Management Plan on file for this structure.

Carding Mill Pond Dam

Carding Mill Pond Dam is an 84 year-old, town owned dam with a concrete core built by Henry Ford in 1923. The dam impounds 43 acres of water and the most recent Phase 1 Inspection Report is dated October 3, 2017. It is considered to be a significant downstream hazard risk. An EAP is currently in development for this dam, with a due date of December 2019. There is not an Operations and Management Plan on file for this structure.

Stearns Mill Pond Dam
Stearns Mill Pond Dam is a concrete dam first built in 1790 and reconstructed around 1900, acquired by the Town in 2006. The most recent Phase 1 Inspection Report is dated May 2, 2014 with a follow up inspection conducted on February 26, 2019. The dam is currently considered a significant downstream hazard risk. An EAP is currently in development for this dam, with a due date of December 2019. There is not an Operations and Management Plan on file for this structure.

Pantry Brook Dam
Pantry and Cold Brooks are small, warm water streams only 3 feet deep and 3-4 wide. In 1987, the Commonwealth of Massachusetts Division of Fisheries and Wildlife reconstructed the 1954 wooden dam structure near the confluence of Pantry Brook and the Sudbury River within the Pantry Brook Wildlife Management Area. The original structure deteriorated and by 1972 the 135-acre impoundment was drained. With funding from Ducks Unlimited, Fish & Wildlife proposed reconstruction of the dam to enhance wildlife habitat. The dam was designed to raise the water elevation in the impoundment by no more than two feet. Calculations showed that in a ten-year storm or greater there would be no flooding impact from this rise in water level due to Sudbury River back-flooding into Pantry Brook and over the dam in storms greater than the ten-year event.

A recent Marlborough, MA Patch article (November 15, 2019) stated the Hager Pond Dam, located in Marlborough, as ‘A threat to Marlborough and Sudbury’. The dam, located near the intersection of Route 20 and Hager Road in Marlborough, includes a spillway that is crumbling and blocked by debris, with trees growing atop the embankments according to a recent inspection (see photo below). Failure of the Hager Pond Dam could impact several nearby homes, destroy the Hager Road bridge, and could even impact the Wayside Inn, downstream from the dam after the Grist Mill Pond. In addition, areas such as Wayside Inn Road, Pride's Crossing Road, Dutton Road, and Hager Road also could be affected.

The article states there is no clear owner of the structure, and thus, ‘no one is either looking for dam problems or doing maintenance.’ The Town of Sudbury should work with the Town of Marlboro and DCR/ODS to resolve the ownership issue and encourage improvements to mitigate a potential breach at the site.

Source: https://patch.com/massachusetts/marlborough/unsafe-dam-threat-marlborough-sudbury-documents

Should there be a dam breach at any of the identified structures, the immediate areas surrounding the structure, as well as properties located downstream (within the inundation zone) of the structure are most vulnerable.

Climate Change Impacts on Dams
The increase in precipitation and frequency of intense rainfall events, which will cause an increase in river discharge and peak flows, may also lead to overtopping and damage of aging dams or structures in need of repair and maintenance.

Flood Hazard Areas
FEMA Flood Zones
Inland flooding caused by major rainstorms combined with stormwater related issues and increasing development and impervious surfaces has been determined as one of the highest risk of natural disaster to the community. HW performed a Vulnerability Analysis that considered those areas in Town impacted by the various flood zones according to land use type, critical facilities, and critical infrastructure. An Economic Analysis of the impacts based on FEMA's flood zones follows later in this section (Tables 2-19 and 2-20).

AE/100-Year Flood Zone
The AE zone or 100-year flood zone (has a 1% chance of flooding occurring each year) is a regulatory standard used by federal agencies and most states to administer floodplain management programs and is also used by the NFIP as the basis for insurance requirements nationwide. Below is a breakdown of the number of parcels (by land use type), critical facilities, and critical infrastructure susceptible to inundation in the AE/100-Year Flood Zone:

Parcels affected: (882 parcels in total)

- Agricultural/Horticultural: 16
- Auto Sales/Service: 3
- Chapter 61B: 4
- Charitable: 24

- Congregate Housing: 1
- Division of Fisheries/Wildlife: 9
- Education: 1
- Eating/Drinking Establishment: 1
- Federal: 54
- Hotel:1
- Housing Authority: 1
- Improved Education: 1
- Improved: Selectmen (Town): 8
- Improved Tax/Title: 1
- Indoor Recreation: 1
- Industrial: 4
- Non-Productive Land: 1
- Nursing Home: 1
- Office: 2
- Recreational Land: 1
- Residential: 543
- Shopping Center/Mall: 2
- Small Retail/Services: 2
- State: 23
- Storage/Warehouse:1
- Utility: 2
- Vacant – Conservation: 60
- Vacant – Developable: 3
- Vacant – District: 21
- Vacant – Potentially Developable: 2
- Vacant – Selectmen (Town): 15
- Vacant – Tax/Title: 12
- Vacant – Developable: 49
- Undisclosed: 1
- Missing Data: 11

Critical Facilities affected:

- Sudbury Water District Wells (2, 3, 5, 6, 7, 8, 9, and 10)
- Sudbury Water District Treatment Plant
- Sudbury Water District Treatment Plant #2
- Stearns Mill Pond Dam
- Carding Mill Pond Dam
- Grist Mill Pond Dam
- Dutton Road Bridge
- Concord Road Bridge
- Peakham Road Bridge
- French Road Bridge
- Wayside Inn Road Bridge

- US 20 Boston Post Road Bridge
- Union Avenue Bridge
- Landham Road Bridge
- Sudbury DPW Garage (old building)
- Sudbury DPW Town Office Building

Critical Infrastructure affected (intermittent sections of listed roadways):

- Raymond Road
- Landham Road
- Boston Post Road
- Clifford Road
- Station Road
- Codjer Lane
- Union Avenue
- Concord Road
- Water Row
- Nobscot Road
- Old Sudbury Road
- Maynard Road
- Morse Road
- Mossman Road
- Marlboro Road
- Haynes Road
- Deacon Avenue
- North Road
- Tantamouse Trail
- Weirhill Road
- Lincoln Road
- Washington Drive
- Hickory Road
- Bent Road
- Rolling Lane
- Jarman Road
- Horse Pond Road
- Marked Tree Road
- Brook Lane
- Hudson Road
- August Road
- Phillips Road
- Fairbank Road
- Run Brooke Circle
- Camperdown Lane

X/500-Year Flood Zone
The X zone or 500-year flood zone is a flood that has a 0.2% chance of occurring each **year**. Below is a breakdown of the number of parcels (by land use type), critical facilities, and critical infrastructure impacted by the X flood zone:

Parcels affected: (1,270 parcels in total)

- Agricultural/Horticultural: 18
- Auto Sales/Service: 5
- Chapter 61B: 4
- Charitable: 35
- Congregate Housing: 1
- Division of Fisheries/Wildlife: 9
- Education: 1
- Eating/Drinking Establishment: 2
- Federal: 55
- Hotel:1
- Housing Authority: 1
- Improved - Education: 4
- Improved – Municipal Public Safety: 1
- Improved: Selectmen (Town): 8
- Improved Tax/Title: 1
- Indoor Recreation: 1
- Industrial: 5
- Multiple Use – Commercial: 1
- Multiple Use – Residential: 1
- Non-Productive Land: 1
- Nursing Home: 1
- Office: 7
- Public Services: 1
- Recreational Land: 3
- Religious: 3
- Residential: 803
- Shopping Center/Mall: 3
- Small Retail/Services: 3
- State: 18
- Storage/Warehouse:5
- Utility: 2
- Vacant – Conservation: 75
- Vacant – Developable: 6
- Vacant – District: 28
- Vacant – Potentially Developable: 4
- Vacant – Selectmen (Town): 21
- Vacant – Tax/Title: 19
- Vacant – Developable: 88
- Undisclosed: 10

- Missing Data: 15

Critical Facilities affected:

- Sudbury Water District Wells (2, 3, and 6)
- Sudbury Water District Treatment Plant
- Dutton Road Bridge
- Concord Road Bridge
- US 20 Boston Post Road Bridge
- Sudbury Extended Day Program – Noyes School
- Noyes Elementary School
- Bright Horizons

Critical Infrastructure affected (intermittent sections of listed roadways):

- Landham Road
- Raymond Road
- Station Road
- Green Hill Road
- New Bridge Road
- North Road
- Weirhill Road
- Lincoln Road
- Lincoln Lane
- Water Row
- Washington Drive
- Hickory Road
- Peakham Road
- Bent Road
- Rolling Lane
- Jarman Road
- Saxony Drive
- Old Lancaster Road
- Willis Road
- Powers Road
- Maynard Farm Road

Property at Risk from Flood-Related Hazards

Sudbury is blessed by its location alongside the serene Sudbury River with the Great Meadows National Wildlife Refuge that lies beside its banks. For most of the year, the river slowly courses its way alongside Sudbury and accommodates various recreational activities such as canoeing, bird watching and fishing (catch and release only due to mercury contaminated fish). In the springtime, however, the river reaches flood stages and with runoff from melting snow and spring rains giving it the appearance of a long, vast lake and has been documented to rise more than twelve feet.

Critical Facilities

Critical facilities are those public or private facilities that possess added value to the community and deserve additional consideration when determining mitigation strategies to protect these resources from natural hazard risks.

A list of critical facilities provided by the Town was reviewed and approved with modifications by the Sudbury LHMC. 78 critical facilities have been identified and are presented in Maps 2.5.1 – 2.5.4 Critical Facilities. A number of the Town's critical facilities are located in high hazard areas, including eight Sudbury Water District wells, both Water District Treatment Plants, three dams, eight bridges, the old DPW garage and DPW Town Office Building, the Sudbury Extended Day Program at Noyes School, Noyes Elementary School, and Bright Horizons Daycare. Floodplains in Sudbury include 'AE' and 'X' Zones, Maps 2-5.1 through 2-5.4 'Critical Facilities' (Appendix A).

Locally Identified Areas of Flooding

Information on flood hazard areas was taken from several sources. Originally were the National Flood Insurance Rate Maps (FIRMs), then FEMA Flood Zones, shown on Map 2-1 in Appendix A. The second was discussions with local officials. The locally identified areas of flooding described below were identified by town staff, supported by information received during the MVP process. Some of these areas do not necessarily coincide with the flood zones, they may be areas that flood due to inadequate drainage systems or other local conditions rather than location within a flood zone, affecting both roadways and bridges.

- Sudbury River Floodplain: Water Row Road area: floods during times of spring frozen ground/ high runoff events: raising roadway would cause loss of flood plain and the road is a scenic byway with wetland permitting issues as well. Flooding here also dependent on timing of water release from Saxonville Dam in Framingham.
- Sudbury River: Concord Road: sheet flow back up related to Great Meadows DCR dam
- Concord Road at Nashawtuc Country Club: Sudbury River floodplain: occurs every 4-5 years; same mitigation issues as site #1
- Hickory Road culvert: Beaver dams block culvert and causes flooding of residential neighborhood area. Beaver activity varies from year to year. Existing impacts from beaver dams have been mitigated, monitoring and maintenance remains ongoing.

Sherman Bridge periodic flooding.

Localized flooding Water Row at Old County Rd.

A Capital Improvement Plan (CIP) for rehabilitation or replacement of culverts has been developed to address stormwater management capacity issues associated with localized flooding (Table 2-6). Culverts were analyzed based on structural integrity itself but also looks at the entire crossing more broadly, as there may be other issues surrounding the site (slopes, erosion, etc.) that may elevate one culvert higher than others. It should be noted that this CIP for culverts was developed in mid-2019 and is subject to change based on changing conditions, priorities and material costs.

Table 2-6 Culvert Capital Improvement Plan

Priority Ranking	*Roadway*	*Crossing ID*	*Rehabilitation/ Replacement*
High			
1	Concord Road	Crossing #11	Replacement
2	Willard Grant Road	Crossing #46	Replacement
3	Old Sudbury Road	Crossing #110/149	Replacement/TBD
5	Morse Road Bridge	Crossing #7	Replacement
6	Old Garrison Road	Crossing #150	Replacement
7	Maynard Farm Road	Crossing #26	Replacement
8	Hopestill Brown Road	Crossing #165	Rehabilitation/TBD
9	Powers Road	Crossing #31	Replacement
10	Bent Road	Crossing #91	Rehabilitation
Medium			
	Wayside Inn Road	Crossing #34	Rehabilitation
	Locker Road	Crossing #61	Rehabilitation
	Nobscott Road	Crossing #161	Rehabilitation
	Maynard Street	Crossing #136	Replacement
	Peakham Road	Crossing #58	Replacement

	Pantry Brook (Unnamed Road)	Crossing #60	Rehabilitation
	Dutton Road	Crossing #70	Rehabilitation
Low			
	French Road	Crossing #78	Rehabilitation
	Haynes Road	Crossing #22	Rehabilitation
	Austin Road	Crossing #57	Rehabilitation
	Goodnow Road	Crossing #99	Rehabilitation
	Concord Road	Crossing #74	Rehabilitation
	Water Row	Crossing #1	Replacement/TBD
	Old Framingham Rd.	Crossing #63	Rehabilitation
Not Ranked			
	Sherman Bridge	Crossing #16	TBD
	Old Sudbury Road	Crossing #146	TBD
	Unnamed Road	Crossing #64	TBD
	Brimstone Lane	Crossing #160	TBD
	Union Ave.	Crossing #95	TBD

Source: Town of Sudbury DPW

Probability of Future Occurrence of Flood-Related Hazards

As new development and urbanization continues, with the increase of impervious surfaces increasing the rate of drainage collection and reducing the carrying capacity of the land, it is likely urban flooding and stormwater runoff events will also increase on a more frequent basis with even lower storm events. Until the Town permanently addresses the number of streets and properties subject to repetitive flooding identified above, the Town will continue to address these areas as needed in the short-term. The presence of the Sudbury River, the continuing increase in frequency and severity of events and compounded by stormwater collection deficiencies in inland areas, the Town will continue to be at high risk for extensive damages at a medium/regional level for flood-related events (Table 2-2 Hazard Index).

2.3.2 Winter-Related Hazards

Winter weather events can include heavy snows, ice, and extreme cold and can affect the entire Town of Sudbury. Heavy snow can bring the community to a standstill by inhibiting mobility (transportation networks, pedestrian travel), knocking down trees and utility lines, and cause structural collapses in older buildings. Ice buildup can down utility lines and communication towers. The impacts of both events can cause indirect issues such as freezing/rupturing pipes from lack of heat, while also changing the ground's frost level, creating problems for underground infrastructure.

Table 2-7 below represents the various significant winter-related hazard events that have occurred in and around the Town of Sudbury over time, utilizing

NOAA's National Climatic Data Center (http://www.ncdc.noaa.gov/). All events are county wide (Middlesex County), unless otherwise noted.

Table 2-7 Significant Winter-Related Events, Middlesex County

Hazard Type	Date	Level/ Description	Damages	Notes
Extreme Cold/Wind Chill				
	2/16/2015	30 degrees below 0		
Blizzards/Heavy Snow/Winter Weather				
	1/2/1996			
	1/7/1996	$1.4 million		
	2/16/1996	6 - 8"		Transportation disrupted
	3/3/1996			
	3/7/1996	7 - 18"		
	4/7/1996	6 - 8"		Scattered power outages
	4/9/1996			
	12/6/1996			
	1/31/1997			
	3/31/1997			
	4/1/1997			
	12/14/1997			
	1/15/1998	8"		
	12/22/1998			Impaired driving
	1/14/1999	6 - 9"		
	2/25/1999			
	3/6/1999	6 - 9"		
	3/15/1999			
	1/13/2000	3 - 6"		
	1/25/2000	12 - 15"		
	2/18/2000			
	1/20/2001			
	2/5/2001	1 - 2'		
	2/25/2001			Impaired driving
	3/5/2001	1 - 2'		
	3/9/2001	4 - 8"		
	12/8/2001	6 - 9"		
	12/25/2002	4 - 7"	$15,000	
	1/3/2003			
	2/17/2003	15"		
	12/5/2003	14"		
	3/10/2004	6"		
	12/26/2004	8"		Power outages
	1/5/2005	4 - 8"		

	1/22/2005			
	2/24/2005	4"		
	3/1/2005	8"		
	2/12/2006		$10,000	Impaired driving
	3/16/2007	7 - 11"		
	12/13/2007			
	12/16/2007			
	1/14/2008		$28,000	
	2/22/2008			
	12/19/2008	8 - 10"		
	12/20/2008	5 - 12"	$8,000	
	12/31/2008	4 - 7"		
	1/11/2009	6"		
	1/18/2009	7.5"		
	3/2/2009	7 - 12"		
	12/20/2009	7 - 12"		
	1/18/2010	6"		
	2/16/2010	3 - 8"	$15,000	
	12/26/2010	10 - 20"		Strong winds gusting near 50 mph produced significant blowing and drifting snow with near blizzard conditions at times.
	1/12/2011	12 - 24"	$50,000	
	1/21/2011	5 - 8"		
	1/26/2011	8 - 10"		
	2/1/2011	9 - 12"	$183,500	
	10/29/2011	2 - 5"	$5,000	Heavy wet snow fell on foliated trees, breaking branches and downing trees and wires, resulting in widespread power outages.
	2/29/2012	2 - 4"		
	3/1/2012	6 - 8"		
	11/7/2012	2 - 5"		
	12/29/2012	2 - 9"		
	2/17/2013	2 - 4"		
	3/7/2013	10 - 17"		
	2/18/2013	1 - 2'		
	12/14/2013	4 - 10"		
	12/17/2013	5 - 8"		
	1/2/2014	6 - 16"		
	1/26/2015	1 - 2'		
	2/2/2015	7 - 17"		
	2/8/2015	9 - 17"		

	2/14/2015	14 - 17"		
	2/21/2015	2 - 3"		
	2/5/2016	6 - 9"	$5,000	
	2/8/2016	3 - 6"		
	3/21/2016	2 - 6"		
	4/3/2016	3 - 4"		
	4/4/2016	4 - 5"		
	12/17/2016	3 - 5"		
	1/7/2017	5 - 8"		
	2/8/2017		$150,000	Freezing rain caused a 55-vehicle pileup on Route 128/Interstate 95 in Wakefield, as well as a 20-vehicle pileup on Route 128/Interstate 95 in Newton. These occurred near the start of the morning commute and caused temporary road closures. Other major arteries also experienced crashes and in some instances temporary road closures.
	2/9/2017	7 - 13"		
	2/12/2017	5 - 10"		
	3/14/2017			Moderate to heavy snow fell during the morning and early afternoon in southeast Middlesex County, before briefly changing to rain. Snowfall totals ranged from 6 inches in Somerville (closer to Boston) to 9 inches in Lexington and 10 inches in Waltham (closer to the Route 128 corridor).
	12/9/2017	6 - 7"		
	12/22/2017		$5,000	Single trees were reported down in Arlington, Newton, and Cambridge. Ice accumulation in Southeast Middlesex County ranged from two-tenths to four-tenths of an inch.
	1/4/2018	12 - 17"	$1,000	
	2/17/2018	5 - 7"		
	11/15/2018	5 - 7"		

Source: NOAA National Climatic Data Center, www.ncdc.noaa.gov., current through March 2019.

Snow/Blizzards/Winter Storms/Nor'easters

Winter storms often include natural hazards such as extreme winds, coastal erosion and flooding. Utility and power lines can break from the weight of snow or ice coupled with strong winds. This could put residents at risk of losing heat, electricity, and water (if using well water). Snow melting poses problems as well such as road flooding in low lying areas. The Town has experienced heavy snow and winter storms which have become more frequent over the past several years.

Heavy snow affects the entire state, but the highest amounts typically occur in the northern and northwestern areas of the state. Usually, the impact and vulnerability of winter weather is measured in terms of the financial costs associated with preparing for, responding to, and recovering from the event. The Town uniformly continues to experience heavy snow and winter storms with greater frequency and severity, as reported by the National Climatic Data Center and indicated in Table 2-7. The Town is considered at high risk for heavy snow/blizzards/winter storms/nor'easters.

Climate Change Impacts on Heavy Snow Events

Climate change will result in increased average global temperatures. These impacts are already being felt in New England, as average winter temperatures in the region have risen 3.8°F in the last 30 years. Although at first glance this would appear to make winters less severe the Northeast has experienced the largest increase in extreme precipitation events in the country, which often fall as heavy wet snow in the winter.

Extreme Cold

Extreme cold events often accompany winter storms, may be left in their wake, or occur without any associated storm activity, and can lead to hypothermia and frostbite. Extreme cold temperatures vary dependent on the normal climate of the region however, Sudbury can expect to be uniformly affected. For Massachusetts, extreme cold typically means temperatures below zero degrees Fahrenheit. Extreme cold can adversely affect people - some more than others, infants and residents 65 years of age or more are especially vulnerable. Based on the low frequency and severity of extreme cold events over time, as reported by the National Climatic Data Center and indicated in Table 2-6, Sudbury is considered at low risk to extreme cold.

Climate Change Impacts on Extreme Cold Temperatures

Climate change will result in increased average global temperatures, which will likely decrease the number of extreme cold days. This decrease in extreme cold days has already been documented and is expected to continue.

MVP Climate Change Projections on Extreme Cold Temperatures

As mentioned above, climate change impacts will result in increased average temperatures so the number of extreme cold days is expected to decrease. Sudbury should experience far fewer days with temperatures below freezing, and

thus, will expend less energy on heating in the winter months. Table 2-8 below includes temperature projections with a Baseline (1971 – 2000) through the end of the century (2090s) for the Sudbury/Assabet/Concord Watershed.

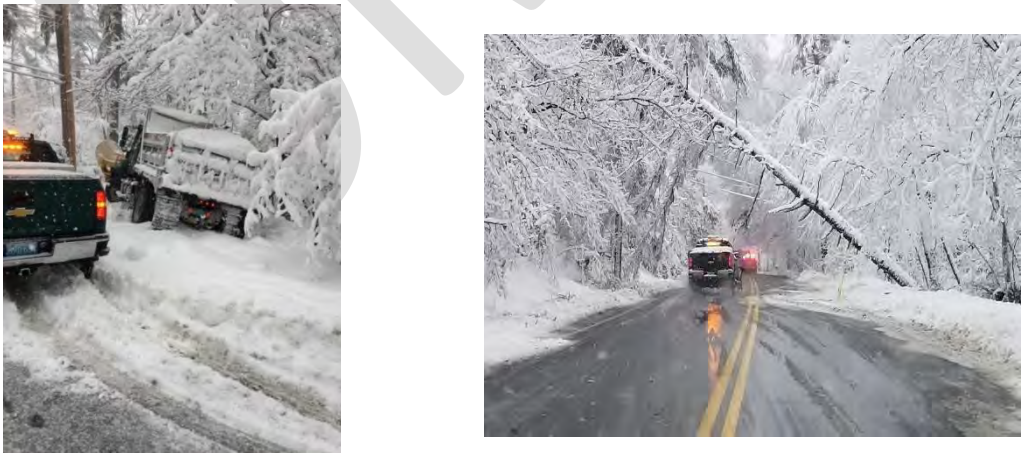
Table 2-8 Extreme Cold Temperature Projections, Sudbury/Assabet/Concord Watershed

Climate Parameter	Baseline (1970 - 2000)	Mid-Century (2050s)	End of Century (2090s)
Average Annual Temperature (F)	48.7	51.6 - 55.0	52.5 - 59.6
Minimum Annual Temperature (F)	37.9	41.0 - 44.3	42.0 - 48.9
Annual Days with Minimum Temperature Below 32 (F)	143.0	103 - 124	78 - 119
Annual Heating Degree-Days (Base 65 F)	6,535	4,948 - 5,789	4,075 - 5551

Source: MVP Program, www.resilientma.org

Property at Risk from Winter-Related Hazards

New England experiences winter storms in more extreme ways than most of the rest of the country. The average annual snowfall for the eastern half of the town, except for the northeast corner is 36.1 – 48.0 inches. The western half and the northeast corner of Sudbury average 48.1 – 72 inches of snow per year (Map 2-4 Average Annual Snowfall Map, Appendix A). The most dangerous hazard associated with winter storms, as it concerns Sudbury, is the possibility of citizens losing power due to downed trees and utility lines (loss of heat, electricity and water). Other minor hazards include flooding during snow melt and treacherous roadways due to ice (low frequency), snow and downed wires/trees making roadways impassable, particularly for emergency vehicles.



The heavily forested terrain of Sudbury makes it extremely susceptible to downed trees and power lines, in addition to treacherous driving conditions.

Probability of Future Occurrence of Winter-Related Events

According to past history and climatic conditions, and the inability to predict extreme snow and temperature events, the Town will continue to be at high risk for serious/extensive damages at a large/multiple community level winter-related events (Table 2-2 Hazard Index).

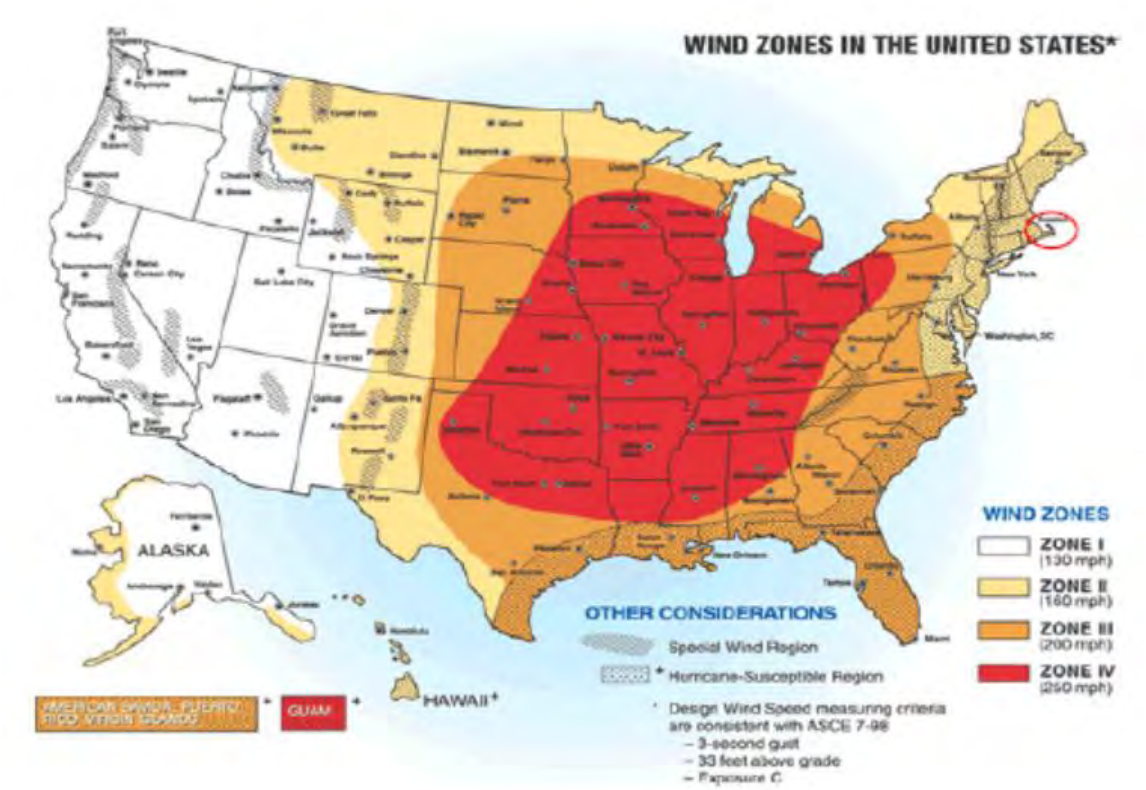
2.3.3 Wind-Related Hazards

Wind is the movement of air caused by a difference in pressure from one place to another. Local wind systems are created by the immediate geographic features in a given area, such as mountains, valleys, or large bodies of water. Wind effects can include blowing debris, interruptions in elevated power and communications utilities, and intensification of the effects of other hazards related to winter weather and severe storms.

Massachusetts is susceptible to high wind from several types of weather events: before and after frontal systems, hurricanes and tropical storms, severe thunderstorms and tornadoes, and Nor'easters. Sometimes, wind gusts of only 40 to 45 mph can cause scattered power outages from trees and wires being downed.[6] Based on historical tornado and hurricane data, FEMA has produced a map that depicts maximum wind speeds for design of safe rooms. The Commonwealth is located within Wind Zone II, with speeds up to 180 mph (Figure 2-1). The entire Commonwealth is also located within the hurricane-susceptible region. Massachusetts wind events can produce damage often associated with thunderstorms or tornadoes.

[6] 2018 State Hazard Mitigation and Climate Adaptation Plan, Commonwealth of Massachusetts.

Figure 2-1 Wind Zones in the United States



Source: FEMA

Table 2-9 below represents the various significant wind-related hazard events that have occurred in and around the Town of Sudbury over time, utilizing NOAA's National Climatic Data Center (http://www.ncdc.noaa.gov/). All events are county wide (Middlesex County), unless otherwise noted.

Table 2-9 Significant Wind-Related Events, Middlesex County

Hazard Type	Date	Level/ Description	Damages	Notes
Hail				
	6/22/1955	1.75"		
	6/13/1956	1"		
	5/15/1957	1"		
	6/19/1957	0.75"		
	7/5/1957	1.75"		
	7/11/1958	0.75"		
	7/11/1958	0.75"		
	6/6/1959	1"		
	6/30/1961	1.75"		
	6/30/1961	1"		
	7/18/1963	2"		
	7/18/1963	0.75"		

	6/6/1966	1.5"		
	6/6/1966	1.5"		
	8/9/1968	1.75"		
	7/19/1982	0.75"		
	6/22/1988	0.75"		
	6/22/1988	2.25"		
	8/6/1989	0.75"		
	7/25/1999	1"		
	8/5/1999	0.75"		
	5/7/2011	0.75"		
	7/18/2012			
	8/4/2015	1.5"		Half dollar to ping pong ball size hail fell in Sudbury.
	8/15/2015	0.88"		
High/Strong Winds				
	1/19/1996			
	1/27/1996			
	10/8/1996	50 kts		Power outages
	12/6/1996			
	12/24/1996			
	3/6/1997			Power outages/Trees downed
	3/31/1997			Power outages
	4/1/1997			Power outages
	4/19/1997			
	8/21/1997		$90	
	11/1/1997		$3,120	
	11/27/1997		$220	
	12/2/1997			
	12/14/1997			
	12/29/1997		$310	
	2/18/1998			
	2/24/1998		$1,250	
	3/9/1998			
	3/21/1998			
	3/26/1998			
	4/9/1998			
	5/9/1998			
	10/1/1998			Trees, wires down
	11/11/1998			
	11/26/1998			
	12/1/1998			
	12/30/1998			
	1/18/1999			

	1/24/1999			
	2/2/1999			
	3/4/1999			
	3/22/1999			
	9/16/1999			
	10/14/1999			
	11/2/1999			
	12/11/1999			
	1/16/2000			
	3/28/2000			
	4/8/2000	55 kts		Power outages
	6/6/2000			
	12/12/2000			
	12/17/2000	50 kts		Power outages
	2/10/2001	50 kts		Power outages/downed trees
	2/17/2001			
	5/3/2002	50 kts	$5,000	Power outages
	4/16/2003		$50,000	
	10/15/2003	50 kts	$15,000	Power outages
	11/13/2003	50 kts	$50,000	Power outages
	11/5/2004	50 kts	$25,000	
	12/23/2004	58 kts	$25,000	
	3/8/2005	50 kts	$25,000	Power outages
	5/7/2005	50 kts	$10,000	Power outages
	5/24/2005	50 kts	$15,000	
	5/25/2005	50 kts	$15,000	Power outages
	9/29/2005	58 kts	$30,000	Power outages/downed trees
	10/16/2005	58 kts	$5,000	
	10/25/2005	58 kts	$15,000	
	12/9/2005	58 kts	$20,000	
	1/21/2006	58 kts	$15,000	
	2/17/2006	58 kts	$80,000	
	10/29/2006	50 kts	$10,000	
	2/10/2008	54 kts		
	3/21/2008	50 kts		
	12/31/2008	51 kts		
	1/25/2010	50 kts	$15,000	
	2/25/2010	50 kts	$50,000	
	4/29/2010		$25,000	
	10/15/2010		$10,000	
	11/17/2010		$5,000	
	9/18/2012		$50,000	
	10/29/2012	54 kts	$100,000	

	1/20/2013		$15,000	
	3/7/2013		$25,000	
	1/31/2013	56 kts	$60,000	
	11/1/2013	50 kts	$35,000	
	11/24/2013		$5,000	
	11/27/2013		$1,000	
	3/26/2014		$5,000	
	4/15/2014		$15,000	
	4/24/2014		$5,000	
	10/22/2014	50 kts	$50,000	
	1/5/2015		$2,000	
	3/17/2015	50 kts	$25,000	
	4/4/2015	35 kts	$22,000	
	12/15/2015		$3,000	
	1/19/2016		$5,000	
	2/25/2016	50 kts	$10,000	
	3/31/2016	50 kts	$20,000	
	5/15/2016		$1,000	
	5/16/2016		$5,000	
	12/15/2016	50 kts	$6,000	
	12/18/2016		$100	
	2/13/2017		$15,000	
	3/14/2017	52 kts	$35,000	
	3/22/2017		$1,000	
	4/16/2017		$8,000	
	10/24/2017	50 kts	$20,000	
	10/30/2017	50 kts	$1,000	
	11/10/2017		$15,000	
	12/5/2017		$20,000	
	3/2/2018	51 kts	$75,000	
	4/16/2018		$1,000	
	5/4/2018		$15,000	
	10/15/2018		$15,000	
	10/27/2018	50 kts	$4,000	
	11/3/2018	51 kts		Amateur radio operator recorded a gust to 59 mph.
Hurricanes				
	8/28/2011	50 kts	$1.2 million	Irene
	10/29/2012	51 kts		Sandy
Lightning/Thunderstorms				
	7/27/1957			
	9/8/1957			
	8/7/1958			

	8/22/1960			
	7/2/1961			
	4/20/1963	57 kts		
	7/19/1966			
	7/10/1968			
	6/21/1971			
	6/4/1972	50 kts		
	6/9/1973			
	3/21/1976			
	8/3/1980			
	6/22/1981			
	7/13/1981	52 kts		
	7/19/1982			
	7/21/1983			
	8/27/1983			
	8/8/1986			
	5/31/1987			
	6/16/1988	55 kts		
	6/22/1988	50 kts		
	7/11/1988	53 kts		
	7/28/1988	50 kts		
	6/2/1989	60 kts		
	7/7/1989	60 kts		
	7/10/1989	60 kts		
	7/30/1989	60 kts		
	5/17/1991	70 kts		
	6/11/1991	50 kts		
	6/12/1991			
	7/21/1991			
	8/18/1991	60 kts		
	8/28/1994			
	8/5/2005	50 kts	$15,000	
	7/28/2006	50 kts	$10,000	
	7/28/2007	50 kts		
	6/6/2010	50 kts	$50,000	
	7/29/2013	50 kts	$5,000	
	8/15/2015	50 kts	$75,000	
	2/25/2016	50 kts	$20,000	
	7/22/2016	50 kts	$5,000	
Tornadoes				
	10/24/1955	F1	$2,500	
	6/19/1957	F1	$25,000	
	6/19/1957	F1	$250	

	7/11/1958	F2	$250,000	
	8/25/1958	F2	$2,500	
	7/3/1961	F0	$25,000	
	7/18/1963	F1	$25,000	
	8/28/1965	F2	$250,000	
	7/11/1970	F1	$25,000	
	10/3/1970	F3	$250,000	1 death
	7/1/1971	F1	$25,000	1 injury
	11/7/1971	F1	$250	
	7/21/1972	F2	$2,500,000	4 injuries
	9/29/1974	F3	$250,000	1 injury
	7/18/1983	F0	$250	
	9/27/1985	F1	$250	
	8/7/1986	F1	$250,000	
	8/22/2016	EF1	$1,000,000	
Tropical Storm				
	8/28/2011	0	$1,200,000	
	9/20/2017	0	$8,000	

Source: NOAA National Climatic Data Center, www.ncdc.noaa.gov.
Data current through March 2019.

Hurricanes

Hurricanes are defined as a large circulating windstorm covering hundreds of miles that forms over warm ocean water. To be officially classified as a hurricane, the wind speeds must exceed 74 miles per hour. In the northern hemisphere winds circulate in a counterclockwise direction. A great dome of water as much as fifty miles in diameter (called the "storm surge") is pushed ahead of the storm by its winds. In some coastal locations, this can result in tides 20 feet higher than usual. Occasionally, storm surge is responsible for damage to property and potential deaths.

The winds that accompany hurricanes have the potential to cause serious damage. Downed power lines leave residents without electricity and can impede business for days. Fallen trees can damage buildings and block roadways. Unsecured building components including gutters, screened enclosures, roof coverings, shingles, car ports, porch coverings, overhangs, siding, decking, windows, walls, gables can be blown off structures and carried by the wind to cause damage in other places. Wind driven rain often causes water damage in roof and wall envelopes.

Measuring the Intensity of a Hurricane

Hurricane damages come from wind, rain, tornadoes, floods/storm surge, and the effects of very low air pressure. The Saffir-Simpson Hurricane Wind Scale (SSHWS) intensity category system was developed in the 1970's to characterize a hurricane's destructive potential by indicating wind speeds and range of

damage, see Table 2-10 below. The SSHWS category system measures sustained wind speed, central pressure, storm surge height, and coastal damage potential within five intensity categories.

Table 2-10 Saffir-Simpson Hurricane Wind Scale

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

Source: NOAA.

The National Weather Service (NWS) will issue a hurricane warning when sustained winds of 74 mph or higher are reached and expected within a coastal area within 24 hours. On average, there are approximately 10 named tropical storms along the east coast of the U.S. each year, six of which are likely to develop into hurricanes, with only two or three likely to reach category 3 on the SSHWS. The SSHWS has undergone a minor modification for 2012 in order to resolve awkwardness associated with conversions among the various units used for wind speed in advisory products. The change broadens the Category 4 wind speed range by one mile per hour (mph) at each end of the range, yielding a new range of 130-156 mph.

Based on the high frequency and extensive severity of hurricane events over time, as reported by the National Climatic Data Center and indicated in Table 2-10, Sudbury is considered at high risk to hurricanes.

Climate Change Impacts on Hurricanes

Climate change is expected to result in the increased frequency and intensification of hurricanes and tropical storms worldwide. Rising sea levels, coupled with potentially higher hurricane wind speeds, rainfall intensity, and storm surges will combine to create more intense hurricanes, resulting in increased impacts to coastal communities. Research predicts a global increase in the intensity of such storms on average, by 2% to 11%, based on the IPCC mid-range emission scenario projections, as well as a poleward expansion in the

latitude at which storms will reach their highest intensity. Some experts have noted that the three massive storms from the 2017 hurricane season (Harvey, Irma, and Maria) are consistent with this expected intensification.

Hurricanes and tropical storms are expected to result in more rainfall. This increase has been observed and is expected both globally (IPCC 2014) and for the Atlantic basin, including the U.S. east coast. Based on a synthesis of current science, NOAA predicts that Atlantic hurricanes and tropical storms in the coming century will have higher rainfall rates than present storms, especially near the center of the storm. Hurricane Harvey, which resulted in a record 51.9 inches of rainfall at one station west of Houston, Texas, is one recent example of this trend.

Tornadoes/High Winds

Tornadoes are violently rotating columns of air in contact with and extending between a cloud and the surface of the earth. Generally, winds in most tornadoes are 100 mph or less, but can exceed 250 mph in the most violent and least frequent tornadoes. Several conditions are required for the development of tornadoes and associated thunderstorm clouds, including abundant low-level moisture to contribute to the development of a thunderstorm, along with a trigger/cold front to lift the moist air. Tornadoes usually form in areas where strong winds are turning in a clockwise direction and can be in the traditional funnel shape, or in a slender rope-like form. They typically begin in a supercell (severe thunderstorm), primarily in the month of May.

Measuring the Intensity of a Tornado

Typically, tornadoes are categorized by frequency values from historic data and area impacted based on the length and width of the damage path. Tornado damage severity is measured by the Fujita Tornado Scale, where wind speed is estimated from the amount of damage. As of February 1, 2007, the National Weather Service began rating tornadoes using the Enhanced Fujita-scale (Table 2-11). The Enhanced Fujita scale is more complicated than the original F-scale, allowing for more precise assessments of tornado severity.

Table 2-11 Enhanced Fujita Scale

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

5	261 - 318	262 - 317	5	200 - 234	5	Over 200

Source: NOAA.

Based on the low frequency and serious severity of tornadoes over time as reported by the National Climatic Data Center and indicated in Table 2-10, the Town of Sudbury is considered at low risk to future tornadoes.

Lightning/Thunderstorms

Thunderstorms are formed when the right atmospheric conditions combine to provide moisture, lift, and warm unstable air that can rise rapidly. Thunderstorms occur any time of the day and in all months of the year but are most common during summer afternoons and evenings and in conjunction with frontal boundaries. Thunderstorms affect a smaller area compared with winter storms or hurricanes, but they can be dangerous and destructive for a number of reasons. Storms can form in less than 30 minutes, giving very little warning; they have the potential to produce lightning, hail, tornadoes, powerful straight-line winds, and heavy rains that produce flash flooding.

All thunderstorms produce lightning, and therefore all thunderstorms are dangerous. Lightning often strikes outside of areas where it is raining and may occur as far as 10 miles away from rainfall. It can strike from any part of the storm and may even strike after the storm has seemed to pass. Hundreds of people across the nation are injured annually by lightning, most commonly when they are moving to a safe place but have waited too long to seek shelter. The Town of Sudbury can be uniformly affected by lightning and thunderstorms, dependent upon the time of day, existing/incoming weather conditions, and time of year.

Building construction, location, and nearby trees or other tall structures will have a large impact on how vulnerable an individual facility is to a lightning strike. A rough estimate of a structure's likelihood of being struck by lightning can be calculated using the structure's ground surface area, height, and striking distance between the downward-moving tip of the stepped leader (negatively charged channel jumping from cloud to earth) and the object. In general, buildings are more likely to be struck by lightning if they are located on high ground or if they have tall protrusions such as steeples or poles which the stepped leader can jump to. Electrical and communications utilities are also vulnerable to direct lightning strikes. Damage to these lines has the potential to cause power and communications outages for businesses, residencies, and critical facilities. Based on the high frequency and minor severity of lightning/thunderstorm events over time, as reported by the National Climatic Data Center and indicated in Table 2-10, the risk of lightning/thunderstorms is considered moderate in Sudbury.

Hail

Hail is formed in towering cumulonimbus clouds (thunderheads) when strong updrafts carry water droplets to a height at which they freeze. Eventually, these

ice particles become too heavy for the updraft to hold up, and they fall to the ground at speeds of up to 120 MPH. Hail falls along paths called swaths, which can vary from a few square acres to up to 10 miles wide and 100 miles long. The Town of Sudbury can be uniformly affected by hail, dependent upon the existing/incoming weather conditions, and time of year.

Structure vulnerability to hail is determined mainly by construction and exposure. Metal siding and roofing is better able to stand up to the damages of a hailstorm than many other materials, although it may also be damaged by denting. Exposed windows and vehicles are also susceptible to damage. Crops are extremely susceptible to hailstorm damage, as even the smallest hail stones can rip apart unsheltered vegetation. Based on the limited frequency and severity of hail events over time, as reported by the National Climatic Data Center and indicated in Table 2-7, the risk of hail is considered moderate in Sudbury.

Property at Risk from Wind-Related Events

Wind events are quite normal in New England and happen regularly each year. In the winter months, the Town of Sudbury is susceptible to high winds from nor'easters and winter storms (both high frequency). Spring and summer seasons usually bring a number of severe thunderstorms to the region (high frequency). During the late summer and fall seasons, the area is at risk from a hurricane or tropical event (high frequency).

Probability of Future Occurrence of Wind-Related Hazards

As previously stated, wind events are quite normal in New England, as evidenced throughout the year. Given the increase in frequency and severity of high wind events realized over the last several years, the Town will continue to be at high risk for extensive/serious damages at an average medium/regional level for wind-related events (Table 2-2 Hazard Index).

2.3.4 Geologic-Related Hazards

Earthquakes

An earthquake is the sudden release of strain energy in the Earth's crust, resulting in energy waves that radiate outward from the earthquake source. The point on the Earth's surface directly above the focus is called the earthquake epicenter. The severity of earthquake effects is dependent upon: magnitude of energy released; proximity to the epicenter; depth to the epicenter; duration; geologic characteristics; and, type of ground motion.

When earthquakes occur, much of the damage is a result of structures falling under the stress created by the ground movement. Another significant effect is damage to the public and private infrastructure (i.e. water service, communication lines, drainage system). Because earthquakes are highly localized it is difficult to assign regional boundaries that share the same relative degree of risk.

Measuring the Intensity of an Earthquake

An earthquake's severity can be expressed in terms of intensity and magnitude. Intensity is defined by the observed effects of ground shaking on people, buildings, and the natural environment, which varies dependent upon the location of the observer with respect to the epicenter. Currently in the U.S., the Modified Mercalli (MMI) Intensity Scale is used to evaluate the effects of earthquakes – specifically, it describes how strongly an earthquake was felt at a particular location, Table 2-12 below. Magnitude is defined by the amount of seismic energy released at the hypocenter of the earthquake, based on the amplitude of the earthquake waves recorded on seismographs (using the Richter Magnitude Scale, Table 2-13). Another measure of the relative strength of an earthquake is the expanse of area the shaking is noticed**.**

Table 2-12 Modified Mercalli Intensity Scale

Mercalli Intensity	Description
I	Felt by very few people, barely noticeable.
II	Felt by few people, especially on upper floors.
III	Noticeable indoors, especially on upper floors, but may not be recognized as an earthquake.
IV	Felt by many indoors, few outdoors. May feel like passing truck.
V	Felt by almost everyone, people have trouble standing. Small objects move, trees and poles may shake.
VI	Felt by everyone, people have trouble standing. Heavy furniture can move, plaster can fall off walls. Chimneys may be slightly damaged.
VII	People have difficulty standing. Drivers feel cars shaking. Some furniture breaks. Loose bricks fall from buildings. Damage is slight to moderate in well-built buildings; considerable in poorly built buildings.
VIII	Buildings suffer slight damage if well-built; severe damage if poorly built. Some walls collapse.
IX	Considerable damage to specially built structures; buildings shift off their foundations. The ground cracks. Landslides may occur.
X	Most buildings and their foundations are destroyed. Some bridges are destroyed. Dams are seriously damaged. Large landslides occur. Water is thrown on the banks of canals, rivers, lakes. The ground cracks in large areas.
XI	Most buildings collapse. Some bridges are destroyed. Large cracks appear in the ground. Underground pipelines are destroyed.
XII	Almost everything is destroyed. Objects are thrown into the air. The ground moves in waves or ripples. Large amounts of rock may move.

Source: USGS, 2012.

Table 2-13 Richter Magnitude Scale

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

Source: USGS, 2012.

Landslides

Landslides include a wide range of ground movements, including rock falls, deep failure of slopes, and shallow debris flows. Often caused by a combination of unfavorable geologic conditions (silt clay or thick till deposits), the most common types in Massachusetts include transitional debris slides, rotational slides, and debris flows. 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.[7] The highest prevalence of unstable slopes is generally found in the western part of the Commonwealth. The entire Town of Sudbury has been classified as having a low risk for landslides, with no recorded landslides in Sudbury to date.

Property at Risk from Geologic-Related Hazards

Because earthquakes have been detected all over New England, seismologists suspect that a strong earthquake could be centered anywhere in the region (Map 2-2). Furthermore, the mapped geologic faults of New England currently do not provide any indications detailing specific locations where strong earthquakes are most likely to be centered.[8]

All structures in Sudbury are potentially vulnerable to seismic ground shaking. The most vulnerable are historic buildings constructed of unreinforced masonry. Other critical facilities or infrastructure at risk are unknown; their construction determines their ability to withstand seismic shaking. The Town has only experienced secondary effects from both regional events and longer-distance events emanating from the northeast in general. However, since building codes do not require seismic proofing, the impact would be expected to be severe if an earthquake were to hit the Town of Sudbury.

The Town of Sudbury can be uniformly affected by landslides, dependent upon the existing/incoming weather conditions, saturation of the ground, and

[7] Massachusetts Hazard Identification and Risk Assessment, 2019, p. 161.
[8] 2018 State Hazard Mitigation and Climate Adaptation Plan, Commonwealth of Massachusetts.

topography of where the event occurs, with the northeast corner having a slightly higher probability should one occur (Map 2-2).

Probability of Future Occurrence of Geologic-Related Hazards

The Commonwealth has a 2% chance that an earthquake with a peak horizontal acceleration of 50 km above magnitude will occur within the next 50 years. A 'G' is the average acceleration produced by gravity at the earth's surface (9.80665 meters per second squared). This measurement describes ground shake during earthquakes. New England is not considered to be a hot spot for earthquakes, especially when compared to the western United States. Given the historic pattern of earthquakes, or more specifically the secondary impacts of earthquakes felt across the region (which has been the historic pattern), the Town will continue to be at low risk for shaking, although extensive damage (Table 2-2 Hazard Index).

Because landslides are often triggered by other natural hazard events, their frequency is also related to the frequency of those other hazards. The majority of the town continues to be at low risk for landslides, with the northeast corner having a slightly higher probability should one occur (Map 2-2).

2.3.5 Drought - Related Hazards

Drought is a temporary irregularity characterized by long durations of below normal precipitation. Drought occurs in virtually all climatic zones yet varies significantly from one region to another, due to its relationship to normal precipitation in that specific region. Drought can affect agriculture, water supply, aquatic ecology, wildlife, and plant life.

Drought can be defined or grouped by the following:

- Meteorological drought is a measure of departure of precipitation from normal, defined solely on the degree of dryness.
- Agricultural drought links various characteristics of meteorological (or hydrological) drought to agricultural impacts with a focus on precipitation shortages, differences between actual and potential evapo-transpiration, soil water deficits, reduced groundwater or reservoir levels, etc.
- Hydrological drought is associated with the effects of precipitation (including snowfall) shortfalls on surface or subsurface water supply and when water supplies are below normal.
- Socioeconomic drought is associated with the supply and demand of some economic goods with elements of meteorological, hydrological, and agricultural drought.

Based on past events and current criteria outlined in the Massachusetts Drought Management Plan, it appears that western Massachusetts may be more

vulnerable than eastern Massachusetts to severe drought conditions.[9] That being said, many factors, such as water supply sources, population, economic factors (i.e., agriculture based economy), and infrastructure, contribute to the severity and length of a drought event. The Town of Sudbury can expect to be uniformly affected by drought conditions. Table 2-14 below represents the significant drought-related hazard events that have occurred in and around the Town of Sudbury over time, utilizing NOAA's National Climatic Data Center (http://www.ncdc.noaa.gov/). All events are county wide (Middlesex County), unless otherwise noted.

Table 2-14 Significant Drought-Related Events, Middlesex County

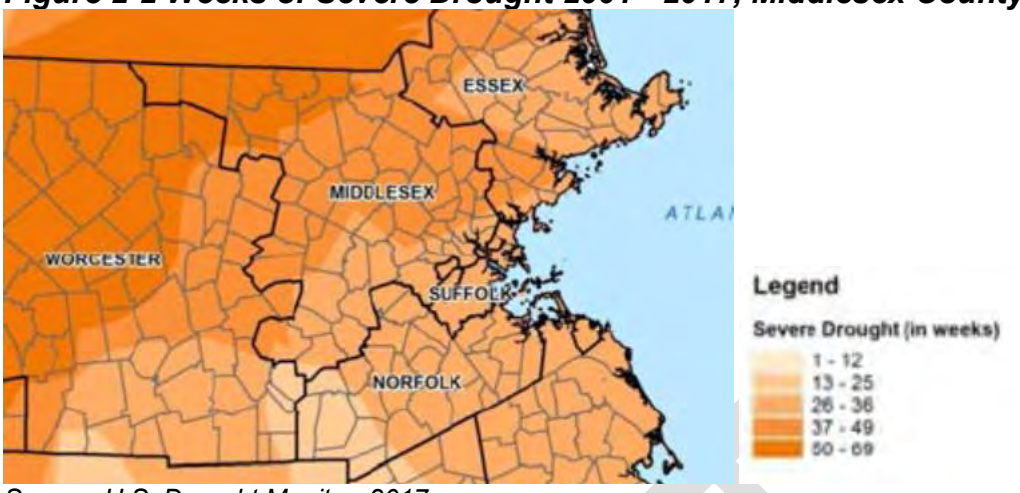
Hazard Type	Date	Level/ Description	Damages	Notes
Drought				
	4/12/2012			
	5/1/2012			
	7/26/2016			
	8/1/2016			
	9/1/2016			
	10/1/2016			
	11/1/2016			
	12/1/2016			
	1/1/2017			
Excessive Heat				
	7/5/2013			

Source: NOAA National Climatic Data Center, www.ncdc.noaa.gov.
Data is current through March 2019

Figure 2-2 shows that Sudbury straddles the 26 – 36 weeks/37 – 47 weeks line of severe drought since 2001.

[9] 2018 State Hazard Mitigation and Climate Adaptation Plan, Commonwealth of Massachusetts.

Figure 2-2 Weeks of Severe Drought 2001 - 2017, Middlesex County



Source: U.S. Drought Monitor, 2017

Climate Change Impacts on Drought-Related Hazards
Climate change will result in increased average global temperatures, which will likely decrease the number of extreme cold days.

Based on the high frequency and serious severity of drought events since the 2010 plan (9 events), as reported by the National Climatic Data Center and indicated in Table 2-14, the risk of drought is considered moderate/high in Sudbury.

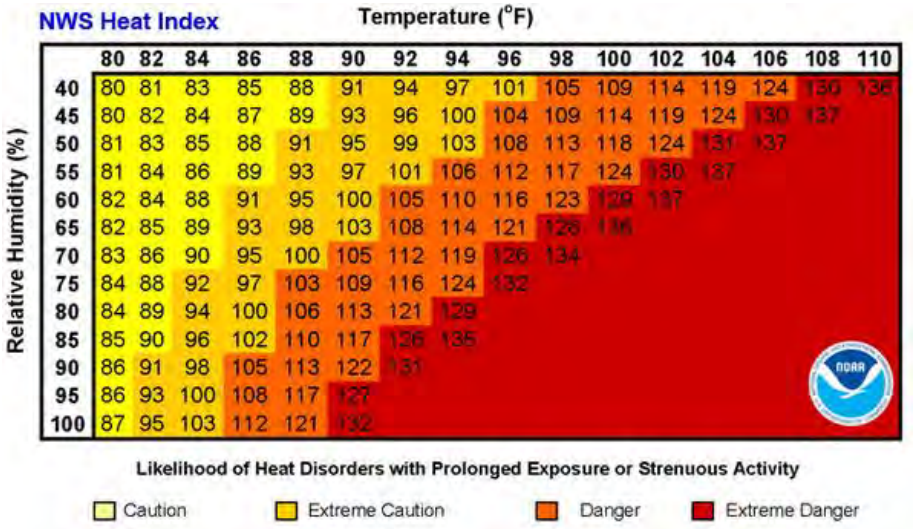
Extreme Heat
Extreme heat occurs when a system of high atmospheric pressure moves into an area. In such a high-pressure system, air from upper levels of our atmosphere is pulled toward the ground, where it becomes compressed and increases temperatures. This high concentration of pressure makes it difficult for other weather systems to move into the area, which is why periods of extreme heat can last for several days, or even weeks. The longer the system stays in an area, the hotter temperatures become. The high pressure inhibits winds, making them faint to almost non-existent. Because the high-pressure system also prevents clouds from entering a region, sunlight can become punishing, increasing temperatures even more. The combination of all these factors come together to create what is known as a heat wave. Typically, a heat wave can last two or more days with significant impacts on human health and/or infrastructure. Heat waves can also cause catastrophic crop failures, cause roads to crumble, and can cause the ground around residences to dry out, leaving them susceptible to subsidence.

NOAA's NWS maintains a Heat Index (Figure 2.3), which is a measure of how hot it really feels when relative humidity is also factored in with actual air temperatures. As an example, if the air temperature is 96°F and the relative humidity is 65%, the heat index, how hot it feels, is 121°F. The NWS also

initiates alert procedures when the Heat Index is expected to exceed 105°-110°F (depending on local climate) for at least two consecutive days:

- Caution – fatigue possible,
- Extreme Caution – sunstroke, muscle cramps, and/or heat exhaustion possible,
- Danger – sunstroke, muscle cramps, and/or heat exhaustion likely, and
- Extreme Danger – heat stroke or sunstroke highly likely.

Figure 2.3 NOAA's National Weather Service Heat Index



Source: https://www.weather.gov/phi/heatcond

Table 2-14 represents the significant extreme heat-related hazard events that have occurred in Middlesex County over time, utilizing NOAA's National Climatic Data Center (http://www.ncdc.noaa.gov/). All events are county wide (Middlesex County), unless otherwise noted.

Climate Change Impacts on Extreme Heat
More intense and prolonged heat waves are predicted with climate change. The frequency of days with high temperatures at or above 90°F has already increased (Vallee and Giuliano, 2014). The average number of days expected to be above 90°F in 1950 was about seven, while the new normal is 12.

MVP Climate Change Projections on Extreme Heat
As mentioned previously, climate change impacts will result in increased average temperature so the number of extreme heat days is expected to increase. Sudbury should experience more days with warmer temperatures, particularly days over 90 degrees, and thus, will expend more energy on cooling. Table 2-15 below includes temperature projections with a Baseline (1971 – 2000) through the end of the century (2090s) for the Sudbury/Assabet/Concord Watershed.

Table 2-15 Extreme Heat Temperature Projections, Sudbury/Assabet/Concord Watershed

Climate Parameter	Baseline (1970 - 2000)	Mid-Century (2050s)	End of Century (2090s)
Average Annual Temperature (F)	48.7	51.6 - 55.0	52.5 - 59.6
Maximum Annual Temperature (F)	59.6	62.3 - 65.5	63.0 - 70.5
Annual Days with Maximum Temperature Over 90 F	8.0	18 - 42	22 - 84
Annual Cooling Degree-Days (Base 65 F)	585	870 - 1,356	743 - 983

Source: MVP Program, www.resilientma.org

Property at Risk from Drought-Related Hazards

Past drought events in Massachusetts have typically affected entire regions, and sometimes the entire state. Although western Massachusetts may be more vulnerable than eastern Massachusetts to severe drought conditions as previously stated, the entire Town is uniformly vulnerable to drought/extreme heat with varying impacts based on the degree of moisture deficiency, the duration, and the size and location of the affected area.

Probability of Future Occurrence of Drought-Related Hazards

Although Massachusetts is relatively small, it has a number of distinct regions that experience significantly different weather patterns and react differently to the amounts of precipitation they receive.[10] Outside of 2016, very few drought events have occurred in Middlesex County. For this update, Sudbury is considered at high risk with serious expected damages for drought-related events, and at low risk with serious damages for extreme heat-related events (Table 2-2 *Hazard Index*).

2.3.6 Urban Fire/Wildfire – Related Hazard

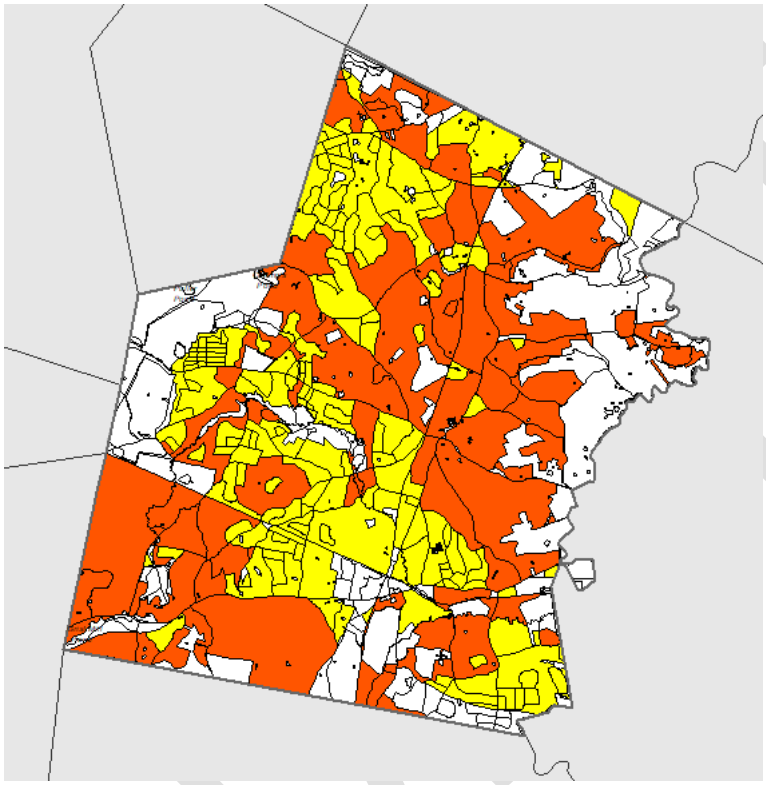
Urban fire or conflagration is a large destructive, sometimes uncontrollable, fire that spreads substantial destruction, typically as a result of other hazards, including storms, earthquakes, gas leaks, transportation accidents, hazardous material spills, criminal activity (arson), or terrorism.[11] Alternatively, smaller-scale structural fires often result from everyday events such as cooking, smoking, equipment/appliance malfunctions, etc.

Wildfires are defined as any non-structure fire that occurs in the vegetative wildland, including grass, shrub, leaf litter/debris, and forested tree fuels. Most susceptible to the hazard are pitch pine, scrub oak, and oak forests – the most flammable vegetative fuels. Small wildfires are common throughout the State,

[10] 2018 State Hazard Mitigation and Climate Adaptation Plan, Commonwealth of Massachusetts
[11] Ibid.

especially when drought or near-drought conditions warrant, the potential for spreading wildfires is real. The State's Wildland Urban Interface (WUI) – the area where structures and human development meet and intermingle with undeveloped wildland, creates an environment in which fire can move readily between structural and vegetative fuels, mapped in yellow as shown below (Figure 2-4). The State's WUI includes the Intermix WUI – areas where housing and vegetation intermingle[12], mapped in red as shown in Figure 2–4).

Figure 2- 4 Sudbury Wildland Urban Interface Zones



Source: http://silvis.forest.wisc.edu/data/wui-change/

The impact and vulnerability to wildfire is influenced by a variety of factors, such as land cover conditions, weather and the effectiveness of land management techniques. Suburban neighborhoods located at the WUI are very vulnerable to wildfire. Individual buildings may be more or less vulnerable to damage from wildfire based on factors such as the clear distance around the structure, and the structure's construction materials. A fire in any of these areas would quickly overwhelm local resources and could possibly threaten homes nearby.

Climate Change Impacts on Urban Fire/Wildfire

Climate change can alter the weather and fuel factors of wildfires. Hot dry spells can increase the risk of fire due to decreased soil moisture and increased

[12] Radeloff, V.C., R.B. Hammer, S.I. Stewart, J.S. Fried, S.S. Holcomb, and J.F. McKeefry. 2005. The Wildland Urban Interface in the United States. Ecological Applications 15:799-805.

evaporation/evapotranspiration. Climate change can also increase winds that spread fires.

Property at Risk from Urban Fire/Wildfire-Related Hazards

The Town averages about twelve brush fires annually. None have resulted in any significant property damage but a brush fire at Peakham Road did result in one death in 2005, although that was due to use of an accelerant to start the fire. The areas with the highest incidence of brush fires are the Sudbury Valley Trustees land, the Boy Scouts of America property.

Two particular areas prone to forest fire threat due to fuel load and geographic positioning include the southwest quadrant of town and the southwest facing areas along Goodman's Hill. The southwest area of Sudbury along Hudson Road and along Dutton Road contain a large amount of pine trees, including scrub pines. Areas along the southwest axis typically have lighter/more susceptible fuel and have greater amounts of sunlight. Under certain conditions in late spring, these areas are very prone to burn.

Probability of Future Occurrence of Urban Fire/Wildfire Hazards

Most urban fires are a result of negligent and/or intentional human behavior (arson, open flames, and cooking) and are preventable. Wildfire season in Massachusetts begins in late March and typically ends in early June, which also corresponds with the driest live fuel moisture periods of the year.

Very few urban fire/wildfire events have occurred in Sudbury. For this update, Sudbury is considered at medium risk with minor expected damages at a small/local level for future urban fire/wildfire-related events (Table 2-2 *Hazard Index*).

2.3.7 Invasive Species-Related Hazards

For this update, invasive species (existing and early detection/emergent) for Sudbury have been incorporated as a hazard impacting the community. Invasive species are non-native species that can impact the environment, the economy or human health. Typically, they have the potential to cause or contribute to the following:

- Habitat loss/degradation
- Loss of native fish, wildlife, and tree species
- Loss of recreational opportunities and income
- Crop damage/diseases in humans

The list of invasives currently impacting Sudbury include:

- Tree of Heaven (*Ailanthus altissima)*
  Produce an overly abundant amount of seeds, reproduction through roots and a chemical that can prevent or kill other plants near it has made it a

species that have many states concerned. This invasive tree threatens to overwhelm our natural areas, agricultural fields and roadsides

- Asian Bush Honeysuckles (*Lonicera tatarica*)
  Form very dense populations that can outcompete and suppress the growth of native plant species.
- Asiatic Bittersweet (*Celastrus orbiculatus*)
  Fast growing vines can cover, shade and outcompete other vegetation. It can even girdle and kill large trees.
- Autumn-olive (*Elaeagnus umbellate*)
  Form a dense shrub layer which displaces native species and closes open areas.
- Black Locust (*Robinia pseudoacacia*)
  Can dominate and shade native species.
- Black Swallow-wort (*Cynanchum louiseae*)
  Overgrows native plants and disrupt natural succession. Additionally, due to the tangling nature of swallow-wort, large patches can be difficult to walk through and may interfere with forest management and recreation.
- Burning Bush (*Euonymus alatus*)
  Threatens a variety of habitats including forests, coastal scrublands and prairies where it forms dense thickets, displacing many native woody and herbaceous plant species.
- Common Reed (*Phragmites australis*)
  Rapidly form dense stands of stems which crowd out or shade native vegetation in inland and estuary wetland areas. Turns rich habitats into monocultures devoid of the diversity needed to support a thriving ecosystem.
- European Water-milfoil (*Myriophyllum spicatum*)
  Dense mats at the water's surface inhibit water recreationists. Overtakes habitat and outcompetes native aquatic plants, potentially lowering diversity.
- Fanwort (*Cabomba caroliniana*)
  Forms extremely dense stands which can clog drainage systems and interfere with recreational activities such as swimming and boating.
- Garlic Mustard (*Alliaria petiolata*)
  Forms dense stands that choke out native plants in the understory by controlling light, water, and nutrient resources.
- Glossy Buckthorn (*Frangula alnus*)
  Out-competes native plants for nutrients, light, and moisture. Degrades wildlife habitat. Contributes to erosion by shading out other plants that grow on the forest floor,
- Japanese Barberry (*Berberis thunbergii*)
  Displaces many native herbaceous and woody plants. In large infestations, its leaf litter causes changes in the chemistry of the soil, making it more basic.
- Japanese Knotweed (*Polygonum cuspidatum)*

chokes-out native species by way of limiting sunlight infiltration, altering nutrient cycles, or by releasing toxic/inhibiting chemicals. Knotweed can contribute to stream bank erosion and flooding.

- Leafy Spurge (*Euphorbia esula*)
  Overtakes large areas of land and displace native vegetation.
- Moneywort (Creeping Jenny), (*Lysimachia nummularia)*
  Dense mats of this plant may take over habitat for more desirable native plant species.
- Multiflora Rose (*Rosa multiflora*)
  Extremely prolific and can form dense thickets, excluding native plant species.
- Norway Maple (*Acer platanoides*)
  Produce large numbers of seeds that are wind dispersed and invade forests and forest edges. The dense canopy formed by Norway maple inhibits the regeneration of sugar maple and other tree seedlings, reducing forest diversity.
- Porcelain-berry *Ampelopsis brevipedunculata)*
  Invades streambanks, pond margins, forest edges and other disturbed areas. The thick mats formed by this climbing vine can cover and shade out native shrubs and young trees.
- Purple Loosestrife (*Lythrum salicaria*)
  Dense growth along shoreland areas makes it difficult to access open water. Overtakes habitat and outcompetes native aquatic plants, potentially lowering diversity. Dense root systems change the hydrology of wetlands.
- Water Chestnut (*Trapa natans*)
  Colonizes areas of freshwater lakes and ponds and slow-moving streams and rivers where it forms dense mats of floating vegetation, causing problems for boaters and swimmers and negatively impacting aquatic ecosystem functioning.

Property at Risk from Invasive Species

Invasive species typically harm native species through predation, habitat degradation and competition for shared resources. Negative consequences can be far-reaching, considering they can spread at astonishing rates and can affect property values, agricultural productivity, public utility operations, native fisheries, tourism, outdoor recreation, and the overall health of an ecosystem. Dependent upon the species, invasives often thrive along roadsides, forested and understory areas, lakes, ponds, rivers, streambanks and pond margins.

Probability of Future Occurrence of Invasive Species

Eradication involves both chemical and mechanical methods, combined with ongoing monitoring. Often, due to limited staffing and diminished municipal budgets, limited controlled stands are typically often realized at best.

Because most invasives are considered more of a nuisance hazard and not directly associated with any primary impacts of other weather-related hazards such as loss of life, limited evacuation, or property damage, Sudbury is considered at low risk with minor expected damages at a small/local level for future spread of invasive species (Table 2-2 *Hazard Index*).

2.4 Vulnerability

Vulnerability indicates what is likely to be damaged by the identified hazards and how severe that damage could be. After identifying types and areas of risk, a vulnerability analysis can help to determine the gaps in the community. This section examines the vulnerability of the built environment, such as structures, utilities, roads, and bridges, as well as social and environmental vulnerability. A vulnerability analysis also estimates the number of people exposed to hazards, including elderly populations and concentrated populations. This also includes such things as whether the shelter capacity is sufficient for the affected population, and whether businesses are likely to face temporary closure due to natural disasters. Historical damages are often good indicators for current exposure and potential damage.

A vulnerability chart was developed based on the identification and profile of the natural hazards that have occurred throughout Sudbury over time, as presented earlier in Section 2.3. Below, Table 2-16 Vulnerability Matrix 2020 describes the expected frequency of occurrence, and the potential severity of the damage resulting from each individual hazard evaluated for this update. Coordination with the State Plan was also a consideration in the development of the updated Vulnerability Matrix.

Table 2-16 Vulnerability Matrix 2020 Update

Hazard	Frequency	Severity
Flood-Related Hazards	High	Extensive
Winter-Related Hazards	High	Extensive/Serious
Wind-Related Hazards	High	Extensive/Serious
Geologic-Related Hazards	Low	Extensive
Drought	High	Serious
Urban Fire/Wildfire	Medium	Minor
Invasive Species	Low	Minor

2.4.1 Development Trends

Since the 2010 plan, Sudbury's vulnerability to natural disasters has not significantly changed. New developments are in compliance with the updated State building codes and stormwater standards, and in turn, these more restrictive codes help facilitate decreases in a structures' overall vulnerability.

Land Use Changes

Sudbury is primarily a residential community with large tracts of open land and an impressive inventory of natural resources. The most significant change can be seen in the tradeoff between open land/natural resources and residential use. In 2016, 45% of Sudbury's total land area is in residential use, as compared to 24% in 2005 (Table 2-17). Complementing these numbers, the percentage of open land/natural resources dropped 20% over the same period (while residential land use increased approximately 21%), essentially an even trade.

Table 2-17 Land Coverage Summary, 2005/2016

Land Use	2005 Acres	% Total Land Area	2016 Acres	% Total Land Area
Open Land/Natural Resources	10,967	69%	7,703	49%
Residential Uses	3,858	24%	7,198	45%
Commercial/Industrial Uses	737	5%	299	5%
Mixed-Use	NR**	NR	499	3%
Recreation open Space	261	2%	143	1%
Total Land	15,823			

Source: MassGIS Land Use 2005 and 2016

***Not reported.*

Residential Development Trends

To better understand the residential growth trend in Sudbury over the same period (2005-2016), it is helpful to look at Building Permit data over that same amount of time. For example, during that time, the range of new residential Building Permits (new homes) was 13 to 59 for a given year, with an annual average of 28. This level of permitting and construction is very reasonable given the location of Sudbury within the region and the desirability of the community.

Development interest and activity continues in Sudbury today. Below is a list of major development projects (completed and proposed since the 2010 plan), the majority which are outside the Special Flood Hazard Area (SFHA), unless otherwise indicated:

- Sudbury Housing Authority Duplex Reconstruction
  - Various locations
  - 12 units (12 subsidized)
- Villages at Old County Road
  - 6 Old County Road
  - 37 units (10 subsidized)
- Landham Crossing
  - 192 Boston Post Road
  - 31 units (8 subsidized)
  - Small percentage of lot within SFHA

- The Coolidge
  - 189 Boston Post Road
  - 64 units (64 subsidized)
- Sudbury Housing Trust/278 Maynard Road
  - 3 Marlboro Road
  - 3 units (3 subsidized)
- Dudley Brook Preserve
  - 40 Tall Pine Drive
  - 26 units (age-restricted)
- Avalon Sudbury
  - Bay Drive
  - 250 units (63 subsidized)
  - Under construction
- Highcrest at Meadow Walk
  - 22 Farmstead Lane
  - 60 units (age-restricted)
  - Under construction
- The Coolidge (Phase II)
  - 189 Boston Post Road
  - 56 units (56 subsidized, age-restricted)
  - Under construction
- Quarry North (and Malone Property)
  - North Road
  - 101 rental units (26 affordable/40R)
  - Permitting to start in coming months)
- Camp Sawetaro
  - Liberty Ledge
  - Private camp (for immediate future)

Commercial Development Trends

Most recent commercial development trends include Meadow Walk – Sudbury (wrapping up occupancy). This multi-use project includes four components – a 75,000 SF village retail center (approximately 15 stores), a 250-unit luxury apartment community (by Avalon Bay Communities), a 60-unit active-adult condominium community (by Pulte Homes) and a 48-unit assisted living community (by National Development/Epoch Senior Living).

2.4.2 Economic Vulnerability

NFIP-Insured Property Damage

As seen in Table 2-18, FEMA estimated that the value of property insured by the NFIP in Sudbury is over $18.6 million as of July 31, 2019 (MA State Floodplain Coordinator). There are now three residential (9 losses) properties that have experienced repetitive loss damages. According to the State Floodplain Coordinator, since the 2010 Plan, there have been nine repetitive loss claims totaling $32,727.72 in payments.

Table 2-18 Summary of National Flood Insurance Program Activity in Sudbury, MA

Total Policies	Coverage Value	Policies in A-Zone	Claims Since 1978
61	$18,606,300	9	14/$55,867

Source: FEMA, NFIP, Loss Statistics from January 1, 1978 through July 10, 2019.

The majority of the NFIP-insured properties are located where development occurs near flood plains or low lying areas.

Impacts of FEMA Flood Zones

As one of the highest risks to the community, HW performed an analysis to estimate the total land and building values within FEMA 100- and 500-year flood zones. The number and types of residential, commercial, industrial, and municipally owned structures are described earlier in Section 2.3.1 and quantified in Tables 2-19 Total Vulnerability FEMA 100-Year Flood Zone Summary and 2-20 Total Vulnerability FEMA 500-Year Flood Zone. All flood zone data presented is based on the FEMA FIRMs as revised through 2018.

Table 2-19 Total Vulnerability FEMA 100-Year Flood Zone Summary

Land Use	No. of Parcels Impacted	Total Value
Agricultural/Horticultural	16	156857
Auto Sales/Service	3	$9,903,500
Chapter 61B	4	$618
Charitable	24	$12,242,700
Congregate Housing	1	$4,200,000
Division of Fisheries/Wildlife	9	$3,383,500
Education	1	$3,917,600
Eating/Drinking Establishment	1	$948,700
Federal	54	$16,334,300
Hotel	1	$2,707,300
Housing Authority	1	$296,200
Improved - Education	1	$337,700
Improved - Selectmen (Town)	8	$51,972,300
Improved Tax/Title	1	$265,800
Indoor Recreation	1	$7,157,200
Industrial	4	$3,393,500
Non-Productive Land	1	$19
Nursing Home	1	$3,833,300
Office	2	$1,439,100
Recreational Land	1	$170,000
Residential	543	$398,277,634

Shopping Center/Mall	2	$8,604,600
Small Retail/Services	2	$2,043,600
State	23	$5,192,900
Storage/Warehouse	1	$467,688
Utility	2	$824,700
Vacant - Conservation	60	$11,426,700
Vacant - Developable	3	$1,180,300
Vacant - District	21	$8,564,400
Vacant - Potentially Developable	2	$513,000
Vacant - Selectmen (Town)	15	$2,741,400
Vacant - Tax/Title	12	$927,400
Vacant - Undevelopable	49	$812,500
Undisclosed	1	$2,096,866
Missing Data	11	$0
Total	**882**	**$566,333,882**

Source: Sudbury Tax Assessor CAMA data, Massachusetts Property Tax Use Code.

Table 2-20 Total Vulnerability FEMA 500-Year Flood Zone Summary

Land Use	No. of Parcels Impacted	Total Value
Agricultural/Horticultural	18	$132,793
Auto Sales/Service	5	$10,021,000
Chapter 61B	4	$369
Charitable	35	$24,216,900
Congregate Housing	1	$4,200,000
Division of Fisheries/Wildlife	9	$3,271,500
Education	1	$3,711,900
Eating/Drinking Establishment	2	$1,985,800
Federal	55	$19,519,400
Hotel	1	$2,148,500
Housing Authority	1	$2,123,900
Improved - Education	4	$37,413,100
Improved - Mun. Public Safety	1	$2,421,800
Improved - Selectmen (Town)	8	$30,634,336
Improved Tax/Title	1	$25,700
Indoor Recreation	1	$6,492,200
Industrial	5	$19,237,900
Multiple Use - Commercial	1	$453,300
Multiple Use - Residential	1	$721,100
Non-Productive Land	1	$15
Nursing Home	1	$3,345,800
Office	7	$4,633,000

Public Services	1	$463,100
Recreational Land	3	$7,195,269
Religious	3	$4,077,900
Residential	803	$542,693,426
Shopping Center/Mall	3	$10,242,900
Small Retail/Services	3	$2,425,500
State	18	$3,938,600
Storage/Warehouse	5	$4,563,068
Utility	2	$688,200
Vacant - Conservation	75	$12,373,600
Vacant - Developable	6	$6,491,500
Vacant - District	28	$8,859,900
Vacant - Potentially Developable	4	$1,120,700
Vacant - Selectmen (Town)	21	$3,589,200
Vacant - Tax/Title	19	$1,574,300
Vacant - Undevelopable	88	$2,441,100
Undisclosed	10	$6,525,524
Missing Data	15	$0
Total	**1,270**	**$795,974,100**

Source: Sudbury Tax Assessor CAMA data, Massachusetts Property Tax Use Code.

Within the 100-Year Flood Zone, there are approximately 543 residential structures, 33 commercial structures and multiple municipally-owned properties including various critical facilities and infrastructure identified previously in Section 2.3.1.

Impacts of Business Interruption

Notwithstanding the obvious costs of commercial property damage, the impacts of potential business interruption from a natural disaster in Sudbury cannot be under-estimated. Business closures result in a reduction of revenues to proprietors and a loss of wages to employees. Also, State and local tax revenues can be significantly reduced. In addition to the costs of commercial property damage, the impacts from potential business interruption following a disaster in Sudbury could have long-lasting effects on the local economy, quality of life, and sense of place that has been maintained and revered for generations.

2.4.3 Social Vulnerability

A critical step in assessing risk and vulnerability of Sudbury to natural hazards is to identify the links between the potential destructive impacts to the built and natural environments and that relationship to the social structure. The social assets/potential losses continue to be key components of the community and include the closure of institutions, loss of vital services (communication and transportation systems), and disruption in the movement of goods and services, and emotional strain from financial and physical losses.

The vulnerability of a community obviously includes the potential for direct damage to residential, commercial and industrial property, as well as, schools, government and critical facilities. However, it also includes the potential for disruption of communication and transportation following disasters. Any disruption to the infrastructure, such as a loss of electric power or break in gas lines, can interrupt businesses and cause stress to affected families. This is especially the case where residents are forced to evacuate their homes and become subject to shortages of basic supplies.

Public Infrastructure and Emergency Life Lines

There are a number of public buildings/structures located in the flood plain. In addition to potential structural damage, various access roads for these buildings/structures also flood from time to time during an event, described previously in Section 2.3.1. The extent of flooding events depends on the type, intensity and duration of the event.

Evacuation/Population at Risk

The use of mass care facilities during an emergency is dependent on a variety of circumstances. These include warning time, public awareness of the hazard, the level of encouragement from public officials and the availability of shelters. The primary shelter for the Town is the Fairbank Center (40 Fairbank Road), with capacity for 150 people, and approved by the American Red Cross. This facility is the primary area of shelter for heating, cooling, phone charging, and evacuation point with resting facilities. This facility also has the ability to provide food services. The secondary shelter for the Town is St. Anselm's Church (106 Landham Road) in the case of a large, widespread emergency. It has the capacity of housing up to 150 individuals, however, there is no generator.

The Town is also currently working with the Towns of Wayland and Concord to develop Memorandums of Understanding (MOU's) for additional backup shelters.

- Wayland: Wayland Middle School, 125 occupancy (201 Main Street)
- Concord: Harvey Wheeler Community Center, 100 occupancy (1276 Main Street)

Shelter use is not easily predicted because each emergency situation has different variables such as the length of the warning period, official encouragement of the evacuation, public awareness of the location and availability of shelter, and the severity of the approaching hazard. Shelter use may be higher in the winter, such as an ice or snowstorm, since homes would be without heat should there be power outages .

2.4.4 Environmental Vulnerability

Hurricanes, earthquakes, nor'easters, floods or any weather-related hazard event, in addition to invasive species, will have particular impacts on the natural and built environment. Differences in storm size, speed of movement, wind

speeds, and landfall location relative to vulnerable resources makes for high variability in impacts and related costs associated with weather-related events. For invasive species, the location and breadth of the growth/stands will cause the same variability in impacts, however, mostly indirect in nature.

When the natural environment is impacted there are both direct and indirect costs. Impacts of severe weather events to the natural environment include both direct (loss of habitat and salinization of land/ groundwater) and indirect costs (widespread inland damage to the built environment, threats to ecosystems/ species, and contamination of potable water supply).

2.5 FEMA Disaster Grant Assistance

FEMA has provided the Town of Sudbury with approximately $1,179, 419 in grant assistance since 2010 for the following disasters:

- March 2010 Flooding
  Disaster Number: DR-1895
  $64,783.40

  Main Items for Funding Provided for:
  - Personnel overtime/equipment (Fire/Police/DPW)
  - Contractors building/system repair costs

- January 2011 Snowstorm
  Disaster Number: DR-1959
  $81,454.61

  Main Items for Funding Provided for:
  - Personnel overtime/equipment (Fire/Police/DPW)
  - Materials expenses (salt/sand)
  - Contractors snow removal and building/system repair costs

- August 2011 Tropical Storm Irene
  Disaster Number: NA
  $43,012.18

  Main Items for Funding Provided for:
  - Personnel overtime/equipment (Fire/Police/DPW)
  - Contractors building/system repair costs

- October 2011 Nor' Easter
  Disaster Number: DR-4051
  $6,458.16

  Main Items for Funding Provided for:
  - Personnel overtime/equipment (Fire/Police/DPW)
  - Contractors building/system repair costs

- February 2013 Snowstorm
  Disaster Number: DR-4100
  $99,297.32

  Main Items for Funding Provided for:
  - Personnel overtime/equipment (Fire/Police/DPW)
  - Materials expenses (salt/sand)
  - Contractors snow removal and building/system repair costs

- January 2015 Snowstorm
  Disaster Number: DR-4214
  $154,121.62

  Main Items for Funding Provided for:
  - Personnel overtime/equipment (Fire/Police/DPW)
  - Materials expenses (salt/sand)
  - Contractors snow removal and building/system repair costs

- March 2018 Snowstorm
  Disaster Number: DR-4379
  $730,291.91

  Main Items for Funding Provided for:
  - Personnel overtime/equipment (Fire/Police/DPW)
  - Materials expenses (salt/sand)
  - Contractors snow removal and building/system repair costs

Section 3 Capability Assessment

3.1 Introduction

The Capabilities Assessment section has been restructured to better document local, state, and federal department, agency and program capabilities in terms of pre- and post-disaster activities. It has been organized into three (3) main sections: Planning and Regulatory capabilities, Administrative and Technical capabilities, and Financial capabilities to better define the programs, policies, and funding opportunities each department or agency is implementing to reduce risk and work towards implementing hazard mitigation programs targeted at increased resiliency.

The Town of Sudbury implements several hazard mitigation policies and procedures, current state laws, executive orders, and regulations to promote the safety of its residents and minimize risk to community assets. This section presents a brief description of each of the primary mitigation programs currently in place.

3.2 Planning and Regulatory Capabilities

Sustainable Sudbury Master Plan 2001

The Town is currently undertaking an update to the Master Plan. The updated Hazard Mitigation Plan will be cited and referenced for consistency across municipal documents.

Open Space and Recreation Plan 2009 - 2013

The Open Space and Recreation Plan is another planning document intended to advise the Board of Selectmen on open space preservation and acquisition efforts, act as a resource for other agencies with open space concerns and advise the Planning Board on elements of the Master Plan.

Sudbury possesses valuable natural areas which provide an opportunity for open space preservation and acquisition. Areas which should be targeted for acquisition include agricultural lands, wetlands, land in drinking water supply watersheds, river and stream corridors, and areas of groundwater recharge. The following goals and objectives applicable to hazard mitigation planning are referenced from the Open Space and Recreation Plan 2009 – 2013:

Goal 1: Preserve town character through the permanent protection of undeveloped land, surface water bodies and wetlands, agricultural lands and uses, publicly cherished viewscapes and historic sites.

Objective 1-B: *Continue support of the Community Preservation Act as a viable funding source to increase the amount of permanently protected land in Sudbury.*

Goal 2: Protect land areas and migration corridors for the well-being of indigenous flora and fauna.

Objective 2-A: *Inventory parcels for environmental sensitivity and to identify those that provide significant unprotected wildlife habitat.*

Objective 2-B: *Work with landowners to obtain Conservation Restrictions in critical areas.*

Goal 4: Protect and restore the quality of the Town's ponds and waterways.

Objective 4-A: *Continue efforts to reduce nitrogen and phosphorus emissions from the Marlborough Easterly Treatment Plant.*

Objective 4-B: *Protect critical parcels along the Sudbury River from further development.*

Objective 4-C: *Implement recommendations of the Ponds and Waterways Committee Master Plan.*

Rules and Regulations Governing the Subdivision of Land

The Town's Rules and Regulations Governing the Subdivision of Land (June 18, 2014) include requirements that address stormwater management and flood hazard mitigation, in addition to other hazards.

- Section H (1): Every subdivision submitted for approval by the Planning Board shall incorporate a system of drainage for the land area occupied by the subdivision including street drainage and runoff from the development. The stormwater management plan shall resemble the natural (pre-development) hydrology, hydrodynamics, and drainage patterns inherent to the property. This drainage system shall maintain the pre-development ratio of infiltration to surface runoff of site precipitation and shall minimize alterations to natural drainage patterns. Any necessary alterations to these natural drainage patterns may not change the natural patterns of drainage outside of the subdivision. Engineering calculations to support the adequacy of the proposed drainage system shall be required.
- Section H (2): The stormwater management plan shall comply with the Wetlands Administrative Bylaw and Regulations, and the Stormwater management Bylaw and Regulations, of the Town of Sudbury.
- Section H (3): The selection and design of the stormwater drainage system shall incorporate the currently recognized Best Management Practices of stormwater management.
- Section H (4): Any subdivision which proposes the use stormwater management structures and/or devices that require periodic and/or regular inspection and maintenance shall be subject to a non-refundable charge based on semi-annual cleaning and inspection of structures for a 2 year

period as recommended by the Department of Environmental Protection (DEP) Stormwater Guidelines.

- Section H (5): Prior to town acceptance of streets, sedimentation must be excavated from all detention basins at least semiannually (after spring snow melt and late fall), Any vegetation uprooted by sediment removal must be replaced.
- Section H (6): All basins shall be contained within drainage easements.
- Section H (7): All leaching pits shall contain manhole covers to facilitate inspection and maintenance.
- Section H (8): All stormwater management systems shall have an Operation and Maintenance Plan.
- Section H (9): When, in the opinion of the Planning Board, the stormwater management system is composed of numerous, complex or new technologies, the systems shall be subject to an enforceable covenant requiring homeowner maintenance and ownership.
- Section I: All subdivisions shall be designed to assure that the proposal minimizes flood damage; all public utilities and facilities are located and constructed to minimize or eliminate flood damage; and adequate drainage to reduce exposure to flood hazards.

Stormwater Management Bylaw Regulations

The Town's Stormwater Management Bylaw Regulations (January 23, 2013) include requirements that address stormwater management and flood hazard mitigation, in addition to other hazards.

Section 8.0 (A) Stormwater Management Plan:

1. The application for a Stormwater Management Permit shall include the submittal of a Stormwater Management Plan to the Planning Board or its designated Reviewing Agent. This Stormwater Management Plan shall contain sufficient information for the Planning Board or its designated Reviewing Agent to evaluate the environmental impact, effectiveness, and acceptability of the measures proposed by the applicant for mitigating adverse impacts from stormwater runoff. This plan shall be designed to meet the Massachusetts Stormwater Standards and additional criteria established in Section 8.A.3 of these Regulations and must be submitted with the stamp and signature of a Professional Engineer (PE) licensed to conduct such work in the Commonwealth of Massachusetts.
2. The Stormwater Management Plan shall fully describe the project in drawings, narrative, and calculations. Required contents of the Stormwater Management Plan are provided in Appendix B of the Regulations.
3. Design and Performance Criteria: At a minimum all projects subject to a SMP shall comply with the performance standards of the most recent version of Massachusetts Stormwater Management Standards and accompanying Stormwater Management Handbook, as well as the criteria contained herein. The following criteria shall be used in the

submittal of an application for a Stormwater Management Permit under the Town of Sudbury Bylaws:

a. The design of the project shall, to the maximum extent feasible, employ environmentally sensitive site design as outlined in the DEP handbook and shall attempt to reproduce natural hydrologic conditions with respect to ground and surface waters.

b. Evaluation of Low Impact Development practices is required and implementation of such practices is required, to the maximum extent practicable and where it provides a substantially equivalent alternative.

c. The Stormwater Management Plan shall incorporate source controls of contaminants and employ Best Management Practices (BMPs) to minimize stormwater pollution.

d. The water quality volume for sizing of BMPs shall be based on 1-inch of runoff from the tributary area.

e. Hydrologic analyses using TR-55/TR-20 methodology shall be performed on the entire project site and include any off-site areas that drain to or through the project site.

f. The analyses shall be analyzed for the 1 inch, and the 2, 10, 25 and 100-year design storms under pre-development and post-development conditions. The 24-hour rainfall amounts for the 2, 10, 25 and 100 year storms are to be based on the Northeast Regional Climate Center “Atlas of Precipitation Extremes for the Northeastern United States and Southeastern Canada.” For Sudbury, the 24 hr rainfall amounts are as follows (rounded to the nearest one-tenth of an inch):

- 2 yr, 24 hr event = 3.2 inches
- 10 yr, 24 hr event = 4.8 inches
- 25 yr, 24 hr event = 6.0 inches
- 100 yr, 24 hr event = 8.6 inches

g. The analysis is to be performed on a pre and post sub-watershed basis with designated control points at each location where runoff leaves the site.

h. The same land area shall be used in the analysis to facilitate comparison of existing and proposed conditions.

i. The total volume of discharge as well as peak rate shall be evaluated at each control point.

j. Redevelopment Standards: Projects involving redevelopment of existing sites shall be designed in accordance with the redevelopment checklist provided in the latest MA Stormwater Handbook All redevelopment projects must provide a net improvement to stormwater conditions at the site, either in the area of disturbance or to other areas on the site. The Planning Board or its designated Reviewing Agent may require improvements to areas outside of disturbance activity where known problems exist and reasonable solutions are available. Such opportunities might include:

- Reduce impervious surfaces
- Implement source controls of potential stormwater pollutants on the entire site
- Reroute drainage to maximize treatment efficiencies
- Segregate roof runoff for direct infiltration or capture and re-use
- Update Operation and Maintenance plans and procedures for the entire site

4. Water Reuse/Water Conservation: In order to conserve potable water supplies and maximize recharge, it may be appropriate on some sites to store and reuse clean runoff (e.g. from roofs) for reuse on the site for irrigation or other graywater purposes. This can be accomplished through the Sudbury Stormwater Regulations Adopted 9/9/09 Revised 1/23/13 Page 12 of 28 use of cisterns and rain barrels. Where appropriate, a water budget may be required to be prepared to determine applicability.
5. Landscape Design
    a. Landscape designs shall be developed based on soil, light and other site-specific conditions. Plant species shall be chosen for their ability to thrive in the post-development soil, water and use conditions of the site without significant supplemental water or fertilizer, once established.
    b. Plant species shall be native to inland Middlesex County or shall be cultivars of these native species.
    c. Wildflower meadows and shrubs are advisable to reduce the amount of lawn or turf on a site. d. For landscape areas adjacent to roadways, salt tolerant plans shall be used. e. Irrigation shall be provided by the use of a rainwater harvesting system to the extent feasible.

Section 8.0 (B) Erosion and Sediment Control Plan:

1. An Erosion and Sediment Control Plan is required at the time of application for all projects. Plan approval by the Planning Board or its designated Reviewing Agent is required prior to any site altering activity. The plan shall be designed to ensure compliance with the Permit, these Regulations, and if applicable, the NPDES General Permit for Storm Water Discharges from Construction Activities. In addition, the plan shall ensure that the Massachusetts Surface Water Quality Standards (314 CMR 4.00) are met in all seasons.
2. If a project requires a Stormwater Pollution Prevention Plan (SWPPP) per the NPDES General Permit for Storm Water Discharges from Construction Activities, then the permittee is required to submit a complete copy of the SWPPP (including the signed Notice of Intent and approval letter) as part of its application for a SMP. If the SWPPP meets the requirements of the NPDES General Permit, it will be

considered equivalent to the Erosion and Sediment Control Plan described in this Section.

3. The Erosion and Sediment Control Plan shall contain sufficient information to describe the nature and purpose of the proposed development, pertinent conditions of the site and the adjacent areas, and proposed erosion and sedimentation controls. The applicant shall submit such material as is necessary to show that the proposed development will comply with the design requirements listed below.
4. For larger developments where construction phasing occurs, the Erosion and Sediment Control Plan shall be updated as needed based on changing conditions at the site.
5. Required contents of the Erosion and Sediment Control Plan are provided in the Appendix C of the Regulations.
6. The Erosion and Sediment Control Plan shall be designed to meet the following criteria and guidelines.
    a. Minimize total area of disturbance and minimize unnecessary clearing and grading from all construction sites. Clearing and grading shall only be performed within areas needed to build the project, including structures, utilities, roads, recreational amenities, post-construction stormwater management facilities, and related infrastructure.
    b. Prior to any land disturbance activities commencing on the site, the developer shall physically mark limits of no land disturbance on the site with tape, signs, or orange construction fence, so that workers can see the areas to be protected. The physical markers shall be inspected daily.
    c. Erosion and Sediment Control measures shall be installed and maintained in accordance with the manufacturer's specifications and good engineering practices to ensure they perform as intended.
    d. Erosion and Sediment Control measures used shall be chosen based on the goal of minimizing site disturbance from installation of such measures, such as the use of filter mitts where appropriate.
    e. Keep Stormwater Runoff Velocities Low. The removal of existing vegetative cover during development and the resulting increase in impermeable surface area after development will increase both the volume and velocity of runoff. These increases must be taken into account when providing for erosion control.
    f. Protect Disturbed Areas from Stormwater Runoff. Best management practices can be utilized to prevent water from entering and running over the disturbed area. Diversions and other control practices intercept runoff from higher watershed areas, store or divert it away from vulnerable areas, and direct it toward stabilized outlets.
    g. Sediment trapping and settling devices shall be employed to trap and/or retain suspended sediments and allow time for them to

settle out in cases where perimeter sediment controls (e.g., silt fence and hay bales) are deemed to be ineffective in trapping suspended sediments on-site. Sediment basins shall also be used to minimize peak rate of runoff in accordance with the Massachusetts Stormwater Standards.

h. BMPs to be used for infiltration after construction shall not be used as BMPs during construction unless otherwise approved by the Board. Many infiltration technologies are not designed to handle the high concentrations of sediments typically found in construction runoff, and thus must be protected from construction related sediment loadings.

i. Sediment shall be removed once the volume reaches ¼ to ½ the height of a hay bale. Sediment shall be removed from silt fence prior to reaching the load-bearing capacity of the silt fence which may be lower than ¼ to ½ the height.

j. Sediment from sediment traps or sedimentation ponds shall be removed when design capacity has been reduced by 50 percent.

k. On and off-site material storage areas, including construction and waste materials, shall be properly protected and managed.

l. Soil stockpiles must be stabilized or covered at the end of each workday. Stockpile side slopes shall not be greater than 2:1. All stockpiles shall be surrounded by sediment controls.

m. Projects must comply with applicable Federal, State and local laws and regulations including waste disposal, sanitary sewer or septic system regulations, and air quality requirements, including dust and debris control;

n. A tracking pad shall be constructed at all entrance/exist points of the site to reduce the amount of soil carried onto roadways and off the site.

o. Permanent seeding shall be undertaken in the spring from March through May, and in late summer and early fall from August to October 15. During the peak summer months and in the fall after October 15, when seeding is found to be impractical, appropriate temporary mulch shall be applied. Permanent seeding may be undertaken during the summer if plans provide for adequate mulching and watering.

p. Slopes (greater than 3:1) shall be protected from erosion by limiting clearing of these areas in the first place or, where grading is unavoidable, by providing special techniques to prevent upland runoff from flowing down a steep slope and through immediate stabilization to prevent gullying. Offsite runoff shall be diverted from highly erodible soils and steep slopes to stable areas.

q. Interim and permanent stabilization measures shall be instituted on a disturbed area immediately after construction activity has temporarily or permanently ceased on that portion of the site. Two methods are available for stabilizing disturbed areas: mechanical

(or structural) methods and vegetative methods. In some cases, both are combined in order to retard erosion.

r. Temporary sediment trapping devices must not be removed until permanent stabilization is established in all contributory drainage areas.

s. All temporary erosion and sediment control measures shall be removed after final site stabilization. Disturbed soil areas resulting from the removal of temporary measures shall be permanently stabilized within 30 days of removal.

Section 8 (C) Operation and Maintenance Plan:

1. An Operation and Maintenance Plan (O&M Plan) is required at the time of application for all projects. The O&M Plan shall be designed to ensure compliance with the Permit, the Bylaw and these Regulations and that the Massachusetts Surface Water Quality Standards, 314, CMR 4.00 are met in all seasons and throughout the life of the system. The O&M Plan shall be a stand-alone document, and shall remain on file with the Planning Board or its designated Reviewing Agent and shall be an ongoing requirement. To ensure that all BMPs continue to function as designed a final O&M Plan shall be submitted prior to issuance of a Certificate of Completion and reflect any modifications made during the permitting process and the site specific conditions.
2. The Operation and Maintenance Plan shall include, at a minimum:
    a. The name(s) of the owner(s) for all components of the system.
    b. The signature(s) of the owner(s).
    c. The names and addresses of the person(s) responsible for operation and maintenance; if responsibility is contracted to a third party, a copy of the maintenance agreement(s) must be provided.
    d. A plan or map showing the location of the systems and facilities including easements, catch basins, manholes/access lids, main, and stormwater devices.
    e. An Inspection and Maintenance Schedule for all stormwater management facilities including routine and non-routine maintenance tasks to be performed.
    f. A list of easements with the purpose and location of each. Easements shall be recorded with the Middlesex South District Registry of Deeds prior to issuance of a Certificate of Completion by the Planning Board or its designated Reviewing Agent.
    g. Provisions for the Planning Board or its designee to enter the property at reasonable times and in a reasonable manner for the purpose of inspection.

h. Any other information required by the Planning Board or its designated Reviewing Agent.

3. O&M Plan shall apply to the entire project site, not just area the disturbance area.
4. At a minimum, inspections shall occur during the first year of operation and in accordance with the operation and maintenance plan in the approved stormwater management permit.
5. The owner of the property shall maintain a log of all operation and maintenance activities, including without limitation, inspections, repairs, replacement and disposal (for disposal, the log shall indicate the type of material and the disposal location). This log shall be made available to the MassDEP and the Planning Board or its designated Reviewing Agent upon request.
6. Inspection reports shall be submitted to and maintained by the Planning Board or its designated Reviewing Agent for all stormwater management systems. Inspection reports for stormwater management systems shall include:
    a. The date of inspection;
    b. Name of inspector;
    c. The condition of each BMP, including components such as:
        i. Pretreatment devices
        ii. Vegetation or filter media
        iii. Fences or other safety devices
        iv. Spillways, valves, or other control structures
        v. Embankments, slopes, and safety benches
        vi. Reservoir or treatment areas vii. Inlet and outlet channels and structures
        viii. Underground drainage
        ix. Sediment and debris accumulation in storage and forebay areas (including catch basins)
        x. Any nonstructural practices
        xi. Any other item that could affect the proper function of the stormwater management system
    d. Description of the need for maintenance;
7. Changes to Operation and Maintenance Plans: The owner(s) of the stormwater management system must notify the Planning Board or its designated Reviewing Agent of changes in ownership or assignment of financial responsibility.
8. The Planning Board or its Reviewing Agent may require recordation of the O&M Plan depending on the complexity of the systems installed.

Flood Plain Overlay District (FPOD)

The purposes of the Flood Plain Overlay Districts are to preserve and protect the streams and other watercourses in the Town and their adjoining lands; to protect the health and safety of persons and property against the hazards of flooding; to

preserve and maintain the ground water table for water supply purposes; to protect the community against the detrimental use and development of lands adjoining such water courses and to conserve the watershed areas of the Town for the health, safety and welfare of the public.

The Flood Plain Overlay District shall consist of the several areas shown as flood plains on the following described maps or as otherwise described:

- Flood Plain Boundaries
  The Flood Plain District is herein established as an overlay district. The District includes all "special flood hazard areas inundated by100-year flood" within the Town of Sudbury designated as Zones A and AE and "floodway areas in Zone AE" on the Middlesex County Flood Insurance Rate Map (FIRM), issued by the Federal Emergency Management Agency (FEMA) for the administration of the National Flood Insurance Program. The map panels of the Middlesex County FIRM that are wholly or partially within the Town of Sudbury are panel numbers 25017C0362F, 25017C0363F, 25017C0364F, 25017C0366F, 25017C0367F, 25017C0368F,25017C0369F, 25017C0386F, 25017C0388F, 25017C0501F, 25017C0502F, 25017C0506F,25017C0507F, 25017C0508F and 25017C0509F datedJuly7, 2014. The exact boundaries of the District maybe defined bythe100-yearbaseflood elevations shown on the FIRM and further defined by the Flood Insurance Study booklet dated July 7, 2014. The FIRM and Flood Insurance Study booklet are incorporated herein by reference and are on file with the Town Clerk, Planning Board, Building Official, Conservation Commission and Engineering Department.
- Floodway Data
  In Zones A and AE along watercourses that have not had a regulatory floodway designated, the best available Federal, State, local, or other floodway data shall be used to prohibit encroachments in floodways which would result in any increase in flood levels within the community during the occurrence of the base flood discharge. The areas in the Flood Plain Overlay District are hereby deemed to be subject to seasonal or periodic flooding, and the use of land in any such area is hereby declared to be dangerous to the health and safety of occupancy thereof, and each said area shall be known as a Flood Plain.

Except as otherwise provided herein, the following uses or activities are prohibited in the Flood Plain Overlay District:

- No building, wall, dam or other structure shall be erected, constructed, altered, enlarged or otherwise created or moved for any living or other purpose, provided that tents, fences, wildlife management shelters, foot paths, bicycle paths, horse paths, and

foot bridges are permitted if (i) they are accessory to lawful primary uses in a single residence district and (ii) they do not affect the natural flow patterns of any watercourse.

- Dumping, filling, excavating or transferring of any material which will reduce the natural floodwater storage capacity or interfere with the natural flow patterns of any watercourse within this district is prohibited.
- Encroachments, including fill, new construction, substantial improvements and other development within any floodway shown on the Middlesex County Flood Insurance Rate Map for the Town of Sudbury Community No. 250217, datedJuly7, 2014, prepared by the Federal Emergency Management Agency under the National Flood Insurance Program(on file with the Town Clerk and incorporated herein by reference), which would result in anyincreaseinthel00-yearflood level are prohibited, and no special permit shall be issued to allow such encroachments.

Upon the issuance of a special permit by the Board of Appeals, and subject to the conditions hereinafter specified and such other special conditions and safeguards as the Board of Appeals deems necessary to fulfill the purposes set forth herein, the following uses, structures and actions, as permitted in Single Residence Districts, may be permitted:

- Duck-walks and boat landings
- Appropriate municipal uses such as waterworks, pumping stations and parks
- Temporary storage of materials or equipment, but in no event to exceed three months
- Dams, excavations or grading, consistent with the purposes of this section, to create ponds, pools or other changes in watercourses for swimming, fishing or other recreational uses, agricultural uses, scenic features, or drainage improvements

Driveways and roads, if alternate means of access are impractical and if the Town Engineer has certified the said driveways and roads if constructed shall not endanger the health, safety and welfare of the public

Any other filling, excavating or transferring of any material, or erection, construction, alteration, enlargement, removal or demolition of any structure, upon the condition that with respect to each such action and structure the Board of Appeals determines that granting a special permit therefore would not result in any risk of pollution or contamination of any waterway or pond, reduction of seasonal high water storage areas, reduction of ground water absorption areas which serve the public water supply or other derogation from the intent and purpose of this Section.

All development in the district, including structural and nonstructural activities, whether permitted by right or by special permit must be in compliance with G.L. c. 131, s.40 and with the following:

- Massachusetts State Building Code as to floodplain and coastal high hazard areas (currently780 CMR)
- Wetlands Protection Regulations, Department of Environmental Protection, DEP(currently 310 CMR 10.00)
- Inland Wetlands Restriction, DEP(currently 310 CMR 13.00)
- Minimum Requirements for the Subsurface Disposal of Sanitary Sewage, DEP (currently 310 CMR 15.000, Title 5)
- The Sudbury Wetlands Administration Bylaw

Wetlands Protection Bylaw

The purpose of this bylaw is to maintain the quality of surface water, the quality and level of the ground water table and water recharge areas for existing, or potential water supplies; to protect the public health and safety; to protect persons and property against the hazards of flood water inundation; to protect the community against the costs which may be incurred when unsuitable development occurs in wetland resource areas; and to provide for the reasonable protection and conservation of certain irreplaceable natural features, resources and amenities for the benefit and welfare of the present and future inhabitants of the Town of Sudbury. Accordingly, this bylaw protects the wetlands, related water resources, and certain adjoining land areas in the Town by providing for prior review and control of activities deemed to have a significant or cumulative adverse effect upon wetlands values, including but not limited to the following: protection of public and private water supply, protection of ground water, flood control, erosion and sedimentation control, storm damage prevention, avoidance of water and soil pollution, protection of fisheries, wildlife habitat, rare species habitat including rare plant species, agriculture, aqua culture, and recreation values, deemed important to the community (collectively, the "wetlands values protected by this bylaw".) This bylaw is intended to utilize the Home Rule authority of this municipality to protect additional resource areas, for additional values, with additional standards and procedures to augment those of the Wetlands Protection Act, G.L. Ch. 131, §40 and Regulations thereunder, 310 CMR 10.00.

Massachusetts State Building Code

The Town of Sudbury enforces the Massachusetts State Building Code which includes many detailed regulations regarding wind loads, earthquake resistant design, flood-proofing and snow loads.

- Wind-Related Hazards
    - The Town enforces the Massachusetts State Building Code where provisions are adequate to mitigate against most wind damage. The code's provisions are the most cost-effective mitigation measure against tornadoes given the extremely low probability of occurrence.

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

      Section 1612.2.5 sets up seismic hazard exposure groups and assigns all buildings to one of these groups according to Table 1612.5. Group II includes buildings which have a substantial public hazard due to occupancy or use and Group III are those buildings having essential facilities which are required for post-earthquake recovery, including fire, rescue and police stations, emergency rooms, power-generating facilities, and communication facilities.

3.3 Administrative and Technical Capabilities

Sudbury Local Emergency Planning Committee (LEPC)

The LEPC's mission is to bring together town elected and appointed officials, community and industries for enhancing hazardous materials, natural disaster, and terrorism preparedness. This includes providing input into the town Comprehensive Emergency Management Plan. The LEPC is a focal point in the town for CERT (Community Emergency Response Teams and an interface with the MRC (Medical Reserve Corp.), and provides resources for the following:

- Create Crisis Toolkits (https://sudbury.ma.us/lepc/2007/02/01/create-crisis-kits/)
- Special Care for Special Folks (https://sudbury.ma.us/lepc/2007/01/09/special-care-for-special-folks/)

Sudbury Medical Reserve Corps (MRC)

The objective of the MRC program is to strengthen communities by establishing a system for medical and public health volunteers to offer their assistance and expertise to existing medical and emergency service providers during times of community need. It is the intention of the Sudbury Board of Selectmen and Board of Health that the MRC build and maintain a volunteer group that will be called upon to organize medical, public health, and other volunteers in support of

existing programs and resources that improve the health and safety of the town of Sudbury.

Sudbury Community Emergency Response Team (CERT)

The CERT volunteer program educates and trains citizens to be better prepared to respond to emergency situations in the community. When emergencies happen, CERT members can be deployed at the direction of the Fire Chief to provide critical support to first responders, provide immediate assistance to victims, and organize spontaneous volunteers at a disaster site. CERT members can also help with non-emergency projects that help improve the safety of the community.

Comprehensive Emergency Management Plan

The Town of Sudbury Comprehensive Emergency Management Plan (CEMP) provides a framework for a community-wide emergency management system to ensure a coordinated response to emergencies and coordinated support of certain pre-planned events. The CEMP addresses the roles and responsibilities of all community departments, agencies, government organizations, volunteers and community partners that may be involved in response operations, and identifies how regional, state, private sector, and other resources may be activated to address disasters and emergencies in the community.

The CEMP is intended to accomplish the following goals:

- Provide a process by which emergency response personnel and local government staff can efficiently and effectively prevent, mitigate, prepare for, respond to, and recover from emergencies and disasters.
- Identify the responsibilities of local agencies and partnering stakeholder and organizations during emergencies or events.
- Identify lines of authority and coordination for the management of an emergency or event.
- Assign responsibilities to agencies, organizations and individuals for carrying out specific actions during an emergency or event.
- Detail the methods and procedures to be used by designated personnel to assess emergencies and take appropriate actions to save lives and reduce injuries, prevent or minimize damage to public and private property, and protect the environment.

Emergency Operations Center

The Town maintains a primary and alternate (in the event that the primary location is rendered or deemed unusable) Emergency Operations Center (EOC) which serve as the central point for coordination of the community's emergency management and response activities, maintaining situational awareness about the emergency situation, and facilitating requests for deployment of resources.

Primary EOC:	Sudbury Police Department Training Room 75 Hudson Rd. Sudbury, MA 01776 (978) 443-2121

Alternate EOC: Sudbury Fire Department Alarm Room
77 Hudson Rd. Sudbury, MA 01776
(978) 440-5301

Mutual Aid System
The Town of Sudbury is part of a mutual aid system (the provision of services from one jurisdiction to another) for additional resources from many fronts. Mutual aid agreements currently include:

- Fire District 14 Mutual Aid Agreement
- MA Fire/EMS Mobilization Plan
- Northeastern Massachusetts Law Enforcement Council (NEMLEC)
- Middlesex County Chiefs of Police Mutual Aid Agreement
- Statewide Hazardous Material Response Plan
- MA Public Works Mutual Aid Agreement

Evacuation Routes
Evacuation routes will be pre-identified by the Emergency Management Director in conjunction with the Chief of Police and DPW Director. Critical arteries and roads in Sudbury include; Route 20 (Boston Post Rd.), Route 27 (Old Sudbury Rd., Hudson Rd., Maynard Rd.), and Route 117 (North Rd., Great Rd.). Depending on the location and type of incident, evacuation routes can change. The public will be notified through different means of communications such as reverse 911, sign boards, social media, the town website and local media news outlets.

Evacuation Assembly Points
Evacuation Assembly Points are the location within an area affected that serve as assembly points for evacuees who do not have their own transportation. They are typically located at cross streets or large parking lots within walking distance of nearby residents. The Town will use buses or other vehicles to pick up evacuees and transport them to either a shelter or to a local destination.

Evacuation Transportation Hub
In situations when residents may need to be evacuated outside of the community, the Town of Sudbury will seek assistance from the regional MetroWest Regional Transit Authority (MWRTA) via MAESF #1 Transportation Plan. Displaced residents will be taken from the assembly point and brought to a hub to await for transportation to either a state-operated Regional reception Center (RRC) or a designated shelter outside of Sudbury.

Municipal Website
The Town's Fire Department/Emergency Management Agency maintains a municipal webpage hosted on the Town's website that includes a variety of local, state and regional emergency program information for residents, business owners and tourists, including:

- Considerations in an Emergency or Disaster (https://s3-us-west-2.amazonaws.com/cdn.sudbury.ma.us/wp-content/uploads/sites/294/2014/08/CONSIDERATIONS5-20-11.pdf?version=b9724f50a91c9f1a900621452c962e3d) on being prepared for:
    - Sheltering in Place
    - Planning for the Elderly or Disabled
    - Planning for Household or Service Animal Emergencies
    - Evacuation, if Necessary
    - Staying in Business
    - Emergency Communication with Friends or Relatives Outside the Community/State
- Tornados (https://s3-us-west-2.amazonaws.com/cdn.sudbury.ma.us/wp-content/uploads/sites/294/2014/08/Tornados5-20-11.pdf?version=3affd422cd47526a28e8ab779d82656d)
    - FEMA information on preparing for and responding to tornadoes
- Hurricanes (https://s3-us-west-2.amazonaws.com/cdn.sudbury.ma.us/wp-content/uploads/sites/294/2014/08/HurricanesTipsPrepareandRespond.pdf?version=ee3745e16f291c10487b5031766b9f03)
- Family Communications Plan (https://s3-us-west-2.amazonaws.com/cdn.sudbury.ma.us/wp-content/uploads/sites/294/2014/08/FamilyEmergencyCommunicationsPlan.pdf?version=d6f4062864fa63c5dfc172a3d85d5e6d)
- Basic Family Preparedness Survey (https://s3-us-west-2.amazonaws.com/cdn.sudbury.ma.us/wp-content/uploads/sites/294/2014/08/FamilyBasicPreparednessSurvey.pdf?version=8c378759064873ec5c71dfa008c5f9ef)
- Items to Have on Hand for an Extended Stay (https://s3-us-west-2.amazonaws.com/cdn.sudbury.ma.us/wp-content/uploads/sites/294/2014/08/FamilyBasicPreparednessSurvey.pdf?version=8c378759064873ec5c71dfa008c5f9ef)
- Evacuation Floor Plan (https://s3-us-west-2.amazonaws.com/cdn.sudbury.ma.us/wp-content/uploads/sites/294/2014/08/Evacuation_Floor_Plan1.pdf?version=19f597ecf4a6eb91e5a2338e3a006178)
- Safety Tips for Open Burning Season (https://s3-us-west-2.amazonaws.com/cdn.sudbury.ma.us/wp-content/uploads/sites/294/2014/08/Evacuation_Floor_Plan1.pdf?version=19f597ecf4a6eb91e5a2338e3a006178)
- Ice/Cold Water Safety (https://s3-us-west-2.amazonaws.com/cdn.sudbury.ma.us/wp-content/uploads/sites/294/2014/08/IceandColdWaterSafety.pdf?version=ab2636dbce9d7dc18693a3231bd99fac)

Sudbury Municipal Vulnerability Preparedness (MVP) Working Group

Under Executive Order 569, as the Commonwealth advances an integrated

climate change strategy, Sudbury (and many other Massachusetts cities and towns) is working at the local and regional level on resiliency planning and climate preparedness efforts. In 2019, through a grant from the Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA), Sudbury completed a Town-wide vulnerability assessment and developed an action-oriented resiliency plan following a Community Resilience Building Workshop in May 2019. The Town became an MVP-Designated community in August of 2019.

The Workshop's central objectives included:

- Define top local natural and climate-related hazards of concern
- Identify existing and future strengths and vulnerabilities
- Develop prioritized actions for the community
- Identify immediate opportunities to collaboratively advance actions to increase resilience

The MVP Workshop ended with consensus on the following top six action items the Town should pursue towards increased resiliency:

1. Tree Maintenance and Forest Management
   a.) Maintain trees at roadways/utility rights-of-way
   b.) Preserve existing tree canopy/plan for future species changes
      i.) Identify/remove dead and falling trees
      ii.) Develop plan for re-planting (native species, size, shape, and placement)
   c.) Purchase bucket truck for DPW
   d.) Public education around trimming and planting
2. Power/Utility Lines Management
   a.) Bury lines underground as roads are repaved
   b.) Establish tree/buffer management
   c.) Evaluate funding resources
      i.) Rate-payer funding
      i) MA Surcharge Program
      ii) Solar facilities
3. Improve Emergency Response Planning and Communication
   a.) Increase capacity and support for Citizen's Emergency Response Team (CERT) and Medical Reserve Corps (MRC) recruitment
   b.) Training and communication protocol for hospitals and home healthcare agencies
   c.) Educate community on Reverse 911
   d.) Assess needs of vulnerable populations to understand sheltering needs (Know-Your-Neighbor)
   e.) Maintain database of vulnerable populations and address data privacy/sharing challenges
4. Update Existing Regulations
   a.) Stormwater regulations to reduce flooding and water quality impacts
   b.) Incorporate latest science and climate change projections

c.) Private well restrictions and water bans during drought events

5. Improve Drainage Infrastructure and Capacity
   a.) Stormwater Infrastructure Assessment
      i.) Retrofits, replacement Low Impact Development (LID), and Green Infrastructure (GI)
   b.) Culvert Replacement
      i.) Repair, replace, engineering/design
6. Strengthen Emergency Shelters (Schools, Libraries, Community Center)
   a.) Generators
   b.) Air conditioning
   c.) Charging stations (cell phones)

Coordination with Neighboring Municipalities

The Town of Sudbury coordinates with the Towns of Lincoln, Wayland, Framingham, Marlborough, Hudson, Stow, Maynard, Acton and Concord periodically across municipal issues. The Town will continue to coordinate with these adjacent communities on natural hazard mitigation planning, specifically any shared resource plans and evacuation plans.

Municipal Administration and Staff

The Sudbury Board of Selectmen, Planning Board, Local Hazard Mitigation Committee, municipal officials and staff all work well together to develop, implement and update policies and plans to promote the safety of its residents and minimize risk to the community.

- **Department of Public Works**. The Department performs a number of duties, as needed, including:
  - *Street sweeping* **–** Every street gets swept once a year or as needed. Some of the street sweeping is contracted out and some is done with a town-owned sweeper.
  - *Catch basin cleaning* **–** The town has a total of 2000 catch basins. Five hundred of the basins are cleaned by an outside contractor on a rolling basis each year so that each basin is cleaned at least once every four years, with some basins needing to be cleaned more often than others due to greater traffic and sand volumes. Under Sudbury's EPA Phase II MS4 Permit, the goal is to clean each catch basin annually. At the present time, catch basins for priority annual cleaning have been identified.
  - *Roadway treatments* **–** The town uses a mixture of sand and salt with a bit more salt in the mix. This is done to minimize the amount of sand that enters catch basins and streams.
  - *Tree-trimming program* – The town owns and uses its own equipment (two chippers) to remove and chip downed trees as needed. NStar has a tree trimming program for its power line corridors help minimize power line disruptions from downed trees.

- **Fire Department.** The Department performs a number of duties, as needed, including:
    - *Permits Required for Outdoor Burning* – The Fire Department requires a written permit for outdoor burning. The property-owner must come into the Fire Station, fill out a form and pay a $10.00 fee.
    - *Subdivision Review* – The Fire Department is involved in reviewing all subdivision plans.

Sudbury/Assabet/Concord River Watershed Cooperative Invasive Species Management Association

The Town of Sudbury is currently working (through volunteers) with the New England Wild Flower Society – Sudbury/Assabet/Concord River Watershed Cooperative Invasive Species Management Association (CISMA) conducting early detection invasive plant species surveys (species that have not invaded or not in populations that are yet problematic in Sudbury). The eleven early detection species that are the targets of the CISMA survey include:

- Flowering Rush *(Butomus umbellatus)*
- Giant Hogweed (*Heracleum mantegazzianum*)
- Japanese Stiltgrass (*Microstegium vimineum)*
- Kudzu (*Pueraria montana)*
- Mile-a-Minute Vine (*Persicaria perfoliate)*
- Reed mannagrass (*Glyceria maxima*)
- Tansy Ragwort/Stinking Willie (*Senecio jacobaea)*
- Brazilian Waterweed (*Anacharis densa)*
- Great yellowcress (*Rorippa amphibia*)
- Hydrilla (*Hydrilla verticillata*)
- Parrot-Feather (*Myriophyllum aquaticum*)

3.4 Financial Capabilities

Federal/State Grant Opportunities

The Town, across all municipal departments, considers and pursues all applicable federal, state and local grant opportunities to assist in implementing hazard mitigation programs, such as FEMA, Housing and Urban Development (HUDCDBG Program, United States Department of Agriculture – Natural Resources Conservation Service (NRCS), and U.S. Economic Development Administration (EDA).

FEMA Hazard Mitigation Assistance (HMA) Program (HMGP, PDM, and FMA) – Since 2010, the Town of Sudbury has applied and received approximately $1,179, 419 in grant assistance from FEMA for various projects (see Section 2.5 for additional details).

USDA NRCS – provides Conservation Technical Assistance, Financial Assistance, and Conservation Innovation Grant programs.

HUD CDBG Program – a flexible program that provides communities with resources to address a wide range of unique community development needs, particularly the Disaster Recovery Assistance Program which provides grants to help cities, counties, and States recover from Presidentially-declared disasters, especially in low-income areas, subject to availability of supplemental appropriations.

3.5 National Flood Insurance Program

Sudbury implements and enforces the state building code and fully participates in the NFIP. Sudbury has supported natural resource management and protection, which is articulated in the Sustainable Sudbury Master Plan 2001 and Open Space and Recreation Plan 2009 - 2013. Sudbury understands that participation in the NFIP is an essential step in mitigation flood damage and is working to consistently enforce NFIP compliant policies in order to continue its participation in this program. FEMA has also developed new floodplain mapping for the Town which was finalized July 14, 2017.

Table 3-1 Actions for Continued Compliance with NFIP below lists those actions that the Town has done and will continue to do and those actions that will be done within the next five years for continued compliance with the NFIP.

Table 3-1 Actions for Continued Compliance with NFIP

Actions (Listed in order of priority)	Done/Ongoing	To be Done
Join the NFIP.	X	
Participate in NFIP training by State and/or FEMA.		X
Establish mutual aid agreements with neighboring communities to address administering the NFIP following a major storm event.	X	
Address NFIP monitoring and compliance	X	
Revise/adopt subdivision regulations and erosion control regulations to improve floodplain management in the community.	X	
Participate in the CRS.		X
Prepare, distribute, or make available NFIP, insurance and building code explanatory pamphlets or booklets.	X	
Identify and become knowledgeable on non-compliant structures in the community.	X	
Identify and become knowledgeable of submit to rate structures.		X

Identify cause of submit to rate structure and analyze how to prevent non-compliant structures in the future.		X
Inspect foundations at time of completion before framing to determine if lowest floor is at or above BFE.	X	
Require use of elevation certificates.	X	
Report any changes in the Special Flood hazard Area to FEMA within 180 days of change.		X
Identify and keep track of LOMA/LOMR in the community.	X	
Gain familiarity with community's Flood Insurance Rate Maps.	X	
Address repetitive loss structures.		X

Source: Sudbury LHMC.

3.6 Community Rating System

NFIP's CRS Program is a voluntary program that recognizes and encourages a community's efforts that exceed the NFIP minimum requirements for floodplain management. The CRS program emphasizes three goals:

- the reduction of flood losses
- facilitating accurate insurance rating
- promoting the awareness of flood insurance

By participating in the CRS Program, communities can earn a 5-45% discount for flood insurance premiums based upon the activities that reduce the risk of flooding within the community.

The Town does not currently participate in the NFIP's CRS Program. However, the Town's adoption of the Flood Zone Mapping and Flood Protection Overlay District allows the Town to continue to participate in the NFIP which means that all property owners in Town continue to be eligible to purchase flood insurance for their property.

3.7 Existing Protection Matrix

A summary of the main identified existing and future protection measures presented above are summarized on Table 3-2. These measures constitute the baseline protection that was further evaluated by the Sudbury LHMC to determine gaps in Sudbury's protection from natural disasters. Goal statements and specific actions were then developed to mitigate the identified gaps in the existing protection. These identified protection measures facilitate the Town of Sudbury to implement various hazard mitigation programs, ultimately making the community more resilient.

Table 3-2 Existing Protection Matrix Sudbury, MA

Existing Protection	Description	Area Covered	Effectiveness and/or Enforcement	Improvements or Changes Needed
Planning and Regulatory				
Sustainable Sudbury Master Plan 2001				
	The Town is currently updating the Master Plan. The hazard mitigation plan update will be cited and referenced for consistency across municipal documents.	Townwide	Effectiveness: Very Good Enforcement: Planning and Community Development	Continue to Utilize
Open Space and Recreation Plan 2009 - 2013				
	Includes goals and objectives relative to the Town's natural resources, particularly the ponds, waterways and environmentally sensitive areas.	Townwide	Effectiveness: Good Enforcement: Parks & Recreation/Conservation Commission	Continue to Utilize
Rules and Regulations Governing the Subdividion of Land				
	Includes goals and objectives relative to the Town's natural resources, particularly the ponds, waterways and environmentally sensitive areas.	Townwide	Effectiveness: Good Enforcement: Parks & Recreation/Conservation Commission	Continue to Utilize
Stormwater Management Bylaw Regulations				
	Includes requirements that address stormwater management and flood hazard mitigation.	New development throughout the community	Effectiveness: Good Enforcement: Planning Board	Continue to Utilize
Flood Plain Overlay District				
	Includes requirements that address stormwater management and flood hazard mitigation.	Townwide or areas shown on the FIRM	Effectiveness: Good Enforcement: Planning Board/Conservation Commission	Continue to Utilize
Wetlands Protection Bylaw				
	Potects the wetlands, related water resources, and certain adjoining land areas in the Town by providing for prior review and control of activities deemed to have a significant or cumulative adverse effect upon wetlands values.	Wetland areas	Effectiveness: Good Enforcement: Planning Board/Conservation Commission	Continue to Utilize

Table 3-2 Existing Protection Matrix Sudbury, MA

Existing Protection	Description	Area Covered	Effectiveness and/or Enforcement	Improvements or Changes Needed
Planning and Regulatory				
Massachusetts State Building Code				
	The Massachusetts State Building Code contains many detailed regulations regarding wind loads, earthquake resistant design, flood-proofing and snow loads.	Townwide	Effectiveness: Most effective for new construction Enforcement: Planning Board/Building Official	Continue to Utilize
Administrative and Technical				
Local Emergency Planning Committee				
	The Massachusetts State Building Code contains many detailed regulations regarding wind loads, earthquake resistant design, flood-proofing and snow loads.	Townwide	Effectiveness: Provides a forum for cooperation on issues related to natural and man-made disaster. Enforcement: Emergency Management Director	Continue to Utilize
Medical Reserve Corp				
	A system for medical and public health volunteers to offer their assistance and expertise to existing medical and emergency service providers during times of community need.	Townwide	Effectiveness: Good Enforcement: Emergency Management Director	Continue to Utilize
Community Emergency Response Team				
	A volunteer program that educates and trains citizens to be better prepared to respond to emergency situations in the community.	Townwide/ dependent upon location and type of emergency/event.	Effectiveness: Good Enforcement: Emergency Management Director	Continue to Utilize
Comprehensive Emergency Management Plan				
	Provides a framework for a community-wide emergency management system to ensure a coordinated response to emergencies and coordinated support of certain pre-planned events.	Townwide	Effectiveness: Good Enforcement: Emergency Management Director	Continue to Utilize

Table 3-2 Existing Protection Matrix Sudbury, MA

Existing Protection	Description	Area Covered	Effectiveness and/or Enforcement	Improvements or Changes Needed
Administrative and Technical				
Municipal Website				
	A municipal webpage hosted on the Town's website that includes a variety of local, state and regional emergency program information for residents, business owners and tourists.	Townwide	Effectiveness: Good Enforcement: Emergency Management Director/Information Technology	Continue to Utilize
Municipal Vulnerability Preparedness Working Group				
	The Town has become an MVP-Certified community, and as such is eligible to seek implementation grants through the Commonwealth for any hazard mitigation actions identified as a result of the MVP process. A forum for resiliency planning and climate preparedness efforts.	Townwide	Effectiveness: Good Enforcement: Planning and Community Development	Continue to Utilize
Coordination with Neighboring Municipalities				
	Coordination to identify applicable efficiencies (resource-sharing and Mutual Aid agreements).	Regional context	Effectiveness: Very Good Enforcement: Emergency Management Director/DPW	Maintain
Municipal Administration and Staff				
	Municipal officials, staff, Borads and Commissions all work together to develop, implement and update policies and plans to promote the safety of residents and minimize risk to the community.	Townwide	Effectiveness: Very Good Enforcement: Town Manager, Board of Selectmen, Municipal Department Chairs	Maintain
Sudbury/Assabet/Concord River Watershed Cooperative Invasive Species Management Association				
	Municipal officials and volunteers working with agencies towards the eraly detecion and hopeful eradication of invasive species.	Townwide	Effectiveness: Good Enforcement: Conservation Commission	Continue to Utilize

Table 3-2 Existing Protection Matrix Sudbury, MA

Existing Protection	Description	Area Covered	Effectiveness and/or Enforcement	Improvements or Changes Needed
Financial				
Federal/State Grant Opportunities				
	HUD CDBG Disaster Recovery Assistance: http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/communitydevelopment/programs/drsi	Low-income areas.		Continue to utilize
	USDA, Natural Resources Conservation Service (NRCS) Conservation Technical Assistance: http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/technical/cta_ Financial Assistance: http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/ Conservation Innovation Grant Programs:	Tribal Lands		Continue to utilize
	MA State Hazard Mitigation Officer (SHMO) and State Mitigation Planners	Statewide		Continue to utilize
	2019 Massachusetts State Hazard Mitigation and Climate Adaptation Plan	Statewide		Continue to utilize

Section 4 Mitigation Strategy

4.1 Introduction

Removing and precluding development from hazardous areas is the best method of mitigation. However, this cannot be the sole focus of hazard mitigation in Sudbury. The Town's character and functionality require a level of intimacy with the areas of greatest risk – flood-related, winter-related and wind-related hazard events.

4.2 Mitigation Activities

In completing the risk and vulnerability analyses, the LHMC considered projects and actions that would reduce Sudbury's vulnerability to the identified hazards. The 2020 Risk Assessment Matrix (Table 2-1) is the basis for the mitigation actions presented in Section 4.3.

4.3 Mitigation Action Plan

The LHMC considered the goals of this plan and re-prioritized the matrix and the associated actions based on historical damage, safety of the population, property protection and consistency with town wide goals and objectives. Although not based on similar methodologies for prioritization, the new 'Priority Score' for each mitigation action (2020 Plan), is followed by the 2010 Plan prioritization (*High, Medium, Low Priority* and *Measures to Ensure Compliance with NFIP*) to reflect any changes in the prioritization of actions for this 2020 update by the LHMC (also included in Table 1-1, *2010 Plan Report Card*). Issues and objectives were aligned to public health risks, evacuation and mass care considerations, disruption of essential services and potential economic losses to the town.

The LHMC determined that the identified objectives could be met by considering actions aligned to the following Mitigation Categories:

- Public Education and Awareness
- Property Protection
- Natural Resource Protection
- Structural Projects
- Emergency Services
- Planning and Prevention

The LHMC has worked to set goals and objectives that are bounded by a time frame and are compatible and consistent with state hazard mitigation goals. Upon submittal of this plan to MEMA, the State Hazard Mitigation Committee (SHMC) is expected to review and approve these goals and objectives to ensure consistency with the statewide goals and objectives. The time frames used for this strategy are as follows:

- Short Term = 0 to 6 Months
- Medium Term = 6 to 18 Months
- Long Term = 18 Months to 5 Years

The following actions use the Risk Assessment Matrix (Table 2-1) to identify areas at risk, offer mitigation strategies and consider benefits. Each action offers a discussion of the project and if applicable, includes the options considered. Multiple actions associated with a vulnerable area reflect town priorities and are simply prioritized high, medium or low. If known, the actions include cost estimates and assign responsible parties to lead the efforts to complete the action. The cost ranges used for this strategy are as follows:

- Staff Time – municipal personnel time
- Minimal – less than $5,000
- Moderate – more than $5,000, but less than $25,000
- Significant – over $25,000

Other relevant departments/agencies that can offer support to the project are also listed. Finally, possible finance options are offered. Once the 2020 update receives FEMA's 'Approved Pending Adoption', the mitigation strategy will be put into motion.

Evaluation/Selection of Mitigation Actions

After reviewing the Town's identified risks and vulnerabilities to natural hazards, the input/feedback from the public workshop and recommendations from the Town, and the local Capability Assessment, the LHMC selected mitigation actions to incorporate into the 2020 update.

Prioritization of Actions

Due to budgetary constraints and other limitations, it is often impossible to implement all mitigation actions. The LHMC needed to select the most cost-effective actions for implementation first to use resources efficiently and develop a realistic approach toward mitigation risks. The DMA 2000 supports this principle of cost-effectiveness by requiring action plans to follow a prioritization process that emphasizes benefits over costs. DMA 2000 states:

> *"The mitigation strategy section shall include an action plan describing how the actions identified in section (c)(3)(ii) will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs."*

Part 1: Review Benefits and Costs
As part of the planning process, the LHMC utilized Review Tools 1, 2, and 3 associated with each action identified.

Part 2 Prioritize Actions – Qualitative Method, Relative Score
The LHMC utilized Method B: Prioritization using the Social, Technical, Administrative, political, Legal, Economic and Environmental (STAPLEE) criterion Relative Scores, suggested in FEMA's Hazard Mitigation Planning How-to-Guide Series (Table 4-1).

Table 4-1 STAPLEE Review and Selection Criteria

Category	Criteria
Social	Is the proposed action socially acceptable to the community?
	Are there equity issues involved that would mean that one segment of the community is treated unfairly?
	Will the action cause social disruption?
Technical	Will the proposed action work?
	Will it create more problems than it solves?
	Does it solve a problem or only a symptom?
	Is it the most useful action considering other community goals?
Administrative	Can the community implement the action?
	Is there someone to coordinate and lead the effort?
	Is there enough funding, staff, and technical support available?
	Are there ongoing administrative requirements that need to be met?
Political	Is the action politically acceptable?
	Is there public support both to implement and to maintain the project?
Legal	Is the community authorized to implement the proposed action? Is there a clear legal basis or precedent for this activity?
	Are there legal side effects? Could the activity be construed as a taking?

	Is the proposed action allowed by a comprehensive plan, or must a comprehensive plan be amended to allow the proposed action?
	Will the community be liable for action or lack of action?
	Will the activity be challenged?
Environmental	How will the action affect the environment?
	Will the action need environmental regulatory approvals?
	Will it meet local and state regulatory requirements?
	Are endangered or threatened species likely to be affected?
Economic	What are the costs and benefits of this action?
	Do the benefits exceed the costs?
	Are initial, maintenance, and administrative costs considered?
	Has funding been secured for the proposed action? If not, what are the potential funding sources (public, non-profit, and private)?
	How will this action affect the fiscal capability of the community?
	What burden will this action place on the tax base of the local economy?
	What are the budget and revenue effects of this activity?
	Does the action contribute to other community goals, such as capital improvements or economic development?
	What benefits will the action provide?

Part 3 Documentation of the Process

Each of the mitigation actions were scored against each of the STAPLEE criteria outlined above with a numerical score. These numbers were then totaled and developed into an overall priority score. The ranking of the Priority Score is a guideline for when the Town should begin acting on the identified strategies, or actions (Table 4-2).

The STAPLEE Method includes a cost-benefit review as part of the Mitigation Actions prioritization process. A more detailed cost-benefit analysis will be done, at the time of application, for those proposed Mitigation Actions that the Town applies for funding under the Pre-Disaster Grant Program and Hazard Mitigation Grant Program.

Table 4-2 STAPLEE Analysis

2020 Action Number	Title	Cost/ Benefit	Social	Technical	Administrative	Political	Legal	Economic	Environmental	Total	Prioritization
PROPERTY PROTECTION											
2020 - 1	Design Standards - Earth Removal Bylaw	Cost	2	2	2	2	2	2	0	12	**23**
		Benefit	1	1	2	1	2	2	2	11	
NATURAL RESOURCE PROTECTION											
2020 - 2	New Regulations for Roof Runoff and Sidewalk Recharge	Cost	2	1	2	1	2	1	0	9	**20**
		Benefit	2	1	2	1	2	1	2	11	
2020 - 3	Devote Resources to Monitoring Privately-Owned Drainage Facilities	Cost	-1	-1	-1	0	0	0	0	-3	**4**
		Benefit	1	1	1	1	1	1	1	7	
2020 - 4	Incorporate Science/Climate Change Projections into Existing Regulations	Cost	-1	0	-1	-1	0	0	0	-3	**5**
		Benefit	2	1	1	1	1	1	1	8	
2020 - 5	Tree Preservation Bylaw	Cost	1	0	-1	1	0	0	0	1	**9**
		Benefit	2	1	1	2	-1	1	2	8	
2020 - 6	Tree Maintenance and Forest Management Plan	Cost	1	0	-1	1	0	-1	0	0	**12**
		Benefit	2	2	1	2	1	2	2	12	
STRUCTURAL PROJECTS											
2020 - 7	Elevate Concord Road Two Feet (3 Locations)	Cost	2	1	-1	0	-1	1	-1	1	**8**
		Benefit	2	2	2	1	0	1	-1	7	
2020 - 8	Pantry Brook Dam Removal/Repairs/Operations and Management Plan	Cost	0	-1	0	0	-1	0	0	-2	**2**
		Benefit	2	1	0	0	-1	1	1	4	
2020 - 9	Improve/Upgrade Drainage Infrastructure/Capacity	Cost	1	0	-1	1	-1	1	2	3	**13**
		Benefit	2	2	0	2	0	2	2	10	
EMERGENCY SERVICES											
2020 - 10	Install Generators at Lincoln-Sudbury High School to Include Heating	Cost	0	2	1	1	-1	2	0	5	**15**
		Benefit	2	2	2	2	0	2	0	10	
2020 - 11	Install Large Capacity Generator at Curtis Middle School	Cost	0	2	1	2	2	2	0	9	**21**
		Benefit	2	2	2	2	2	2	0	12	
2020 - 12	Improve Emergency Response Planning	Cost	2	2	-1	1	0	0	0	4	**14**
		Benefit	2	2	1	1	2	2	0	10	
2020 - 13	Strengthen Emergency Shelters	Cost	2	0	2	2	2	1	0	9	**21**
		Benefit	2	2	2	2	2	2	0	12	

2020 Action Number	Title	Cost/ Benefit	Social	Technical	Administrative	Political	Legal	Environmental	Economic	Total	Prioritization
EMERGENCY SERVICES											
2020 - 14	Address Expansion/Improvements to Fire Stations 2, 3	Cost	1	1	-1	1	0	1	0	3	**15**
		Benefit	2	2	2	2	2	1	1	12	
PLANNING AND PREVENTION											
2020 - 15	Relocate Overhead Electrical/Cable Lines Underground	Cost	2	-1	-1	-1	-1	-1	-1	-4	**-3**
		Benefit	2	-1	1	0	0	-1	0	1	
2020 - 16	Feasibility Study for Earthquake Proof Public Buildings	Cost	-1	2	-1	1	2	-1	0	2	**5**
		Benefit	-1	1	0	0	2	1	0	3	

PROPERTY PROTECTION

Action #1

Incorporate design standards for earth removal into the Zoning Bylaw (strengthen Earth Removal Bylaw) and Subdivision Rules and Regulations (Site Plan Review) to minimize vegetation, slope and land disturbance.

Although the existing Sudbury Zoning Bylaw, Section 3427: Site Development Criteria – Natural Features Conservation, Section 5136: Cluster Development Zoning - Preservation of Natural Features, Section 5400: Incentive Senior Development Zoning, Stormwater Bylaw and Wetlands Bylaw include regulatory thresholds for land disturbance, none provide detailed limitations for development on slopes, preservation of vegetation or limits on area of alteration.

Incorporate design standards into the Zoning Bylaw and Subdivision Rules and Regulations that limit the area of alteration, prohibit alteration of steep slopes, and limit the removal of existing vegetation or trees on a site.

- Action Type: Planning, Pre-Disaster
- Priority Score: 23
- Lead: Planning and Community Development
- Supporting: Building Department
- Time Frame: Short term
- Financing Options: N/A
- Cost Estimate: Staff time

- Benefit: Reduced damages/costs to public/private property, Improved public safety
- Vulnerable Area: Site Disturbance

NATURAL RESOURCE PROTECTION

Action #2

Incorporate new regulations for runoff (roof) and hardscape (sidewalk) recharge into the Zoning Bylaw/Water Resource Protection District regulations.

Roof Runoff Recharge:

Require roof runoff to be recharged within the Zone II. Add to prohibitions in Section 4242: Roofs of any primary structures that do not direct runoff to a system designed to recharge the roof runoff such that the annual volume of water recharged is equal to or greater than under natural vegetated site conditions. The following language to be considered with input from the Sudbury Water District and should be cross-referenced with MADEP's underground injection program prior to modification of the Sudbury Zoning Bylaw or Water Resource Protection District regulations.

a.) Add the following language as a prohibition within Section 4242 of the Sudbury Zoning Bylaw:

> "Residential roofs of any primary structures that do not direct runoff to a system designed to recharge the roof runoff."

b.) Add the following language as a requirement within *Section 2.2 of the Water Resource Protection District Rules and Regulations:*

> *"Rooftop Recharge Design and Calculations*
> Stormwater runoff collected from a residential rooftop shall be recharged directly into the ground, preferably through surface infiltration systems. Infiltration of runoff from a metal roof and/or at a non-residential site requires pretreatment by means of a BMP capable of removing metals, nutrients and bacteria, such as a sand filter, organic filter, filtering bioretention area or equivalent. Metal roofs are galvanized steel or copper.
>
> 1. The applicant shall provide a plan documenting location for rooftop runoff storage and infiltration. Infiltration recharge design criteria shall be based on recharge requirements as outlined within the Massachusetts Stormwater Handbook Standard 3.
> 2. For residential development, rooftop downspouts shall be designed to discharge to systems that will allow for natural infiltration. These systems may include surface or subsurface infiltration (e.g. drywells), but surface infiltration

is preferable to allow for uptake of metals nutrients or other harmful pollutants within the surface soil profile. Drywells may be regulated as Underground Injection Systems and subject to additional regulations described by the Massachusetts Department of Environmental Protection under the Underground Injection Control program.

3. Use of drywells or other subsurface infiltration system will be prohibited where seasonal groundwater is within 4 feet of the bottom of the drywell. Otherwise place drywells at least 10 feet from the building foundation or basement, 20 feet from any cesspool or septic system, and 5 feet from any property lines. Drywells must be at least 500 feet from private drinking water wells.
4. Building projects involving additions greater than 25% of the existing building footprint but less than 50% of the existing building footprint shall collect the entire runoff from the roof of the addition plus runoff from the roof on the side of the existing structure that contains the addition.
5. Building projects involving additions that are 50% or greater than the existing building footprint shall capture the stormwater runoff from the entire roof.
6. The property must be located within an area of suitable soils for infiltration as defined during evaluation for Wastewater Disposal Plan outlined in 2.2.5. and as documented by on-site soil test pits.
7. An As-Built drawing showing all stormwater management systems shall be submitted to the regulatory authority prior to the issuance of an Occupancy Permit.
8. The as-built (certified) Plot Plan showing the improvements to the property shall be stamped by a Massachusetts Registered Land Surveyor."

<u>Hardscape (Sidewalk) Recharge:</u>
Allow sidewalks in the Village Business District to be constructed of pervious/porous materials.

a.) Revise Section 3561 of the Zoning Bylaw to include:

"In Village Business Districts, sidewalks shall be constructed of brick, stone, concrete, porous/pervious concrete or porous/pervious pavers, and be maintained by the owner."

- Action Type: Planning, Pre-Disaster
- Priority Score: 20
- Lead: Planning and Community Development
- Supporting: Sudbury Water District
- Time Frame: Short term

- Financing Options: N/A
- Cost Estimate: Staff time
- Benefit: Reduced environmental contamination, Improved public safety
- Vulnerable Area: Wetlands/Resource Areas

Action #3
Devote more resources to monitoring privately-owned drainage facilities.

- Action Type: Planning, Pre-Disaster
- Priority Score: 4
- Lead: Planning and Community Development
- Supporting: Sudbury Conservation Commission/DPW
- Time Frame: Medium term
- Financing Options: Sudbury Capital Improvement Plan
- Cost Estimate: Moderate
- Benefit: Reduced damages/costs to private property and environmental contamination, Improved public safety
- Vulnerable Area: Local roads subject to flooding

Action #4
Incorporate latest science and climate change projections as a consideration into existing regulations to reduce flooding and water quality impacts, in addition to protecting water supply during periods of drought.

The Commonwealth of Massachusetts has established a Massachusetts-specific climate data clearing house, resilientma.org, to easily enable municipalities and stakeholders to access regional data for use in climate preparedness planning. Overall, an emphasis on future projections for temperature and precipitation served as the two primary focus areas under this program.

Stormwater Bylaw:
Investigate options for increasing the design volumes to which stormwater practices and conveyances are designed to anticipate increases due to climate change. Currently, Section 8.0 defines the SMP Standards and Requirements, and Section 8.A.3.f defines the design storm events that the project must use in sizing its stormwater management systems. In order to provide the permitting agency with the ability to incorporate input from the DPW requiring that the applicant design to a higher standard for projects draining to areas where the municipal drainage system is already stressed, the following revised language is recommended:

> "In areas identified by the DPW in a publicly available list or map as having frequent flooding or an otherwise strained municipal drainage system, these design volumes may be adjusted up by as much as 25% at the request of the DPW upon review of the project."

Similar language might be considered within the standards presented in Section 6.J for GSMPs, which apply to smaller projects.

In support of this language, the DPW will need to maintain a list or map of areas with frequent flooding or otherwise strained stormwater systems.

Outdoor Water Use Bylaw:
Utilize the MassDEP Model Outdoor Water Use Bylaw to limit non-essential outdoor water use through the declaration of a local "State of Water Supply Conservation", “State of Drought” or "State of Water Supply Emergency" during periods of extended drought. This Model also includes additional language that towns can choose to incorporate into their outdoor water use by-law if they want the ability to regulate outdoor water use from private wells, or if they want to regulate the installation of in-ground irrigation systems.

- Action Type: Planning, Pre-Disaster
- Priority Score: 5
- Lead: Planning and Community Development
- Supporting: Department of Public Works
- Time Frame: Medium term
- Financing Options: N/A
- Cost Estimate: Staff time
- Benefit: Reduced damages/costs to private property and environmental contamination, minimize impacts to water supply, Improved public safety
- Vulnerable Area: Local roads subject to flooding/Wetlands/Resource Areas

Action #5
Incorporate standards for tree preservation into the Zoning Bylaw (Tree Preservation Bylaw) and Subdivision Rules and Regulations (Site Plan Review) to maximize tree preservation/limit site disturbance and character throughout the community.

Establish a Tree Preservation Bylaw - an effective mechanism to regulate tree preservation on both public property as well as private property. This bylaw would apply to all existing properties and trees across the town. In general, development approvals such as site plan review or subdivision approval will include their own standards and conditions addressing tree preservation, and these approvals can be essentially exempted from the general bylaw. However, the general bylaw can serve to define the tree preservation standard, establish a tree commission or tree warden with enforcement powers and master planning responsibilities, and create mitigation requirements, including a tree fund or tree bank. The tree preservation standards and mitigation requirements can be incorporated into the development approval regulations, either by reference or by directly incorporating the language of the standards or incorporated within the conditions of approval as appropriate.

- Action Type: Planning, Pre-Disaster
- Priority Score: 9
- Lead: Planning and Community Development
- Supporting: Department of Public Works, Building Department
- Time Frame: Medium term
- Financing Options: N/A
- Cost Estimate: Staff time
- Benefit: Reduced damages/costs to public/private property, Improved public safety, Continuity of essential services, Preservation of community character
- Vulnerable Area: Wetlands/Resource Areas/Site Disturbance

Action #6
Develop a Tree Maintenance and Forest Management Plan.

Given the projected increase in severe weather events due to climate change, and the existing amount of natural tree coverage, a plan for regular tree trimming, dead tree removal and re-forestation plan (due to projected species migration) is needed. The plan should address the following:

a.) Maintaining trees at roadways and utility rights-of-way
b.) Preserving existing tree canopy and plan for future species changes
    i. Identify/Remove dead and falling trees
    ii. Develop plan for re-planting (native species, size, shape, and placement)
c.) Purchase bucket truck for DPW
d.) Public Education around trimming and planting

- Action Type: Planning, Pre-Disaster
- Priority Score: 12
- Lead: Department of Public Works
- Supporting: Conservation Commission
- Time Frame: Medium term
- Financing Options: N/A
- Cost Estimate: Moderate
- Benefit: Maintain resource areas, Reduced damages to private property, Minimized cleanup costs
- Vulnerable Area: Wetlands/Resource Areas/Emergency Response

STRUCTURAL PROJECTS

Action #7
Elevate the grade of Concord Road two feet in three separate locations:
- *Between Lincoln Road and Old Sudbury Road*
- *Eastern end of the roadway*

Water Row Road (Concord Road between Lincoln Rd. and Old Sudbury Rd.):
The project would require an initial compensatory storage study as wetland resources near Lincoln Road and Route 27 would be impacted, in addition to the actual elevation of Water Row itself.

Eastern end of Concord Road:
Sheet flow back up may be related to water releases at DFW Pantry Brook Dam.

Near Nashawtuc Country Club:
Flooding occurs once every five years on average and impacts the country club area.

- Action Type: Mitigation, Pre-Disaster
- Priority Score: 8
- Lead: Department of Public Works
- Supporting: Engineering
- Time Frame: Medium term
- Financing Options: Sudbury Capital Improvement Plan
- Cost Estimate: $450,000/$150,000/$150,000 respectively
- Benefit: Improved public safety, maintain viable evacuation routes, Reduced damages to private property, Minimized cleanup costs
- Vulnerable Area: Local roads subject to flooding

Action #8
Evaluate the potential removal of Pantry Brook Dam first, then, if not deemed appropriate, complete repairs and develop an Operations & Management Plan.

Owned and operated by Mass Fish and Wildlife, the structure is in need of repairs and the establishment of a regular maintenance program.

- Action Type: Planning, Pre-Disaster
- Priority Score: 2
- Lead: Mass Fish & Wildlife
- Supporting: Department of Public Works
- Time Frame: Medium term
- Financing Options: MA Fish & Wildlife budget
- Cost Estimate: Moderate
- Benefit: Reduced damages to private property, Minimized economic impacts
- Vulnerable Area: Dams

Action #9
Improve/Upgrade drainage infrastructure and capacity.

The Department of Public Works has developed a Culvert Capital Improvement Plan to address deficient drainage systems throughout the town. The Town

should consider Low Impact Development (LID) and Green Infrastructure (GI) techniques when implementing this plan.

The following culverts are listed by priority for rehabilitation, replacement or still to be determined:
(subject to change based on changing conditions, priorities and material costs)

High Priority:

Roadway/Crossing ID	Rehabilitation/Replacement	Probable Cost
Concord Road/Crossing #11	Replacement	$445,000

Summary of recommended work:
- Replace crossing

Willard Grant Rd./Crossing #46	Replacement	$215,000

Summary of recommended work:
- Replace crossing

Old Sudbury Rd./Crossing #110/149	Replacement/TBD	$515,000

Summary of recommended work:
- Replace crossing/headwalls
- Replace pipe
- Perform H & H analysis to determine if crossing is necessary

Morse Road Bridge/Crossing #7	Replacement	$900,000

Summary of recommended work:
- Seek MassDOT Bridge Grant Funds
- Replace bridge

Old Garrison Rd./Crossing #150	Replacement	$260,000

Summary of recommended work:
- Replace pipe
- Install headwalls approx. 5 – 8 feet from roadway
- Install guardrail

Maynard Farm Rd./Crossing #26	Replacement	$170,000

Summary of recommended work:
- Replace crossing

Hopestill Brown Rd./Crossing #165	Rehabilitation/TBD	$105,000

Summary of recommended work:
- Replace downstream headwall
- Upstream headwall in unknown condition
- Brush/debris needs to be cleared to assess

Powers Road/Crossing #31	Replacement	$140,000

Summary of recommended work:

- Replace crossing
- Construct new headwalls
- Add new guardrail

Bent Road/Crossing #91 Rehabilitation $155,000

Summary of recommended work:

- Replace upstream/downstream headwalls

Medium Priority:

Roadway/Crossing ID	Rehabilitation/Replacement	Probable Cost
Wayside Inn Rd./Crossing #34	Rehabilitation	$100,000

Summary of recommended work:

- Replace granite portion of crossing
- Replace upstream headwall
- Repoint downstream headwall

Loker Rd./Crossing #61 Rehabilitation $90,000

Summary of recommended work:

- Replace inlet headwall with cast in place concrete
- Repair end of pipe
- Mortar outlet headwall
- Remove vegetation
- Install guardrail

Nobscott Rd./Crossing #161 Rehabilitation $135,000

Summary of recommended work:

- Replace corrugated metal pipe (left barrel)
- Repair downstream headwall

Maynard St./Crossing #136 Replacement $70,000

Summary of recommended work:

- Reconstruct inlet and outlet headwalls with mortared stone masonry via reuse of existing stones

Peakham Rd./Crossing #58 Replacement $360,000

Summary of recommended work:

- Evaluate H & H for lining
- Repoint mortar
- Grout inject scour holes
- Replace pipe

Pantry Brook/Crossing #60 Rehabilitation $45,000

Summary of recommended work:

- Remove overgrowth
- Stabilize embankments
- Plug seepage paths with concrete

- Install guardrail

Dutton Rd./Crossing #70 Rehabilitation $120,000

Summary of recommended work:
- Monitor gaps between precast units
- Replace downstream wingwalls

Low Priority:

Roadway/Crossing ID	Rehabilitation/Replacement	Probable Cost
French Rd./Crossing #78	Rehabilitation	$20,000

Summary of recommended work:
- Repoint downstream headwall
- Remove two trees at downstream end

Haynes Rd./Crossing #22 Rehabilitation $100,000

Summary of recommended work:
- Replace upstream embankment with headwall
- Raise and extend guardrail
- Reconstruct downstream headwall, install guardrail

Austin Rd./Crossing #57 Rehabilitation $45,000

Summary of recommended work:
- Remove seven trees
- Spot repointing of masonry and reconstruction of headwalls

Goodnow Rd./Crossing #99 Rehabilitation $25,000

Summary of recommended work:
- Repair inlet control structure via mortar and reconstruction of collapsed stones
- Reconstruct outlet headwall with mortar

Concord Rd./Crossing # 74 Rehabilitation $85,000

Summary of recommended work:
- Remove trees at downstream
- Install riprap to prevent further upstream erosion
- Inject grout in scour areas

Water Row/Crossing # 1 Replacement/TBD
Evaluation $5,000 – 10,000
Replacement $110,000

Summary of recommended work:
- Perform a larger watershed evaluation due to the crossing location in flood prone area

Old Framingham Rd./Crossing #63 Rehabilitation $30,000

Summary of recommended work:

- Fence-off upstream end from pedestrians
- Repoint mortared headwall

Not Ranked:

Roadway/Crossing ID	Rehabilitation/Replacement	Probable Cost
Sherman Bridge/Crossing #16	TBD	

Summary of recommended work:
- Review recent inspections and/or perform new inspection to determine replacement/repair

Old Sudbury Rd./Crossing #146	TBD	$150,000

Summary of recommended work:
- Jet line
- Dig out downstream end

Unnamed Rd./Crossing #64	TBD

Summary of recommended work:
- Repair downstream channel walls
- Evaluate crossing after debris are jetted

Brimstone Lane/Crossing #160	TBD

Summary of recommended work:
- Evaluate crossing after debris are jetted

Union Ave./Crossing #95	TBD

Summary of recommended work:
- Follow MassDOT recommendations

    - Action Type: Planning, Pre-Disaster
    - Priority Score: 13
    - Lead: Department of Public Works
    - Supporting: Engineering/MassDOT
    - Time Frame: Long term
    - Financing Options: Sudbury Capital improvement Plan
    - Cost Estimate: Significant
    - Benefit: Improved public safety, maintain viable evacuation routes, Reduced damages to private property, Minimized cleanup costs
    - Vulnerable Area: Local roads subject to flooding

EMERGENCY SERVICES

Action #10

Install generators at Lincoln-Sudbury High School to include heating capability.

Reconfigure generators at Lincoln-Sudbury High School to include heating. Fit all school buildings with stationary, multi-fuel generators to allow for emergency use

as evacuation shelters. Estimated cost for reconfiguration would be approximately $450,000 per site.

- Action Type: Mitigation, Pre-Disaster
- Priority Score: 15
- Lead: Emergency Management/Fire
- Supporting: Department of Public Works
- Time Frame: Medium term
- Financing Options: Sudbury Capital Improvement Plan
- Cost Estimate: Significant
- Benefit: Improved public safety, Enhanced emergency response
- Vulnerable Area: Emergency Response

Action #11
Install a large-capacity, multi-fuel generator at the Curtis Middle School.

Install a large capacity, multi-fuel generator at the Curtis Middle School, to serve as an additional Emergency Evacuation Center.

- Action Type: Mitigation, Pre-Disaster
- Priority Score: 21
- Lead: Emergency Management/Fire
- Supporting: Department of Public Works
- Time Frame: Medium term
- Financing Options: Sudbury Capital Improvement Plan
- Cost Estimate: Significant
- Benefit: Improved public safety, Enhanced emergency response
- Vulnerable Area: Emergency Response

Action #12
Improve emergency response planning and communication.

a.) Increase capacity and support for Citizen's Emergency Response team (CERT) and Medical Reserve Corps (MRC) recruitment
b.) Training and communication protocol of hospitals and healthcare agencies
c.) Educate community on Reverse 911
d.) Assess needs of vulnerable populations to understand sheltering needs (Know Your Neighbor)
e.) Maintain database of vulnerable populations and address data privacy/sharing challenges

- Action Type: Mitigation, Pre-Disaster
- Priority Score: 14
- Lead: Emergency Management/Fire
- Supporting: Department of Public Works
- Time Frame: Medium term
- Financing Options: N/A

- Cost Estimate: Staff time
- Benefit: Improved public safety, Enhanced emergency response
- Vulnerable Area: Communications/Emergency Response

Action #13
Strengthen Emergency Shelters (Schools, Libraries, Community Center).

a.) Install air conditioning
b.) Install charging stations (cell phones)

- Action Type: Mitigation, Pre-Disaster
- Priority Score: 21
- Lead: Emergency Management/Fire
- Supporting: Department of Public Works
- Time Frame: Medium term
- Financing Options: Sudbury Capital Improvement Plan
- Cost Estimate: Significant
- Benefit: Improved public safety, Enhanced emergency response
- Vulnerable Area: Communications/Emergency Response

Action #14
Address the necessary expansion/improvements of Fire Stations No. 2 and No. 3.

Originally constructed in the early 1960's, both Stations create challenges to modern firefighting. Both do not fit modern fire trucks, which are longer, wider and taller. The apparatus bays are too narrow for equipment and create difficult paths for firefighters to maneuver, and the current design of both makes it difficult to house firefighters of both genders (one restroom/shower facility and one bunkroom that accommodates two beds).

Over the past 25 years, Sudbury's population has grown significantly. The Department estimates an additional 348 calls per year, a 15% increase. Over time, the Department has added additional personnel, vehicles and equipment to handle these increases.

- Action Type: Planning, Pre-Disaster
- Priority Score: 15
- Lead: Emergency Management/Fire
- Supporting: Department of Public Works
- Time Frame: Long term
- Financing Options: Sudbury Capital Improvement Plan
- Cost Estimate: Significant
- Benefit: Improved public safety, Enhanced emergency response
- Vulnerable Area: Fire Management, Emergency Response

PLANNING AND PREVENTION

Action #15
Relocate overhead electrical/cable lines underground.

Complementing the need for a Tree Maintenance and Forest Management Plan discussed previously, projected increases in severe weather events due to climate change, and the existing amount of natural tree coverage, the Town should consider relocating overhead electrical and cable lines underground. The plan should address the following:

a.) Burying lines underground as roads are repaved
b.) Establishing tree/buffer management
c.) Evaluating funding resources
    i. Rate-payer funding
    ii. MA Surcharge Program
    iii. Solar facilities

- Action Type: Mitigation, Pre-Disaster
- Priority Score: -3
- Lead: Department of Public Works
- Supporting: Building Department
- Time Frame: Long term
- Financing Options: Sudbury Capital Improvement Plan, Rate-Payer funding, MA Surcharge Program, Solar facilities
- Cost Estimate: Significant
- Benefit: Improved public safety, Enhanced emergency response, Continuation of lifeline systems
- Vulnerable Area: Emergency Response, Communications

Action #16
Conduct feasibility study to investigate options for all public buildings to be earthquake proof.

- Action Type: Mitigation, Pre-Disaster
- Priority Score: 5
- Lead: Department of Public Works
- Supporting: Fire Department
- Time Frame: Long term
- Financing Options: Sudbury Capital Improvement Plan
- Cost Estimate: Moderate
- Benefit: Public safety, Minimize economic/social damages
- Vulnerable Area: Municipally owned structures

Section 5 Plan Implementation and Maintenance

5.1 Implementation, Evaluation, and Revision of Plan

Implementation

The LHMC realized that assigning a time frame to each recommended mitigation action is important so that activities can be coordinated with other important governmental functions, such as committee meetings and budget hearings. Assigned time frames also provide input to a project plan used for tracking the progress of all activities. Once the 2020 update receives FEMA's 'Approved Pending Adoption', the mitigation strategy will be put into motion and the Board of Selectmen will adopt the Plan (within one year of FEMA's approval). It is recognized that progress on plan implementation may vary dependent upon available funding and capacity of staff to complete assigned tasks.

Evaluation

The Town Manager will bring the LHMC together annually to review the status of the mitigation actions. Within two months of this meeting, a status report will be given to the Planning Board and Board of Selectmen. Progress will be reviewed annually at advertised public hearings held by the Sudbury Planning Board. It is advantageous the annual review be conducted prior to the Town's annual budget process so any locally funded projects can be considered in the budget process.

Revision

As per 44 CFR S 201.6(d)(3), the Plan will be reviewed and revised to reflect progress in local mitigation efforts and changes in priorities and resubmitted for approval within 5 years in order to continue to be eligible for mitigation project grant funding. In order to ensure that the plan remains current, the LHMC, which consists of representatives from the Planning Department, EMA, Public Works, Zoning and Code Enforcement, Water/Sewer Department, Fire Department, and Police Department, Board of Health, and Conservation Commission will meet annually. The Plan will also be evaluated and updated after a disaster, or as funding opportunities arise for the actions and projects identified in the plan. Any updates will be reviewed and submitted to MEMA upon local approval to ensure that the state hazard mitigation strategy remains current.

The Town of Sudbury Hazard Mitigation Plan will be incorporated into the Town's Comprehensive Emergency Management Plan (CEMP) and Comprehensive Master Plan when updated and for consistency.

5.2 Continued Public Involvement

The Town of Sudbury will continue public involvement in the plan maintenance process by:

- The approved/adopted plan will be posted on the Town's web site;
- The annual meeting of the LHMC to review the implementation of the plan will be posted/advertised as a public meeting as per Town guidelines; and

- The LHMC will include the public in the preparation of the five-year update using the same public participation process as in the development of this update.

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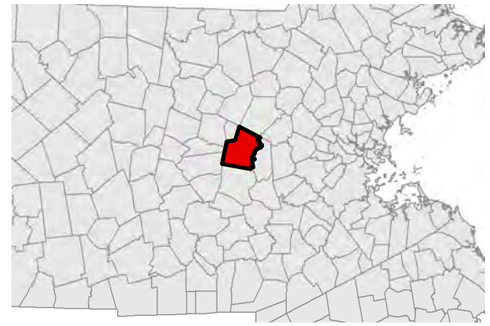
Appendix A – Maps

ACTON
CONCORD
MAYNARD
STOW
LINCOLN
HUDSON
SUDBURY
WAYLAND
MARLBOROUGH
FRAMINGHAM
Puffer Pond
Cutting's Pond
Willis Pond
Crystal Lake
Steam's Mill Pond
Sudbury River
Blanford Pond
Garding Mill Pond
Grist Mill Pond

Town of Sudbury, MA

Miles
0 0.5 1 2

N



Map 1-1
Location Map

October 1, 2019
Source: MAPC/ Town of Sudbury/ MASS GIS

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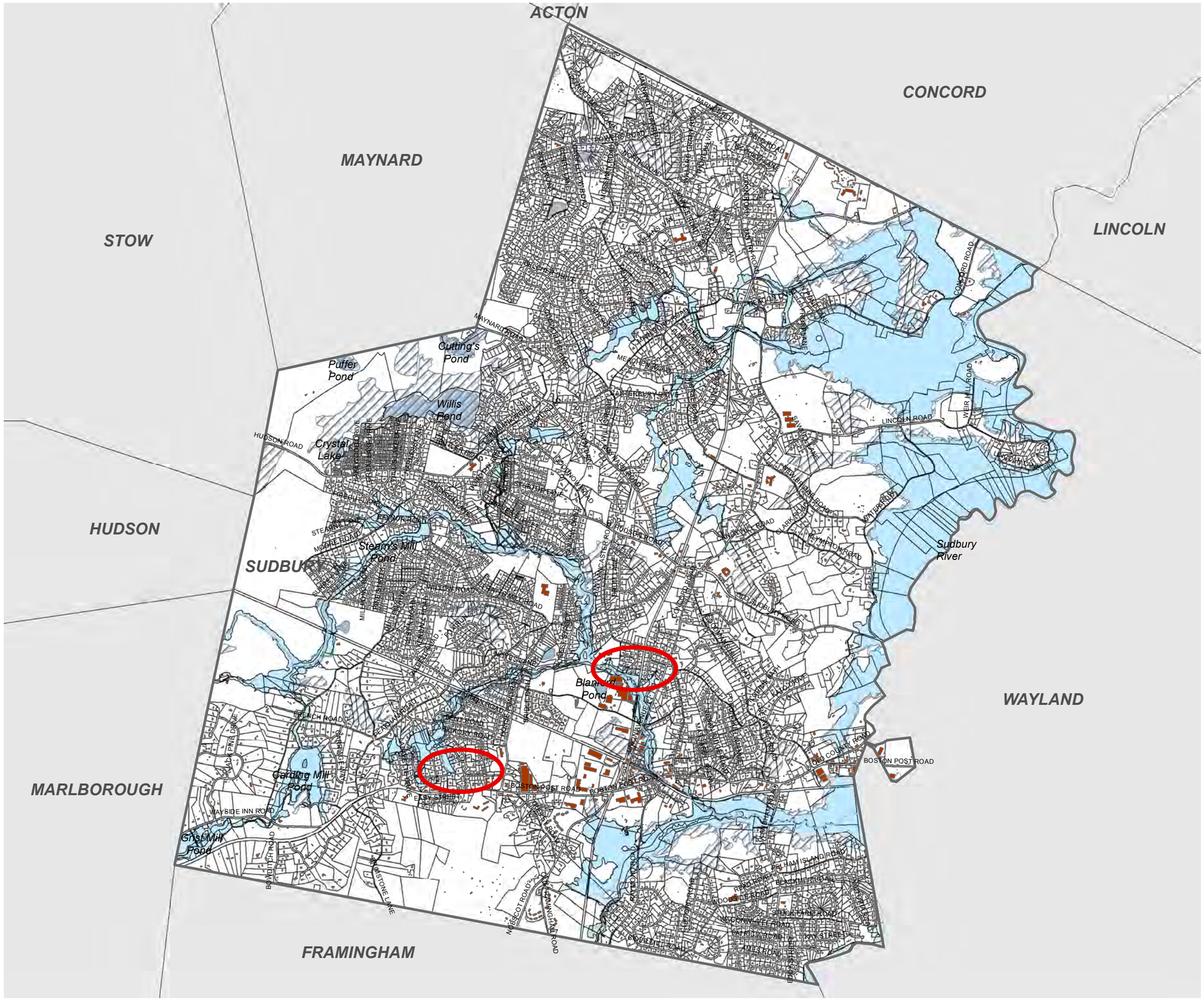

Town of Sudbury, MA

0 0.5 1 2 Miles

N

Legend

- Repetitive Loss Area
- Structures
- 100-Year Flood Zone
- 500-Year Flood Zone

Map 2-1
Flood Hazard Areas

October 1, 2019
Source: MAPC/ Town of Sudbury/ MASS GIS

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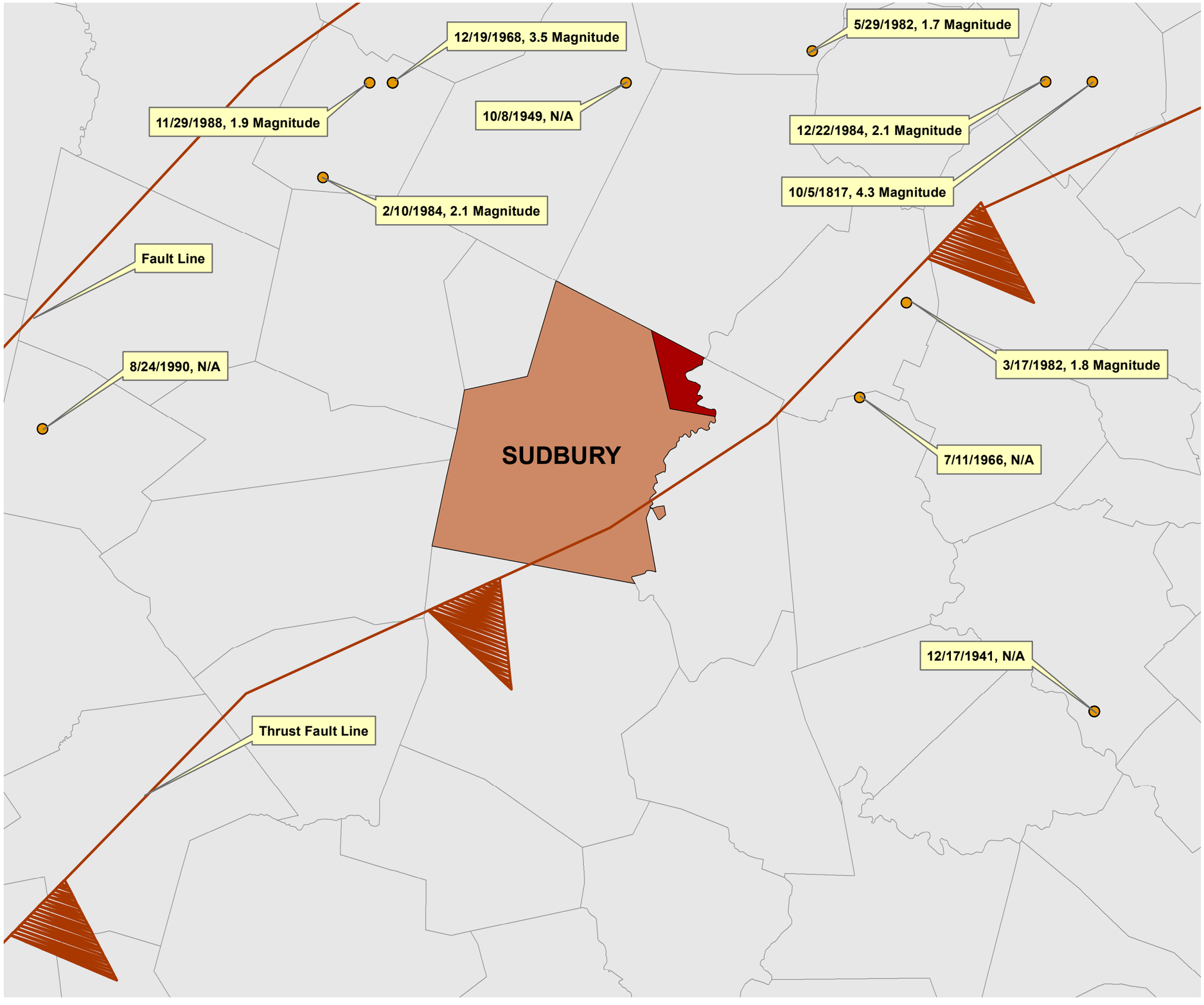

Town of Sudbury, MA

0 1.5 3 6 Miles

N

Legend

- Earthquake Points

Landslide Incidence

- Low Incidence
- Moderate Incidence

- Fault Lines

Map 2-2 Earthquakes/Landslides

October 1, 2019
Source: MAPC/ Town of Sudbury/ MASS GIS

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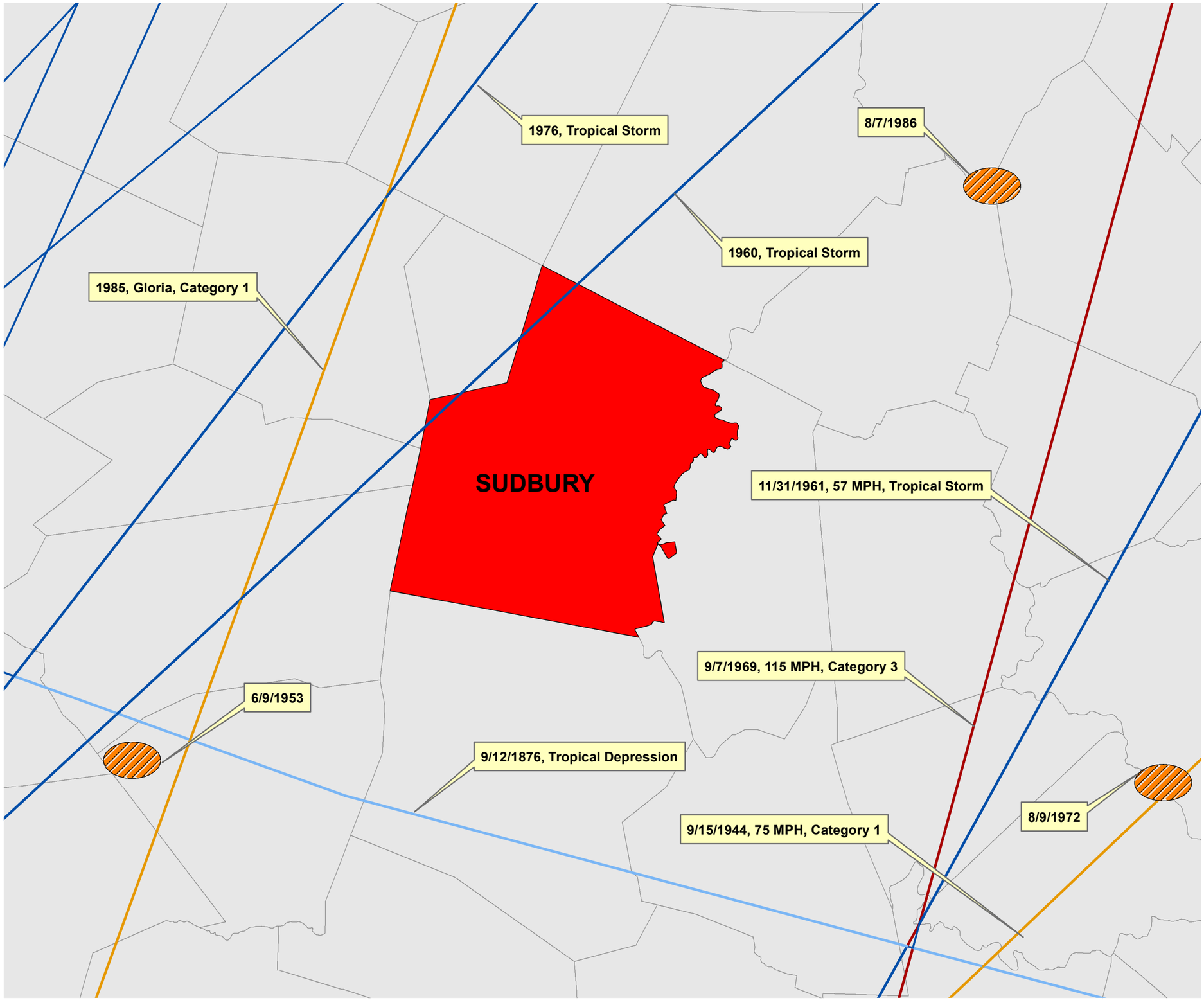

Town of Sudbury, MA

0 1.25 2.5 5 Miles

N

Legend

- Tornado

Hurricane Tracks

Category

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

Wind Zone

- Zone II (160 MPH)

Map 2-3
Hurricanes/Tornadoes

October 1, 2019
Source: MAPC/ Town of Sudbury/ MASS GIS

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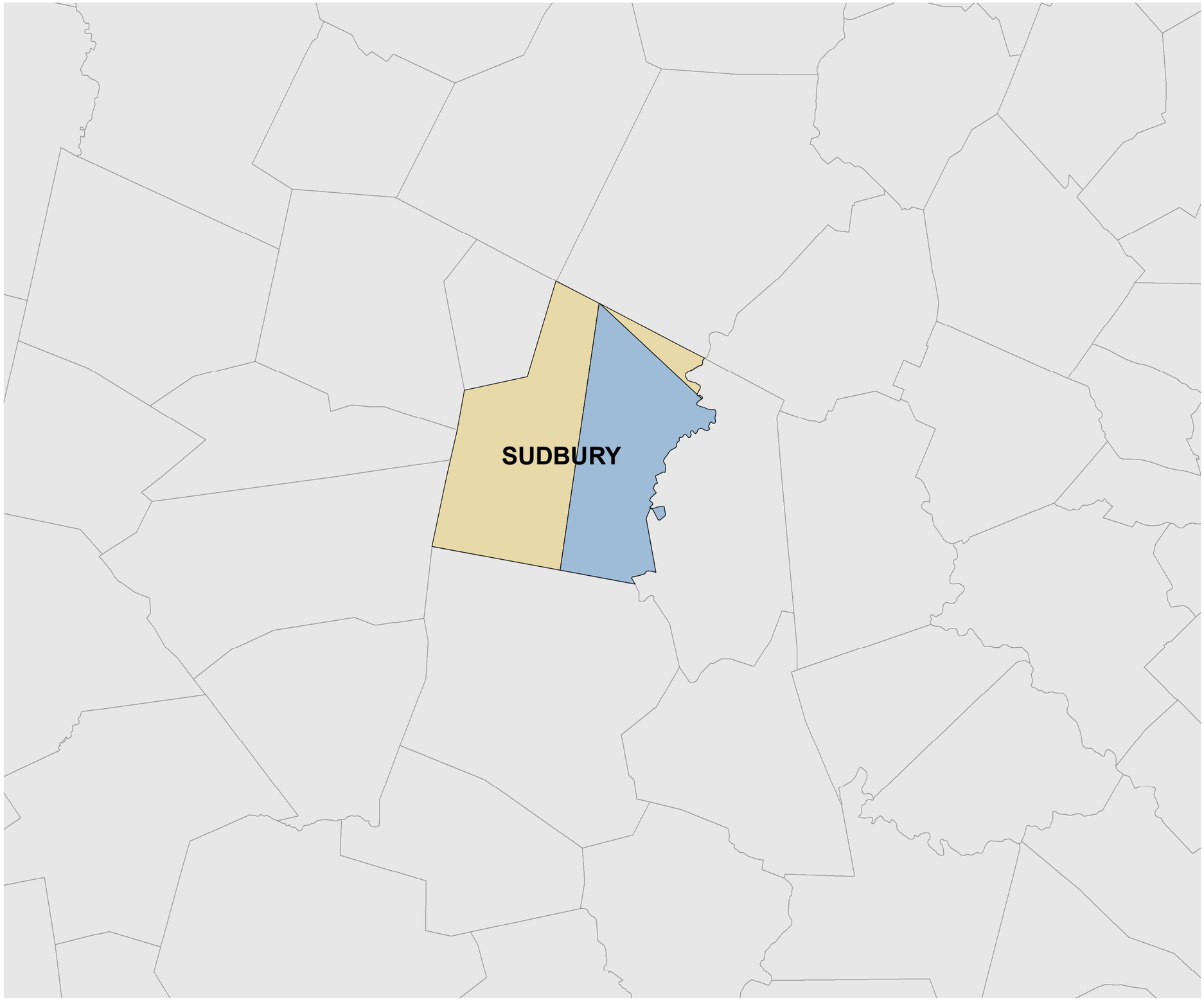

Town of Sudbury, MA

0 1.5 3 6 Miles

N

Legend

Average Annual Snowfall

- 36.1 - 48.0 Inches
- 48.1 - 72.0 Inches

Map 2-4
Average Annual Snowfall

October 1, 2019
Source: MAPC/ Town of Sudbury/ MASS GIS

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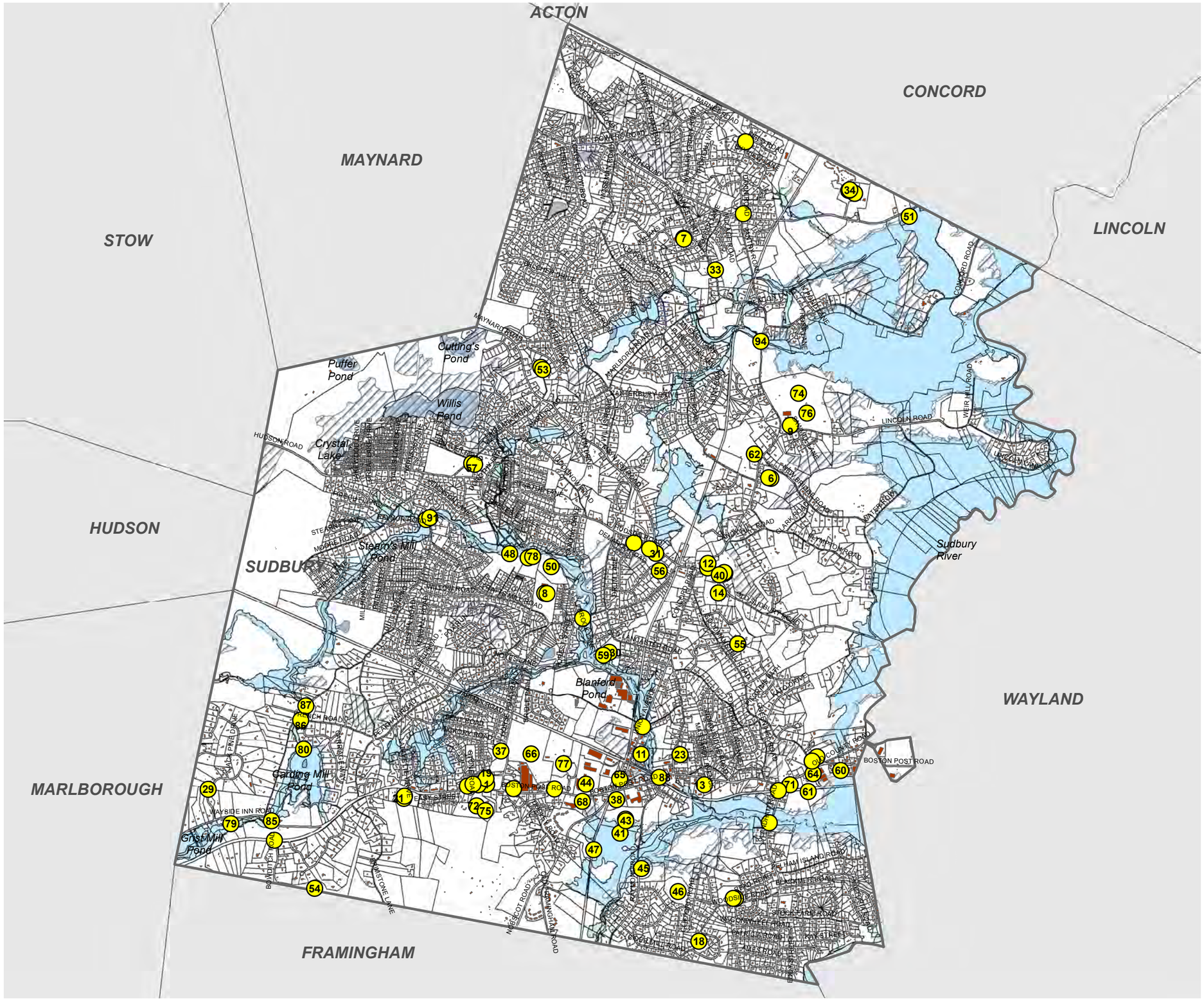

Town of Sudbury, MA

0 0.5 1 2 Miles

N

Legend

- 46 — Critical Facilities
- Structures
- 100-Year Flood Zone
- 500-Year Flood Zone

Map 2-5
Critical Facilities

October 1, 2019
Source: MAPC/ Town of Sudbury/ MASS GIS

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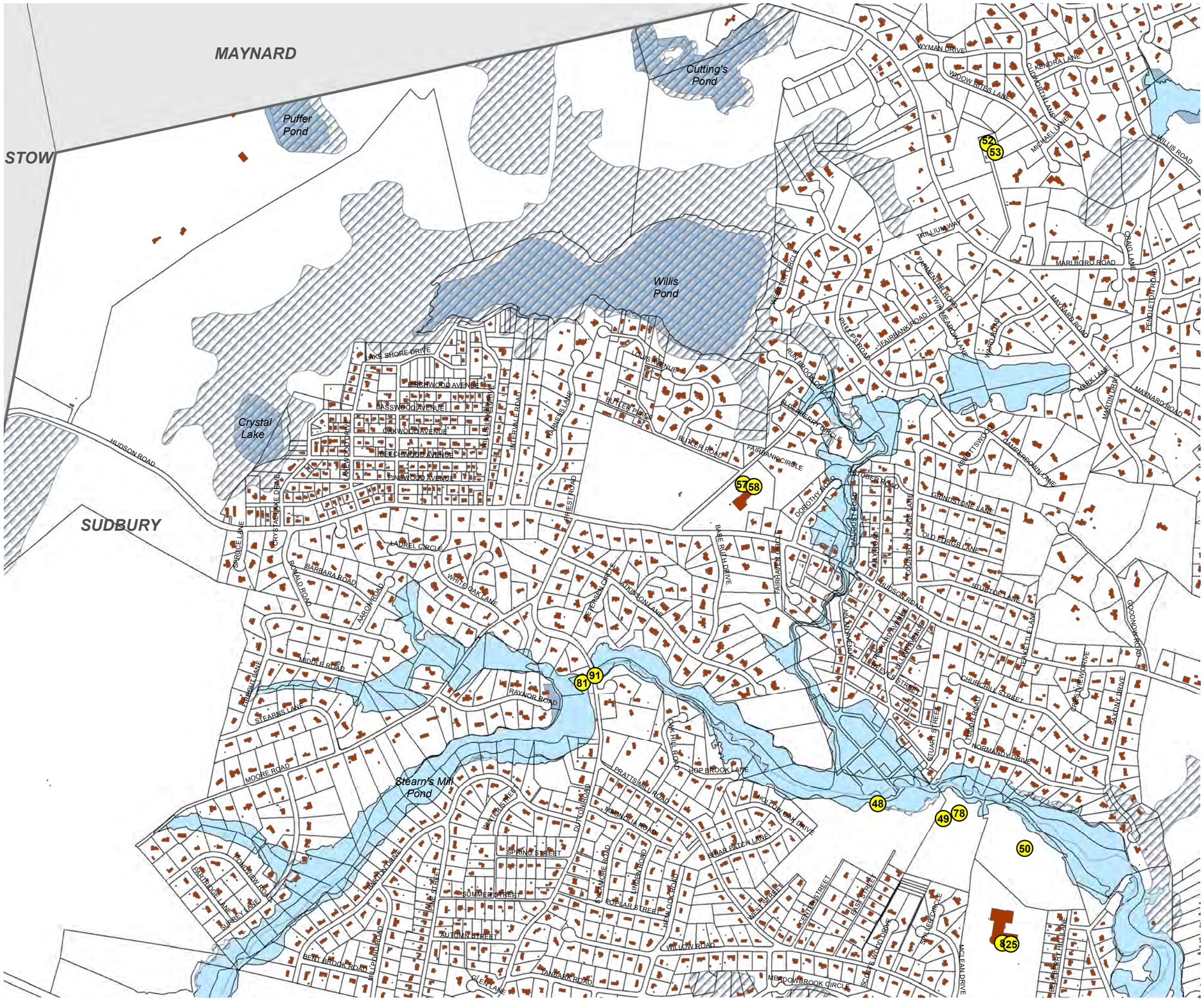

Town of Sudbury, MA

Miles
0 0.125 0.25 0.5

N

Legend

- 46 — Critical Facilities
- Structures
- 100-Year Flood Zone
- 500-Year Flood Zone

Map 2-5.1
Critical Facilities
NW Quadrant

October 1, 2019
Source: MAPC/ Town of Sudbury/ MASS GIS

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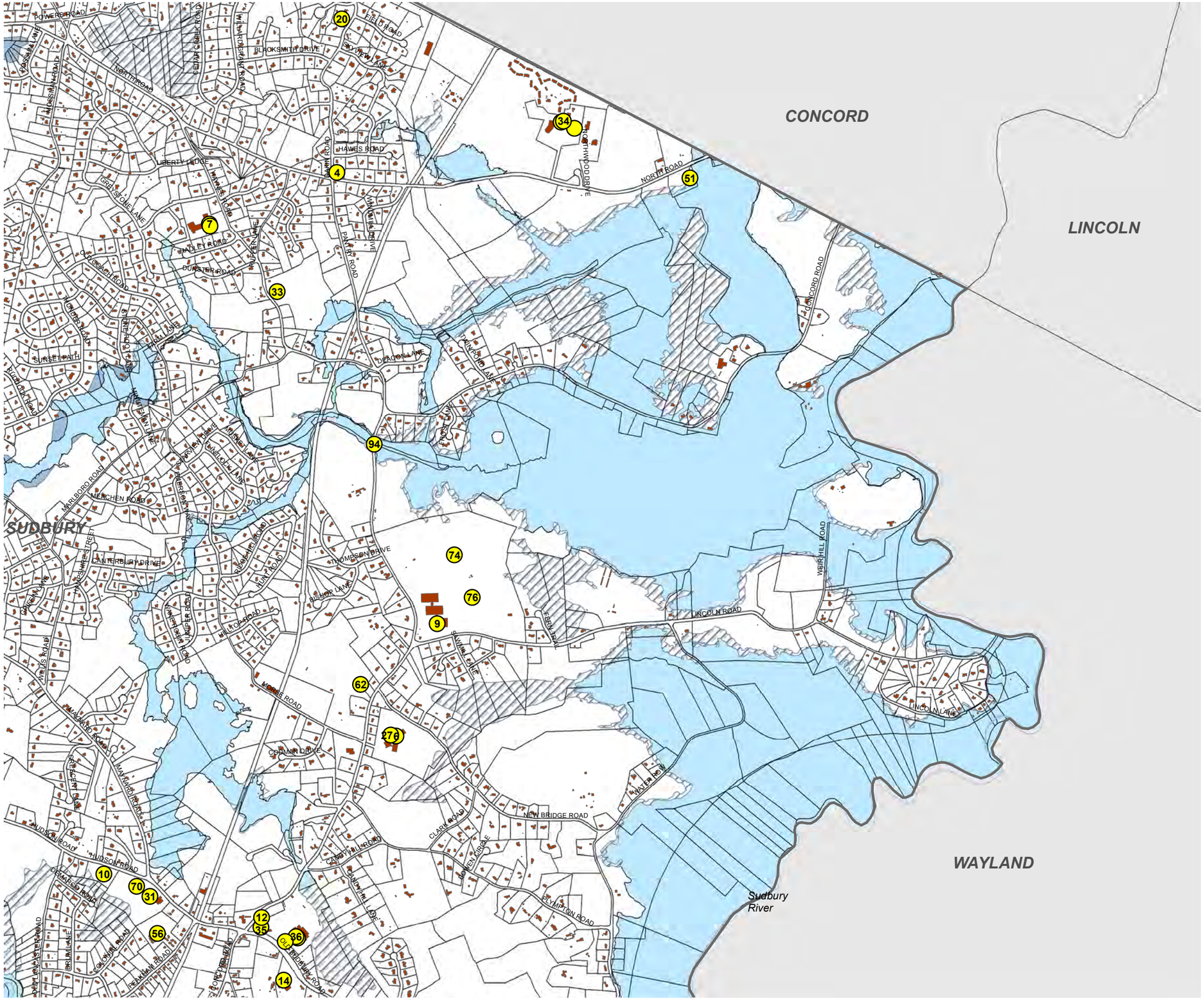

Town of Sudbury, MA

0 0.225 0.45 0.9 Miles

N

Legend

- 46 Critical Facilities
- Structures
- 100-Year Flood Zone
- 500-Year Flood Zone

Map 2-5.2
Critical Facilities
NE Quadrant

October 1, 2019
Source: MAPC/ Town of Sudbury/ MASS GIS

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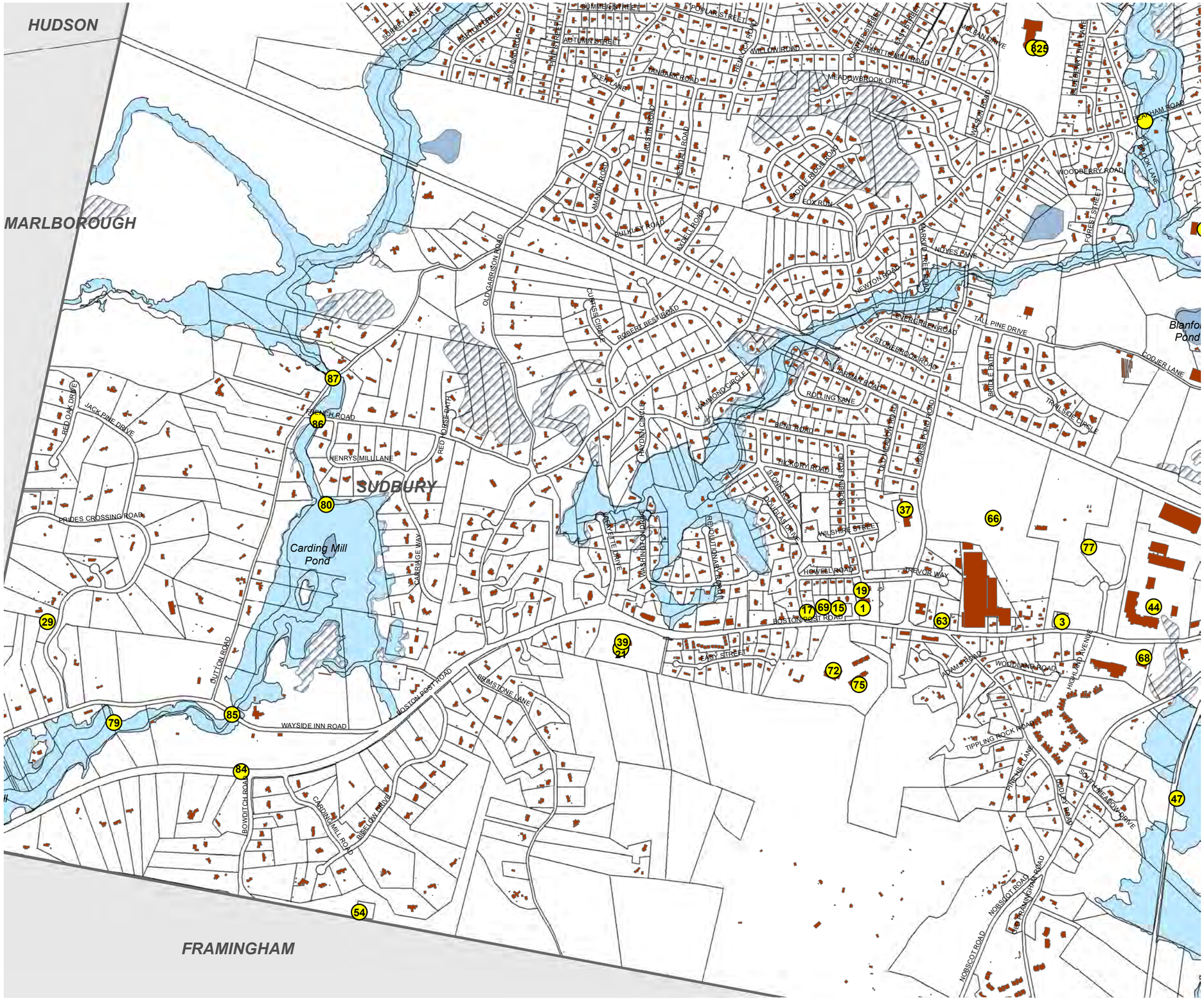

Town of Sudbury, MA

0 0.175 0.35 0.7 Miles

N

Legend

- 46 Critical Facilities
- Structures
- 100-Year Flood Zone
- 500-Year Flood Zone

Map 2-5.3
Critical Facilities
SW Quadrant

October 1, 2019
Source: MAPC/ Town of Sudbury/ MASS GIS

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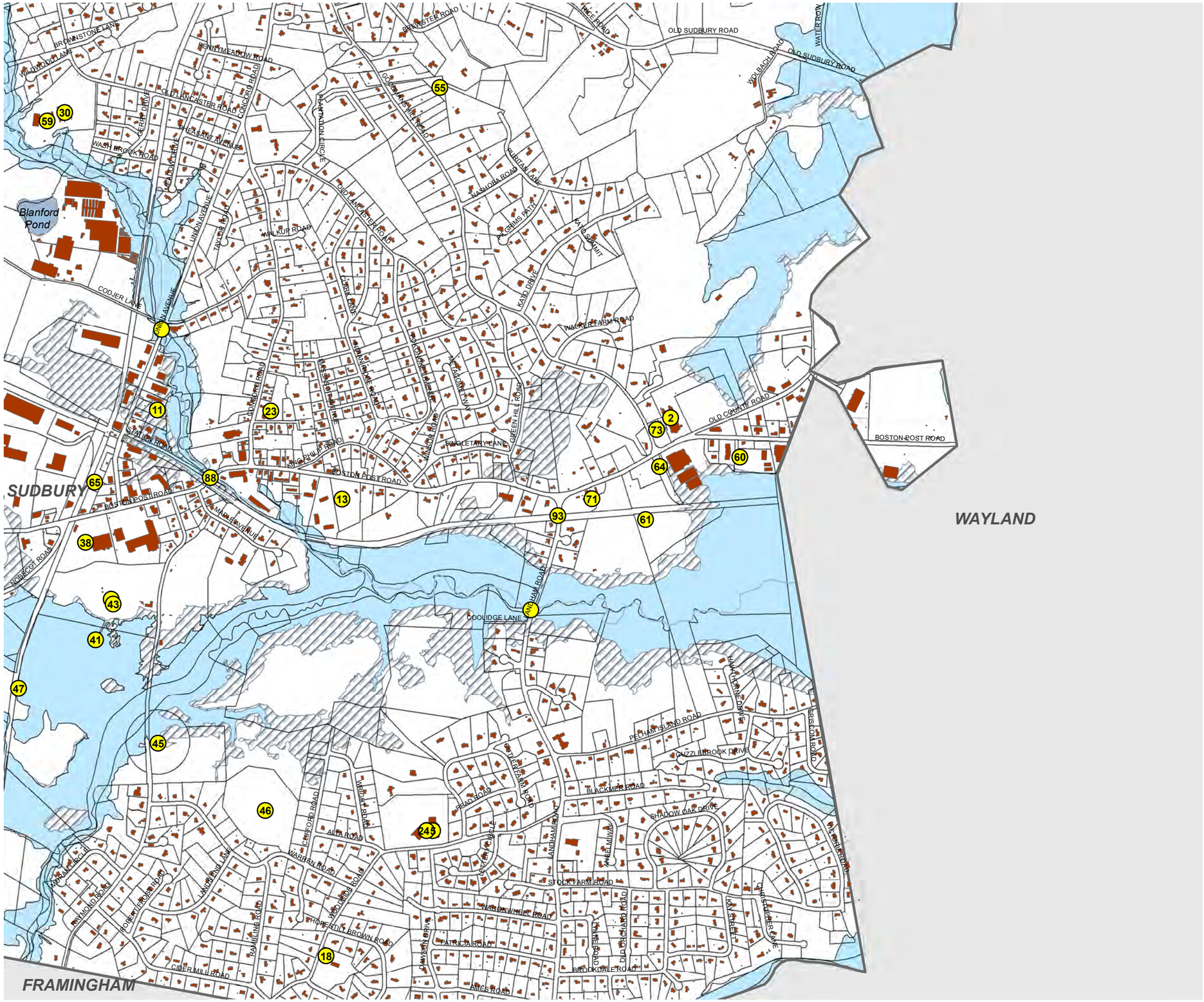

Town of Sudbury, MA

Miles
0 0.175 0.35 0.7

N

Legend

- 46 — Critical Facilities
- Structures
- 100-Year Flood Zone
- 500-Year Flood Zone

Map 2-5.4
Critical Facilities
SE Quadrant

October 1, 2019
Source: MAPC/ Town of Sudbury/ MASS GIS

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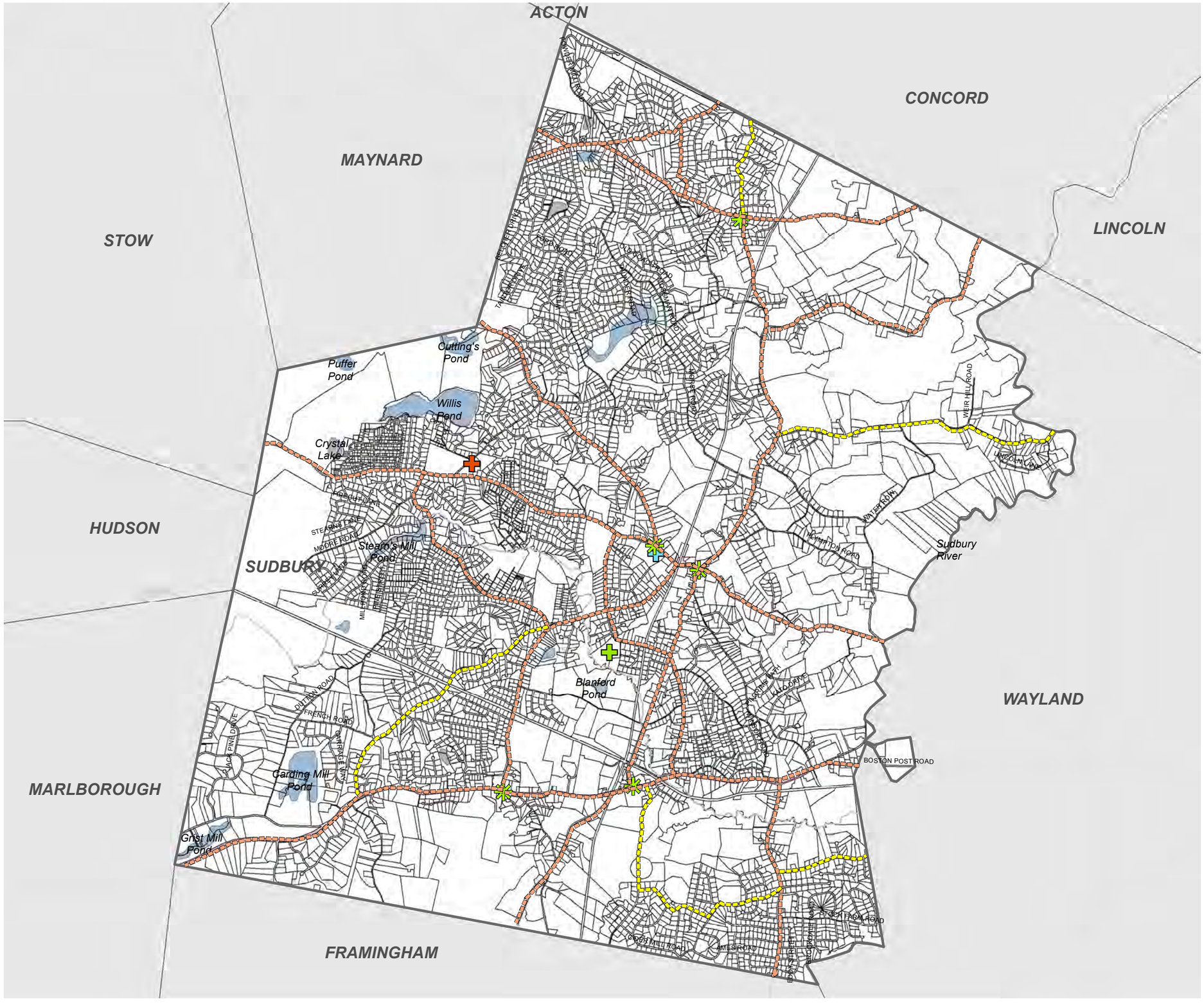

Town of Sudbury, MA

0 0.5 1 2 Miles

N

Legend

- Shelter
- EOC - Primary
- EOC - Alternate
- Traffic Control Points

Evacuation Routes

- Primary Route
- Secondary Route

Map 2-6
Traffic Control Points/ Evacuation Routes

October 1, 2019
Source: MAPC/ Town of Sudbury/ MASS GIS

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Appendix B – Public Information and Outreach

Project Webpage

Local Hazard Mitigation Committee Meeting #1: April 19, 2019

Public Workshop #1: May 30, 2019

Local Hazard Mitigation Committee Meeting #2: September 5, 2019

Local Hazard Mitigation Committee Meeting #3: October 30, 2019

Local Hazard Mitigation Committee Meeting #4: December 4, 2019

Public Workshop #2: January 29, 2020

On-Line Survey (8/19 – 9/19)

Project Webpage

FEMA defines hazard mitigation as:

A series of actions and policies designed to reduce and/or eliminate the impacts of naturally occurring disasters on people and property.

About the Hazard Mitigation Plan Update

A hazard mitigation plan should be considered a living document that must grow and adapt, keeping pace with a community's growth and change. The Disaster Mitigation Act of 2000 (DMA) places high priority on the continuation of the planning process after the initial submittal, requiring communities to seek and receive re-approval from FEMA in order to remain eligible for assistance. The evaluation, revision and update process is also a means to create an increased institutional awareness and involvement in hazard mitigation as part of daily activities.

This Update will replace the existing 2010 Hazard Mitigation Plan. The approach for this Update is premised on four primary methods, all geared towards meeting the requirements of the DMA 2000 Public Law 106-390, October 10, 2000:

- Planning Process—Outreach and Stakeholder Coordination
- Risk Assessment—Identifying Hazards and Estimating Losses
- Mitigation Strategy— Identifying Mitigation Actions and Implementation Strategies
- Plan Maintenance—Implementation, Evaluation and Revision/Update

Stay tuned for more information on how to get involved!

Contacts

Craig Pereira—Project Manager
Horsley Witten Group, Inc.
55 Dorrance St. Suite 200
Providence, RI 02903
cpereira@horsleywitten.com
Phone: (401)272-1717

Local Hazard Mitigation Committee Meeting #1: April 19, 2019

Municipal Vulnerability Preparedness Core Team/Local Hazard Mitigation Committee Meeting

DPW Engineering Room
275 Old Lancaster Road
Sudbury, MA
April 19, 2019 10:00 AM – 12:00 PM

Agenda

1. MVP Workshop
   a. Confirm Stakeholder's List
   b. Draft Evite
   c. Data/Reference Materials to be Developed
      i. Examples of Vulnerabilities/Strengths
      ii. Climate Change Projections
      iii. Demographic data
      iv. Key Recommendations from 2010 Hazard Mitigation Plan
      v. Maps
         1. Population Densities
         2. Critical Facilities with FEMA Flood Zones
   d. Confirm Town Manager's participation?
   e. Scribes confirmed?
   f. Lunch confirmed?
   g. Historic photos of hazard events?

2. HMP Update
   a. Confirm Membership
   b. Confirm updated list of critical facilities
   c. Confirm 2010 Plan Report Card
   d. HW review of NOAA's Climatic Data Center – Storm Database

3. Policy/Regulatory Review
   a. Board of Selectmen Workshop…5/28/19 confirmed
   b. Planning Board?
   c. Board of Health?

Town of Sudbury, MA

Municipal Vulnerability Preparedness Workshop/Local Hazard Mitigation Committee Meeting

DPW Engineering Room
275 Old Lancaster Road

April 19, 2019 10:00 AM - 12:00 PM

Name	Email Address
CRAIG PERREIRA	cperreira@horsleywitten.com
Adam Duchesneau	DuchesneauA@Sudbury.ma.us
Vincent Roy	Vroy@Sudburywater.com
Bill Barletta	BARLETTAW@SUDBURY.MA.US
Bill Murphy	murphyb@sudbury.ma.us
John Whalen	whalenJ@sudbury.ma.us
Beth Suedmeyer	Suedmeyer@Sudbury.ma.us
Mark Herweck	Herweckm@Sudbury.ma.us

Horsley Witten Group

Memorandum of Meeting

To: Sudbury MVP Core Team/HMP Team

From: Craig Pereira

Date: April 19, 2019

Re: Sudbury Municipal Vulnerability Preparedness (MVP) / Hazard Mitigation Plan (HMP) Update / Regulatory Review Project Kickoff Meeting

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In attendance:

John Whalen – Sudbury Fire Chief
William Barletta – Facilities Director
Beth Suedmeyer – Environmental Planner
Adam Duchesneau – Director, Planning and Community Development
Bill O'Rourke – Deputy Director, Public Works Dept. (on telephone)
Mark Herweck – Building Inspector
Vincent Roy – Sudbury Water District
Bill Murphy – Board of Health

Consultant Team
Craig Pereira, Project Manager - Horsley Witten Group, Inc. (HW)

MVP:

1. Stakeholder List
    a. Still in development. Some save the dates have gone out, not all.
    b. To be added to the list:
        i. State Building Inspector (Mark Herweck to outreach)
        ii. Permanent Building Commission (Bill Barletta to outreach)
        iii. Sudbury Water District (Vin Roy)
    c. Craig will update the spreadsheet and forward to Core Team.
    d. All outreach/save the dates to go out by Wednesday, April 24, 2019. Craig will coordinate with Beth by COB 4/24 to review spreadsheet. All Core Team members should coordinate with Beth before 4/24 to update spreadsheet.
    e. Craig will coordinate with Adam on Friday, April 26, 2019 to finalize the stakeholder list. Craig will send out evites Monday, April 29, 2019 with RSVP deadline of May 8, 2019.
    f. Late additions are welcome…please forward necessary information to Craig to add to evite main list.
    g. Beth will forward the draft evite language to the Town Manager for approval.
2. Data/Reference materials to be developed for the MVP Workshop:
    a. Full-day Agenda
    b. Facilitator/Scribe Guide
    c. Table materials:

i. Examples of Vulnerabilities/Strengths based on three areas…Infrastructural, Societal, Environmental
ii. Climate Change Projections (Temperature/Precipitation – Northeast Climate Science Center)
iii. Demographic Data (MA Dept. of Health)
iv. Key Recommendations from 2010 Hazard Mitigation Plan
v. Maps
1. Population Density:
a. Council on Aging conducted research recently…Beth to provide data to Craig.
b. Master Plan process recent work on this…Craig to coordinate with Krista (HW).
c. Sudbury just became a Livable Community…Craig to obtain report.

3. Craig requested photos from past hazard events…Bill O'Rourke will work on this.
4. Sudbury Town Manager can't make the beginning of the Workshop for introduction, hopes to be there for the afternoon. Beth will see if Assistant Town Manager can be there, or Board of Selectmen representative can do opening.
5. Scribes…Beth will identify 3 scribes.
6. Lunch…Beth to continue working on securing donations for lunch.
7. MVP workshop will not be filmed…Listening Session will be filmed.

Hazard Mitigation Plan Update

1. Craig received updated list of Critical Facilities/Infrastructure from Chief Whalen. Craig compared this list against data files received from MAPC (secured by Beth). Craig will update/edit GIS shapefile to reflect changes…for use at MVP Workshop and HMP.
   - Chief Whalen will conduct final revisions and forward list to Craig by Wednesday, April 24, 2019. Once GIS shapefile modified, Craig will export Attribute Table and circulate to the Core Team for review.
2. Craig reviewed the 2010 Plan Report Card. Sudbury LHMC to review and identify the following (to Beth by end of next week/4/26):
   - Completed (year, funding mechanism, department)
   - Completed – ongoing (will be moved to Capability Assessment)
   - Not Completed – Carry Forward (why not completed)
   - Not Completed – Remove (why removed)
3. LHMC:
   - To be added:
     - MEMA representative (also Sustainable Sudbury) – Heather Tecce heather.tecce@mass.gov
     - Citizen – Marie Royea…Beth to provide contact information
4. HW completed NOAA Climatic Data Center -Storm Events Database…will develop Risk Index/Vulnerability Matrix.
5. Chief Whalen will review wildfires since 2010 Plan (date/damages/injuries/deaths) and structural fires (broad overview/dates/type of structure/estimated damages).

Policies/Regulatory Review

1. Potential dates for two remaining workshops…HW to confirm with staff's availability:
    a. Planning Board: May 15 or May 29, 2019.
    b. Board of Health: May 14 (immediately following the MVP Workshop) 4:30 pm or 5:30 pm.

Sudbury, MA
Municipal Vulnerability Preparedness (MVP)/Hazard Mitigation Plan Update (HMP)/Regulatory Review
Project Overview

Municipal Vulnerability Preparedness (MVP) Workshop

- Community Resilience Building framework developed by Nature Conservancy – lays out the process for the project.
- MA Executive Office of Energy and Environmental Affairs has created the opportunity:
  - To build community resilience and adapt to extreme weather and hazards
  - To advance education, planning and ultimately implement priority actions
- Characterize Hazards affecting the community
- Identify Vulnerabilities and Strengths based on three categories: Infrastructural, Environmental, Societal…will inform HMP update development
- Identify/Prioritize Community Actions…will inform HMP update development
- MVP Core Team, Public Workshop, Listening Session
- Deadline for grant process – June 30, 2019

Hazard Mitigation Plan (HMP) Update

- 2010 Plan Report Card (accomplishments)…will inform MVP Workshop presentation
- Update Risk Assessment…will inform MVP Workshop presentation
- Vulnerability Assessment
- Update Mapping (Hazards and Risks)…will inform MVP Workshop presentation
- Update Capability Assessment
- Develop Mitigation Strategy
- Local Hazard Mitigation Committee, Municipal Interviews, Public Workshops
- Deadline for grant process – June 30, 2020

Policy/Regulatory Review

- Review of existing policies/regulations to identify areas for improved resiliency
- Development of new/expanded policies/regulations to facilitate improved resiliency…will inform MVP and HMP processes and deliverables
- Planning Board, Board of Health, BOS Workshops

Sudbury, MA
Municipal Vulnerability Preparedness (MVP)/Hazard Mitigation Plan Update (HMP)/Regulatory Review
Tasks and Timeline

Component	**MVP**	**HMP**	**Policies/Regulatory Review**
Scope of Work	Task 1. Core Team Planning Support **Kickoff Meeting: April 2, 2019** *Overview* *Develop Stakeholders invitation/responsible party* *Set all meeting dates* **MVP Core Team #1: April 19, 2019 10 am – 12 pm** *Confirm Stakeholder Invitee List* *Draft E-Vite: Emailed 4/22/19 RSVP 5/3/19* *Data/reference materials to be developed* **MVP Core Team #2: May 2, 2019 11 am – 12 pm (call)** *Outstanding Stakeholders update* *Workshop Logistics (agenda/timing)* **MVP Core #3: May 6, 2019 10 am – 12 pm** *Facilitator/Scribe Guide* *Confirmation of Priority Policy Initiatives* *Review of reference materials* Task 2. Workshop Facilitation **Public Workshop: May 14, 2019** Task 4. Listening Session **Listening Session: May 30, 2019 (Part 1)** Task 3. Summary of Findings Draft to MVP Core by June 14, 2019 Final to State by June 28, 2019	Task 1. Coordinate LHMC **Kickoff Meeting: April 2, 2019** *Overview* *Set LHMC Meeting #1 date* *Set Public Workshop meeting date* Task 2. Identify Changes to the Plan **LHMC Meeting #1: April 19, 2019 10 am – 12 pm** *2010 Plan Report Card* *Workshop Logistics* Task 3. Improve Risk Assessment Task 4. GIS Mapping **Municipal Interviews: week of May 20, 2019** **Public Workshop #1: May 30, 2019 (Part 2)**	Task 1. Initiate Review **Kickoff Meeting: April 2, 2019** *Overview* *Set Boards/Commissions dates (completed by 5/31/19)* Wrap-up review…draft to MVP Core by 4/29/19 **Planning Board: week of _____** **Board of Health: week of _____** **BOS: May 28, 2019 (tentative)** Policy/regulatory changes draft language 6/14/19
Component Deliverables	**MVP** Final MVP Report	**HMP** FEMA-Approved Hazard Mitigation Plan	**Policies/Regulatory Review** Policy/Regulatory Changes
Benefits	Clear understanding of risks/vulnerabilities MVP-Certified Community designation Eligibility for state implementation funds	Clear understanding of risks/vulnerabilities Eligibility for federal funds	Improved resiliency Minimized damages

Public Workshop #1: May 30, 2019

Thursday
May 30, 2019
7 – 9 PM

Sudbury Grange Hall
Meeting Room
326 Concord Road
Sudbury, MA

MAY 30, 2019

Planning for Resiliency

Listening Session and Public Workshop

Listening Session -

Municipal Vulnerability Preparedness (MVP)

The Town is currently working with community stakeholders to identify and prioritize steps to reduce risks and improve resilience to projected climate change impacts across the community. Please join us (7 – 8 PM) to hear the findings developed from the MVP process.

Public Workshop – Hazard Mitigation Plan

The Town is currently updating the 2010 Hazard Mitigation Plan. This plan is important because it helps the Town remain eligible to receive funding for projects that reduce the risk of injury or damage to property from future natural hazard events such as flooding and hurricanes. Please join us (8 – 9 PM) to understand what the Town has accomplished since the 2010 Plan and what we should be working on for the next five years.

Questions?

Contact Beth Suedmeyer

Environmental Planner

978-639-3363

suedmeyerb@sudbury.ma.us

Public Listening Session (MVP)/Public Workshop (HMP)

Sudbury Grange – Meeting Room
326 Concord Road
Sudbury, MA
May 30, 2019 7 – 8 PM MVP Public Listening session/8 – 9 PM HMP Public Workshop

Agenda

Part 1 – MVP Public Listening Session

1. MVP Overview
2. Workshop Findings
3. Questions/Comments

Part 2 – HMP Public Workshop

1. Overview
2. Why Hazard Mitigation Planning
    a. Mitigation Process
    b. Mitigation Goals
    c. Mitigation Measures
3. 2010 Plan Report Card
4. Questions/Comments

Sudbury Municipal Vulnerability Plan/Multi-Hazard Mitigation Plan Update

Public Listening Session/Public Workshop #1

Sudbury Grange - Meeting Room
326 Concord Road

May 30, 2019 7 - 8 PM MVP/8 - 9 PM HMP

Name	Email Address
Adam Duchesneau	DuchesneauA@sudbury.ma.us
Bill Murphy	murphyb@sudbury.ma.us
Bob May	robert.may3@comcast.net
John Whalen	whalenJ@sudbury.ma.us.
Beth Suedmeyer	Suedmeyerb@sudbury.ma.us
Pat Brown	BrownP@sudbury.ma.us
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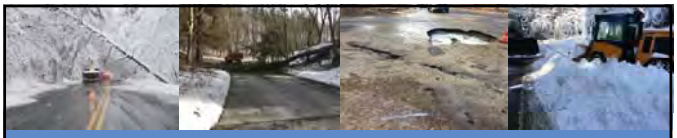
KAY BELL	kaybell@mail.com
Richard Morse	RAMORSE01@gmail.com
TANIA VITVITSKY	TVITVITSKY@GMAIL.COM
Olga Allen	olenka33@gmail.com
Steve Allen	sasoallen333@gmail.com



Sudbury, MA
2010 Hazard Mitigation Plan Update
Public Workshop

Craig Pereira, CFM
Project Manager – Horsley Witten Group

May 30, 2019 8:00 PM
Sudbury Grange Hall – Meeting Room

1

Why Hazard Mitigation Planning

Disaster Mitigation Act of 2000, Interim Final Rule, 44 CFR Parts 201 and 206 states, "All communities must have an approved Multiple Hazards Mitigation Plan in order to qualify for future federal disaster mitigation grants".

Reduction or elimination of long-term risk to life, property, and the environment.

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Sudbury
Local Hazard Mitigation Committee

- John Whalen, Sudbury Fire Chief
- Beth Suedmeyer, Environmental Planner
- Adam Duchesneau, Director of Planning and Community Development
- Dan Nason, Director of Public Works
- Bill Murphy, Health Director
- Bill O'Rourke, Deputy Director of Public Works
- Bill Barletta, Facilities Director
- Mark Herweck, Building Inspector
- Vin Roy, Executive Director Sudbury Water District
- Marie Royea, Citizen's Emergency Response Team
- Heather Tecce, MEMA
- Craig Pereira, Project Manager – Horsley Witten Group

3

Mitigation Process

- **Assess Risks**
- Establish Goals
- Identify Projects/Actions
- Update/Maintain Plan

4

Assess Risks…
Risk and Vulnerability Assessment

Natural Hazard:

"Any event or physical condition that has the potential to cause fatalities, injuries, property damage, infrastructure damage, and agricultural loss, damage to the environment, interruption of business, or other types of harm and/or loss".

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Hazards Affecting Sudbury (2010 Plan)

- Flood Related
  - Riverine, Inland/Urban, Heavy Rain
    - Sudbury River Floodplain (Water Row area)
    - Sudbury River (Concord Road)
    - Concord Road at Nashawtuc Country Club
    - Hickory Road culvert
  - Dam Failures
    - Division of Fish & Wildlife Pantry Brook Dam
    - Wayside Inn Grist Mill Dam
    - Town-owned Carding Mill Dam
    - Town-owned Stearns Mill Dam

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Hazards Affecting Sudbury (2010 Plan)

- Winter Related
  - Blizzards/Snow
  - Ice Storms
  - Extreme Cold
- Wind Related
  - Hurricanes
  - High/Strong Winds
  - Tornadoes
  - Lightning/Thunderstorms
  - Hail

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Hazards Affecting Sudbury (2010 Plan)

- Geologic Related
  - Earthquakes
  - Landslides
- Drought Related
  - Drought
  - Extreme Heat
- Wildfire
  - Boy Scout Reservation
  - Sudbury Valley Land Trust/Town Forest Land
  - MA DEM/USFW land near Tenneco natural gas pipeline

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Hazard Index (2020 Plan)

The Horsley Witten Group has evaluated each of the hazards affecting Sudbury to establish a **Hazard Index** – the natural hazards posing the most risk to the community, based on historical frequency and severity. Findings from the evaluation include the following top hazards:

- Inland/Urban Flooding, Heavy Rain
- Blizzards/Snow
- Hurricanes
- High/Strong Winds
- Drought

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Sudbury's Hazard Risk Index

	Frequency	Severity
• Flood-Related Hazards		
- Riverine/Flash Flooding	Low	Serious
- Inland/Urban Flooding, Heavy Rain	High	Extensive
- Dam Failures	Low	Serious
• Winter-Related Hazards		
- Blizzards/Snow	High	Extensive
- Ice	Low	Serious
- Extreme Cold	Low	Serious

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Sudbury's Hazard Risk Index

	Frequency	Severity
• Wind-Related Hazards		
- Hurricanes	High	Extensive
- High/Strong Winds	High	Serious
- Tornadoes	Low	Catastrophic
- Lightning/Thunderstorms	High	Minor
- Hail	High	Minor
• Geologic-Related Hazards		
- Earthquakes	Low	Extensive

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Sudbury's Hazard Risk Index

	Frequency	Severity
• Drought-Related Hazards		
- Drought	High	Serious
- Extreme Heat	Low	Serious
• Wildfire		
- Brush Fires	Medium	Minor
• Landslides		
- Landslide	Low	Minor

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Assess Risks…
Risk and Vulnerability Assessment - Assets

- **Economic Assets**
  - Businesses/major employers
  - Tourist destinations
- **Social Assets**
  - Vulnerable populations
  - Cultural locations

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Assess Risks…
Risk and Vulnerability Assessment - Assets

- **Natural Resources**
  - Lifeline and utility systems
  - Wetlands
  - Conservation and recreation lands
- **Essential Buildings and Critical Facilities**
  - Municipal buildings
  - Hazardous facilities
  - Roadways

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Mitigation Process

- Assess Risks
- **Establish Goals**
- Identify Projects/Actions
- Update/Maintain Plan

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Establish Goals…
Mitigation Goals (2010 Plan)

- Prevent and reduce loss of life, injury, public health impacts and property damages resulting from all major natural hazards.
- Identify and seek funding for measures to mitigate or eliminate each known significant flood hazard area.
- Integrate hazard mitigation planning as an integral factor in all relevant municipal departments, committees and boards.
- Prevent and reduce the damage to public infrastructure resulting from all hazards.

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Establish Goals…
Mitigation Goals (2010 Plan)

- Encourage the business community, major institutions and non -profits to work with the Town to develop, review and implement the hazard mitigation plan.
- Work with surrounding communities, state, regional and federal agencies to ensure regional cooperation and solutions for hazards affecting multiple communities.
- Ensure that future development meets federal, state and local standards for preventing and reducing the impacts of natural hazards.
- Take maximum advantage of resources from FEMA and MEMA to educate Town staff and the public about hazard mitigation.

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Establish Goals…
Mitigation Measures

- Planning and Prevention
- Property Protection
- Natural Resource Protection
- Structural Projects
- Emergency Services, and
- Public Education and Awareness

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Mitigation Process

- Assess Risks
- Establish Goals
- **Identify Projects/Actions**
- Update/Maintain Plan

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Identify Projects/Actions… Identification of Mitigation Actions

Mitigation actions to be developed based on review of the Town's identified risks and vulnerabilities to natural hazards.

Each action incorporates a brief description of the intended action, who the responsible parties are, a proposed time frame for completion and potential funding sources.

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Identify Projects/Actions… Prioritization of Actions

- **S**ocial
- **T**echnical
- **A**dministrative
- **P**olitical
- **L**egal
- **E**conomic
- **E**nvironmental

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Identify Projects/Actions… Implementation

- Town Capability
- Plan Adoption/Incorporation into Existing Plans

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Mitigation Process

- Assess Risks
- Establish Goals
- Identify Projects/Actions
- **Update/Maintain Plan**

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2010 Plan Report Card

High Priority Mitigation Measures

- Enhance Flood Plain Bylaw enforcement assistance. (Not completed, carry forward)
- Revise wetlands bylaw to provide better wildlife habitat protection and comply with new DEP Stormwater regulations. (Completed, ongoing)
- Increase Town emergency response to imminent storms and during winter storms. (Completed, ongoing)
- Elevate the grade of Concord Road two feet (between Lincoln Road to Old Sudbury Rd.). (Not completed, carry forward)
- Elevate Concord Road two feet (eastern end of Concord Rd.). (Not completed, carry forward)
- Remove beaver dam and conduct beaver trapping/removal as needed. (Completed, ongoing)

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2010 Plan Report Card

High Priority Mitigation Measures

- Develop inspection/maintenance plans: Carding Mill and Stearns Mill Dams. (Completed)
- Establish a regular tree inventory and maintenance plan. (Not completed, carry forward)
- Establish microwave link communications system with repeater at Nobscot Mountain. (Completed)
- Establish a municipal HAM radio station and provide training/licensing for operators. (Not completed, remove)

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2010 Plan Report Card

High Priority Mitigation Measures

- Build a municipal Emergency Operations Center as part of the redesign of Fire Dept. or new Police Station. (Completed)
- Reconfigure generators at Lincoln-Sudbury High School to include heating capability. (Not completed, carry forward)
- Install a large-capacity, multi-fuel generator at the Curtis Middle School. (Not completed, carry forward)
- Acquire a large, mobile diesel generator for the Fire Dept. (Completed)

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2010 Plan Report Card

Measures to Ensure Compliance with NFIP

- Adopt new regulations for the Water Resource Protection District bylaw. (Not completed, carry forward)
- Develop/Adopt new Stormwater bylaw in conjunction with MAPC. (Completed)
- Develop/Adopt new Earth Removal Bylaw. (Not completed, carry forward)
- Acquire wetlands parcels in the Sudbury River floodplain. (Completed)
- Increase funding for preventative practices on drainage infrastructure. (Not completed, carry forward)

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2010 Plan Report Card

Medium Priority Mitigation Measures

- Continue ongoing education for town residents on stormwater and wetland resources. (Completed, ongoing)
- Complete repairs and develop Operations and Management Plan for Pantry Brook Dam. (Not completed, carry forward)
- Elevate Concord Rd. near Nashawtuc Country Club. (Not completed, carry forward)
- Upgrade older drainage systems in town. (Not completed, carry forward)
- Beaver dam removal, beaver trapping/removal as needed. (Completed, ongoing)
- Establish more frequent maintenance schedules for town-owned drainage facilities. (Completed)
- Acquire Soft Suction pond water drafting system. (Completed)

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2010 Plan Report Card

Medium Priority Mitigation Measures

- Devote more resources to privately-owned drainage facilities. (Not completed, carry forward)
- Relocate overhead electrical/cable utility lines underground. (Not completed, carry forward)
- Conduct feasibility study to investigate options for all public buildings to be earthquake proof. (Not completed, carry forward)
- Add manpower to the Fire Dept. and provide homeowner education on fire prevention using building/landscaping best management practices.. (Completed, ongoing)

Low Priority Mitigation Measures

- Increase outreach and education on subsidence, erosion, stormwater and BMPs to landscapers and contractors. (Completed, ongoing)

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High Priority Actions

- Tree and Forest Management
  - Preserve existing tree canopy/Plan for future species changes
    - Identify/remove dead/failing trees
    - Develop plan for re-planting (native species/size/shape/placement)
  - Purchase bucket truck for DPW
  - Public education around trimming/planting
- Power/Utility Lines
  - Bury lines underground as roads are repaved
  - Establish tree/buffer management
  - Evaluate resources
    - Rate-payer funding
    - MA Surcharge Program
    - Solar facilities

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High Priority Actions

- Emergency response planning and communication
  - Increase capacity and support for CERT and MRC (recruitment)
  - Training/communication protocol for hospitals and home care agencies
  - Educate community on Reverse 911
  - Assess needs of vulnerable populations to understand sheltering needs/'know your neighbor'
  - Maintain database of vulnerable populations, address data privacy/sharing challenges
- Update existing regulations
  - Stormwater regulations to reduce flooding/water quality impacts
  - Incorporate latest science/climate change projections
  - Private well restrictions/water bans during drought events

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High Priority Actions

- Stormwater Infrastructure Capacity
  - Stormwater Infrastructure Assessment
    - Retrofits, replacement, Low Impact Development/Green Infrastructure
  - Culvert Replacement
    - Repair, replace, engineering/design
- Strengthen emergency shelters (schools, libraries, Community Center)
  - Generators
  - Air-conditioning
  - Charging stations

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Project Schedule

Draft Update available for public comment – **December 2019**

Draft Update to MEMA – **February 2020**

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Contact Us…

Questions and/or comments about the Hazard Mitigation Plan Update, please contact:

John M. Whalen – Fire Chief
Town of Sudbury
77 Hudson Road
Sudbury, MA 01776
WhalenJ@Sudbury.ma.us
Phone: (978) 440-5311

Craig Pereira—Project Manager
Horsley Witten Group
55 Dorrance Street, Suite 200
Providence, RI 02903
cpereira@horsleywitten.com
Phone: (401) 272-1717

Thank You!

Horsley Witten Group

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Local Hazard Mitigation Committee Meeting #2: September 5, 2019

Local Hazard Mitigation Committee Meeting #2

DPW Engineering Room
275 Old Lancaster Road
Sudbury, MA
September 5, 2019 10:00 AM – 12:00 PM

Agenda

1. Project Website

2. Proposed Update Layout

3. Section 1 Introduction
    a. Mission Statement
    b. Goals
    c. Online Survey

4. Section 2 Risk Assessment
    a. Mapping Update
    b. Repetitive Flood Loss Properties
    c. FEMA Flood Zones
    d. Development Trends
    e. NFIP Property Data Update
    f. Impact of FEMA Flood Zones (Economic Analysis)
    g. Mass Care/Reception Shelters
    h. FEMA Grant Disaster Assistance

5. Section 4 Mitigation Strategy

6. MVP Action Grant RFP/Information Sessions

Town of Sudbury, MA

Local Hazard Mitigation Committee Meeting #2

DPW Engineering Room
275 Old Lancaster Road

September 5, 2019 10:00 AM - 12:00 PM

Name	Email Address
Beth Suedmeyer	suedmeyer@sudbury.ma.us
ANDREW LEWIS	LEWISA@SUDBURY.MA.US
TIM CHOATE	CHOATET@SUDBURY.MA.US
BILL BARLETTA	BARLETTAW@SUDBURY.MA.US
John Whalen	WhalenJ@Sudbury.ma.us
Scott Nix	NIXS@[redacted]SUDBURY.MA.US
Adam Duchesneau	DuchesneauA@Sudbury.ma.us
DAN NASON	nasond@sudbury.ma.us
LORI Capone	caponel@sudbury.ma.us
MARIE ROMEA	@ GMAIL
Heather Tecce	heather.tecce@mass.gov
Jeffrey Zukowski	jeffrey.zukowski@mass.gov
CHRIS CAPUANO	CCapuano@horsleywitten.com

Horsley Witten Group

Memorandum of Meeting

To: Sudbury LHMC

From: Craig Pereira

Date: September 11, 2019

Re: Sudbury Hazard Mitigation Plan (HMP) Meeting

In attendance:

John Whalen – Sudbury Fire Chief
William Barletta – Facilities Director
Beth Suedmeyer – Environmental Planner
Adam Duchesneau – Director, Planning and Community Development
Andrew Lewis – Building Inspector's Office
Tim Choate – Fire Dept.
Scott Nix – Sudbury Police Chief
Dan Nason – DPW Director
Lori Capone – Sudbury Conservation Agent
Marie Royea – Citizen/CERT Team
Healther Tecce – Sustainable Sudbury/MEMA Representative
Jeff Zukowski – MEMA Representative

Consultant Team
Craig Pereira, Project Manager - Horsley Witten Group, Inc. (HW)

1. Project Website:
    - Craig asked if the Town's landing page could include the HMP Update under 'Projects' or 'Recent News'…currently the survey link is on the Community Planning/Development page.
    - The May 30, 2019 HMP Public Workshop powerpoint and static 'About the Hazard Mitigation Plan' pdf are now posted on Fire Department's page (with Community Survey link).
    - Community Survey link is available and will be open through at least the end of September.
        - **LHMC members** should continue to push this out to professional and personal networks (https://www.surveymonkey.com/r/SudburyCommunitySurvey).
        - **Craig** will push it out via the distribution list for the MVP project participants.
        - **Chief Whalen** will get it posted to the Town's Facebook page and push it out there.
        - **Chief Whalen** will push it out via Town boards/commissions distribution list.

2. Proposed Plan Update Layout
    - Craig reviewed the proposed update layout (attached), as discussed at the LHMC meeting No. 1. This is a tested layout with both MEMA and FEMA, reads well and addresses all the items in FEMA's Crosswalk document (utilized for plan approval).
    - LHMC members should review the proposed layout and provide feedback by September 18, 2019.
3. Section 1 - Introduction
    - The majority of data needed has been collected.
    - Outstanding items for discussion/consideration include:
        - Mission Statement…currently there is no mission statement. For consideration: *The purpose of the Sudbury Hazard Mitigation Plan is to preserve the quality of life, property values, natural and historic resources by identifying all potential natural hazards impacting the community and mitigating their effects to reduce loss of life, as well as, losses of economic, natural, and historic resources*.
            - **LHMC members** should review and provide feedback on the mission statement.
        - Goals…the following eight goals are included in the existing plan:
            - Prevent and reduce the loss of life, injury, public health impacts and property damages resulting from all major natural hazards.
            - Identify and seek funding for measures to mitigate or eliminate each known significant flood hazard area.
            - Integrate hazard mitigation planning as an integral factor in all relevant municipal departments, committees and boards.
            - Prevent and reduce the damage to public infrastructure resulting from all hazards.
            - Encourage the business community, major institutions and non-profits to work with the Town to develop, review and implement the hazard mitigation plan.
            - Work with surrounding communities, state, regional and federal agencies to ensure regional cooperation and solutions for hazards affecting multiple communities.
            - Ensure that future development meets federal, state and local standards for preventing and reducing the impacts of natural hazards.
            - Take maximum advantage of resources from FEMA and MEMA to educate Town staff and the public about hazard mitigation.

            Craig suggested these be consolidated to four overarching goals, with the mitigation actions providing more details:
            - Protect the public's health, safety and welfare.
            - Reduce property damages caused by hazard impacts.
            - Minimize social distress and economic losses/disruption.
            - Provide an ongoing forum for the education and awareness of natural hazard mitigation issues, programs, policies, projects and resources.
                - **LHMC members** should review and provide feedback on the mission statement.
4. Section 2 – Risk Assessment

- Mapping…some of the data has been collected through the MVP project, with several maps already created. Craig commented that existing maps (developed as part of the MVP project as a table resource only) and new maps will follow a new format, appropriate for inclusion in a hazard mitigation plan.
  - Location Map: **Craig** to develop.
  - Critical Facilities: One town-wide map already developed (Critical Facilities table already updated). **Craig** will modify this into three sections (north/central/south) and add numbers to facilities 9rather than icons) that will correlate to a Critical Facilities table for ease of read.
  - Flood Hazard Areas: **Craig** to develop with FEMA Flood Zones and Repetitive Loss Areas.
    - **Chief Whalen** to reach out to Joy Duperault, Director – Flood Hazard Management Program/State NFIP Coordinator and Deputy Hazard Mitigation Officer (joy.duperault@mass.gov) to get updated list of properties (three properties identified in 2010 plan). To be shown as 'general areas' and not specific sites in the plan update.
  - Landslides/Earthquakes: **Craig** will modify to include earthquakes and remove FEMA flood zones.
  - Hurricanes/Tornadoes: **Craig** to develop.
  - Annual Snowfall: **Craig** will modify to include open water and remove FEMA flood zones.
  - Traffic Control Points/Evacuation Routes: **Craig** to develop.
    - Chief Whalen stated that evacuation routes were provided via the MVP project (**Craig** to confirm) and the Master Plan Transportation Map includes traffic control points (**Craig** to confirm).
- Development Proposals/Trends
  - A number of development proposals/projects were identified through the municipal interviews already conducted. **Beth/Adam** to provide additional details for each, including number of units or GFA, impacts, and status (built/not built/under construction), and locations on a plan (Map/Lot).
    - Quarry North (and Malone Property)
    - Camp Sawetaro
    - New Community Center
    - Coolidge, Phase II
    - National Development – Meadow Walk
  - A listing of completed development projects completed since the 2010 plan (with the same details as referenced above) is also requested (**Beth/Adam**).
- NFIP property update…**Chief Whalen** to again reach out to Joy Duperault (contact information above) for an update, including:
  - Total number of policies
  - Coverage value
  - Policies in A Zone
  - Claims since 1978
- FEMA Flood Zones (Economic Analysis)
  - Craig needs a new parcels shapefile that includes a new data dump from the Assessor's that includes additional fields, including land use type (residential, commercial, industrial, etc.), ownership, land/building/accessory

values. **Chief Whalen** to coordinate with GIS/Assessor's office first, then **Craig** will follow up.

- Mass Care/Reception Centers…in addition to the primary and secondary shelters for the Town, **Chief Whalen** to provide a list of mass care/reception shelters. Data needed includes name, location and capacity.
- FEMA Disaster Grant Assistance…**Chief Whalen** to provide a list of any grant assistance the Town has received since the 2010 plan, to include:
  - Date
  - Declaration number
  - Description of what the funds were used for
  - Total funds provided

5. Section 4 – Mitigation Strategy
   - Craig pulled together the beginning of a mitigation strategy from actions identified for carry over from the 2010 plan Report Card (attached), the top priority actions identified from the MVP project, and the actions identified from the 2019 MVP Code Review process (MVP information located here: https://sudbury.ma.us/pcd/2019/05/31/municipal-vulnerability-preparedness-mvp-planning/.
     - **LHMC members** should review the *Sudbury Mitigation Actions for Consideration* document (attached), revise existing content as necessary and add projects based on their specific role within the community. **LHMC members** should be ready to discuss the mitigation strategy and new actions at the next LHMC meeting.
6. MVP Action Grant opportunities…there are a number of informational sessions around guidance for submitting MVP Action grant applications. **Beth** is scheduled to attend a session, and **LHMC members** should consider a range of projects for submission.
7. Next Steps…
   - LHMC meeting #3 to occur in mid-October
   - Public Workshop #2…provide the Town with at least one month notice of proposed workshop date to avoid conflicts with other project meetings/workshops.

Sudbury Hazard Mitigation Plan (proposed layout)

Section 1: Introduction

Overview

- Hazard mitigation planning in general

What Hazard Mitigation Can do for Sudbury

- Benefits of hazard mitigation planning

Sudbury Goals

- Protect the public health, safety and welfare.
- Reduce both public and private property damages caused by hazard impact.
- Minimize social distress and economic losses/business disruption.
- Provide an ongoing forum for the education and awareness of natural hazard mitigation issues, programs, policies, projects and resources.

Planning Process

- Overview of approach/process of the project
    - Local Hazard Mitigation Committee Meetings
    - Public Workshops
    - Municipal Interviews
    - Survey

Environmental Setting

- Geographic location
- History
- Government Structure

History of Disaster Declarations

- Federal Emergency and Major Disaster Declarations for the County

Recent Disaster Declarations

- Recent (2010 – forward) Federal Emergency and Major Disaster Declarations for the County

Section 2: Risk Assessment

Introduction

- Which hazards merit special attention
- What actions might be taken to reduce the impact(s) of those hazards
- What resources are likely to be needed

Hazard Identification

- Required to evaluate all hazards identified in the State Plan…anticipated list:
    - Riverine/Flash Flooding
    - Heavy Rain/Inland and Urban Flooding
    - Climate Change/Sea Level Rise
    - Dam Failure
    - Blizzards/Heavy Snow/Winter Weather/Nor'easters
    - Ice Storms
    - Extreme Cold
    - Hurricanes
    - Tornadoes/High Winds

    - Lightning/Thunderstorms
    - Hail
    - Earthquakes/Landslides
    - Drought
    - Extreme Heat
    - Urban Fire/Wildfires
    - Invasive Species
- Likely not to be addressed:
    - Avalanche
    - Expansive Soils
    - Land Subsidence
    - Volcanoes
    - Tsunamis

Hazard Profiles

- Review of NOAA's National Climatic Data Center (http://www.ncdc.noaa.gov/) 'Storm Events' database and develop tables based on hazard type, date, level/description and damages to develop a Hazard Index.
    - Flood Related
    - Winter Related
    - Wind Related
    - Geologic Related
    - Drought Related
    - Urban Fire/Wildfire Related

- Evaluate the location/history/probability of future occurrence of hazards

  Criteria for Frequency Categorization:

  Very low frequency: events that occur less frequently than once in 1,000 years (less than 0.1% per year).

  Low frequency: events that occur from once in 100 years to once in 1,000 years (0.1% to 1% per year).

  Medium frequency: events that occur from once in 10 years to once in 100 years (1% to 10% per year).

  High frequency: events that occur more frequently than once in 10 years (greater than 10% per year).

  Criteria for Severity Categorization (based on past hazard events):

  Minor: Limited and scattered property damage; no damage to public infrastructure; contained geographic area; essential services not interrupted; no injuries or fatalities.

  Serious: Scattered major property damage; some minor infrastructure damage; wider geographic area; essential services are briefly interrupted; some injuries/fatalities.

  Extensive: Consistent major property damage; major damage to public infrastructure; essential services are interrupted for several hours to several days; many injuries and fatalities.

Catastrophic: Property and public infrastructure destroyed; essential services stopped; thousands of injuries and fatalities.

- Mapping will also be developed
    - Critical Facilities
    - FEMA Flood Zones
    - Snowfall, Hurricane paths, storm surge, etc.

Vulnerability

- Evaluates vulnerability of built environment, social and environment.

Development Trends

- Changes over time, future development plans (residential/commercial/industrial)

Economic Vulnerability

- Impacts of FEMA flood zones (Economic by land use type, land/building values)

Social Vulnerability

- Impacts to built/natural environment and that relationship to the social structure of the community
- Infrastructure/Emergency lifelines
- Evacuation/Populations at risk

Environmental Vulnerability

FEMA Disaster Grant Assistance

- Has the Town received any financial assistance from MEMA/FEMA?

Section 3: Capability Assessment

Introduction

- Documents local, state and federal department, agency and program capabilities in terms of pre and post-disaster activities

Planning/Regulatory Capabilities

- Planning documents
- Regulations/Bylaws
- Building Code

Administrative Capabilities

- Emergency Management Plan
    - Emergency Operations Center/Shelter
- Municipal Website
- Coordination with Neighboring Communities
- Municipal Structure/Staff

Financial Capabilities

- Federal/State Grant Opportunities

National Flood Insurance Program

- NFIP/Compliance with NFIP

Existing Protection Matrix

- Summary of all above

Section 4: Mitigation Strategy

Introduction

Mitigation Activities

- Requires an action for every vulnerability identified in the plan

Mitigation Action Plan

- Categories
    - Public Education and Awareness
    - Property Protection
    - Natural Resource Protection
    - Structural Projects
    - Emergency Services
    - Planning and Prevention

- Time Frame
    - Short Term = 0 to 6 Months
    - Medium Term = 6 to 18 Months
    - Long Term = 18 Months to 5 Years

- Cost Estimate
    - Staff Time – municipal personnel time
    - Minimal – less than $5,000
    - Moderate – more than $5,000, but less than $25,000
    - Significant – over $25,000

- Prioritization of Actions (abbreviated Benefit/Cost Analysis)
  STAPLEE Criteria

    - **S**ocial: Is the action compatible with present and future local community needs and values?
    - **T**echnical: Is the action feasible with available local resources (or as supplement by outside resources as necessary)?
    - **A**dministrative: Does the community have the administrative capacity to implement the action?
    - **P**olitical: Is there strong public support to implement and maintain the action?
    - **L**egal: Does the community have the legal authority to implement the action?
    - **E**conomic: Is the action cost-effective?
    - **E**nvironmental: Does the action impact environmental resources, and is the impact positive, negative, or neutral?

- Action Description
    - Action Type:
    - Priority Score:
    - Lead:
    - Supporting:
    - Time Frame:
    - Financing Options:

    - Cost Estimate:
    - Benefit:
    - Vulnerable Area:

Section 5: Plan Implementation/Maintenance

Implementation/Evaluation/Revision

- Implementation
    - Following municipal adoption

- Evaluation
    - Annually

- Revision
    - Every 5 years/after a major event

Continued Public Involvement

- Posted on Town's website
- Annual Town Meeting

Local Hazard Mitigation Committee Meeting #3: October 30, 2019

Local Hazard Mitigation Committee Meeting #2

DPW Engineering Room
275 Old Lancaster Road
Sudbury, MA
October 30, 2019 10:00 AM – 12:00 PM

Agenda

1. Follow Up from Meeting #2
    a. Mission Statement…
    b. Goals…
    c. Proposed Plan Layout…
    d. Mapping Update…
        i. Maps updated
        ii. Remaining needs…traffic control points
    e. Development Trends…
        i. Received multi-family development since 2010 plan
        ii. Remaining needs…other developments since 2010 plan, map/lot for all
    f. Vulnerability Analysis/FEMA Flood Zone impacts…
        i. Received new CAMA export/GIS overlay and analysis completed
    g. Mass Care/Reception Shelters…
        i. Remaining needs…anything else other than Fairbank Center? (name…location…capacity…purpose)

2. Actions for Continued Compliance with NFIP

3. Dams Summary

4. Survey Report-out

5. Mitigation Strategy
    a. Comments from actions distributed at last meeting…
    b. Culverts CIP from Dan…how to incorporate…

6. Next Steps
    a. LHMC Meeting #4
    b. Public Workshop #2

Town of Sudbury, MA

Local Hazard Mitigation Committee Meeting #3

DPW Engineering Room
275 Old Lancaster Road

October 30, 2019 10:00 AM - 12:00 PM

Name	Email Address
Craig Pereira	cpereira@horsleywitten.com
Bill Barletta	BarlettaW@Sudbury.ma.us
Jeffrey Zukowski	jeffrey.zukowski@mass.gov
John Whalen	WhalenJ@Sudbury.ma.us
Tim Crocker	Crockert@Sudbury.MA.US
Scott Nix	NIXS@SUDBURY.MA.US
Andrea Lewis	LEWISA@SUDBURY.MA.US
Bill Murphy	murphyb@sudbury.ma.us
Lori Capone	Caponel@Sudbury.ma.us
Adam Duchesneau	DuchesneauA@Sudbury.ma.us
Beth Suedmeyer	Suedmeyerb@sudbury.ma.us

Horsley Witten Group

Memorandum of Meeting

To: Sudbury LHMC

From: Craig Pereira

Date: November 5, 2019

Re: Sudbury Hazard Mitigation Plan (LHMC) Meeting #3

In attendance:

John Whalen – Sudbury Fire Chief
William Barletta – Facilities Director
Beth Suedmeyer – Environmental Planner
Adam Duchesneau – Director, Planning and Community Development
Andrew Lewis – Building Inspector's Office
Tim Choate – Fire Dept.
Scott Nix – Sudbury Police Chief
Lori Capone – Sudbury Conservation Agent
Bill Murphy – Director of Health
Jeff Zukowski – MEMA Representative

Consultant Team
Craig Pereira, Project Manager - Horsley Witten Group, Inc. (HW)

1. Follow up from LHMC Meeting #2:
    - Mission Statement: no comments on the proposed mission statement…consensus on mission statement as is, '*The purpose of the Sudbury Hazard Mitigation Plan is to preserve the quality of life, property values, natural and historic resources by identifying all potential natural hazards impacting the community and mitigating their effects to reduce loss of life, as well as, losses of economic, natural, and historic resources*.'
    - Goals: no comments on the proposed goals…consensus on goals as is:
        - Protect the public's health, safety and welfare.
        - Reduce property damages caused by hazard impacts.
        - Minimize social distress and economic losses/disruption.
        - Provide an ongoing forum for the education and awareness of natural hazard mitigation issues, programs, policies, projects and resources.
    - Proposed Plan Layout: Jeff Zukowski approved, no comments from others…consensus on plan layout as presented in meeting #2.
    - Mapping Update: Craig presented the updated map series. Consensus on mapping as presented.
        - Chief Nix commented that critical facility #67 Rite Aid Pharmacy is no longer in business.

- #32 and #70 (Police) are duplicates.
- Chief Nix provided the traffic control points.
- Beth requested street labels for the major roadways.

o Development Trends: **Beth and Andrew** to follow up with Map/Lot information for multi-family and other development projects since the 2010 plan and proposed for future development.

o Vulnerability Analyses/FEMA Flood Zone impacts: Updated CAMA data received.
- Beth questioned 100 yr v. 500 yr…**Craig** will revisit this analysis.

o Mass Care/Reception Shelters: Chief Whalen mentioned a church on Landham Rd. and regional shelters (Wayland and the Concord Armory. **Chief Whalen** to provide name/location/capacity/purpose.

2. Actions for continued compliance with NFIP:
   o Craig reviewed the draft table with actions to determine if 'done/ongoing' or 'to be done'. The group completed the table which will be incorporated into the text of the plan update.
3. Dams Summary:
   o Craig commented that there is conflicting data on existing dams in Sudbury from Sudbury 2010 plan, National Inventory of Dams, and OLIVER. Craig submitted a data request to MA Office of Dam Safety. Current list includes:
      - Grist Mill Dam
      - Carding Mill Pond Dam
      - Stearns Mill Pond Dam
      - Willis Pond Dam
      - Cuttings Pond Dam
      - DFW Pantry Brook Dam
   o Once received, Craig to share findings of research with LHMC.
   o Craig also followed up with Bill O'Rourke after the meeting:
      - Grist Mill Dam…Wayside Inn is confirmed owner.
      - Carding Mill Pond Dam…
      - Stearns Mill Pond Dam…Town just completed rehabilitation.
      - Willis Pond Dam…not on Willis Pond…on Blanford Pond?
      - Cuttings Pond Dam…in Maynard, remove from Sudbury list.
      - DFW Pantry Brook Dam…
4. Survey Results:
   o 90 respondents in total…a good response rate.
   o Hazards of most concern:
      - Winter
      - Wind
      - Temperature
      - Flood
   o Generally, the public feels prepared for natural hazard events
   o Most get hazard information via local news and social media, but also:
      - Internet
      - Autodial
      - Fire/Rescue
   o Generally, the public is interested in becoming more resilient, and using personal funds to do so.

- Mitigation actions the Town should be focusing on:
  - Utilities resilience
  - Retrofitting public infrastructure
  - Providing information to residents
  - Address area bridges
  - Address public facilities (Police/Fire/Emergency/Schools)
- Anecdotal comments:
  - Town needs Tree Management plan/ordinance and should consider undergrounding of utilities.

5. Mitigation Strategy:
   - No comments/additions were received since the last LHMC meeting when Craig presented mitigation actions from the 2010 plan for carryover (not yet completed), from the MVP process, and from the Code/Regulatory review process.
   - Craig asked if invasive species mitigation action should be added…consensus to add to plan.
   - Craig received the Culvert Capital Improvement Plan from Dan following the last LHMC meeting. These will be presented as one mitigation action and listed as either 'rehabilitation' or 'replacement' with the accompanying data as presented. **Craig** will confirm priority ranking with Dan prior to discussing at next LHMC meeting.
   - Craig also revisited the MVP report and presented the additional actions that weren't part of the top 6 actions…
     - Develop informational pamphlets on hazards: LHMC feels the Town is doing enough in this area…perhaps consider enhancing the Town's emergency management website?
     - Develop Operations and Management plans for private/public dams: dependent upon what data is returned from the MA Office of Dam Safety request, include actions for O & M plans, and Emergency Action Plans (if not already developed for high/significant hazard structures). **Craig** to follow up with MA Office of Dam Safety.
     - Sherman Bridge…replace planks: this is an ongoing agreement with Wayland…every other year, each community is responsible for maintaining the historic bridge.
     - Update Fire Station for North Quarry development: not accurate fire station…Station 3 on Boston Post Rd. needs attention. **Chief Whalen** to provide summary of Station 3 needs to Craig.
     - Emergency Plan for pets and livestock:
       - Existing shelter at Fairbanks accommodates pets.
       - Possibly coordinate with large animal vet for livestock sheltering plan. **Chief Whalen** to reach out.
     - Storm Plow Prioritization Plan: Town just acquired software for this…currently conducting training to be operational late 2020.
     - Prioritized Hydrant Cleaning/Clearing: Craig to coordinate with Vin at Sudbury Water District.
     - Purchase high-profile fire truck: Chief Whalen stated it is not needed, Town can reach out to MEMA, and other agencies for equipment.
     - **LHMC members** should review the *Sudbury Mitigation Actions for Consideration* document (attached), revise existing content as necessary and

add projects based on their specific role within the community…provide to Craig by November 20, 2019. **LHMC members** should be ready to discuss/prioritize the mitigation strategy and new actions at the next LHMC meeting.

6. Next Steps…
    - LHMC meeting #4 scheduled for December 4, 2019, 9 AM to 12 PM
    - Public Workshop #2…TBD, sometime in mid-January 2020.

Actions for Continued Compliance with NFIP

Actions (Listed in order of priority)	Done/Ongoing	To be Done
Join the NFIP.		
Participate in NFIP training by State and/or FEMA.		
Establish mutual aid agreements with neighboring communities to address administering the NFIP following a major storm event.		
Address NFIP monitoring and compliance		
Revise/adopt subdivision regulations and erosion control regulations to improve floodplain management in the community.		
Participate in the CRS.		
Prepare, distribute, or make available NFIP, insurance and building code		
Identify and become knowledgeable on non-compliant structures in the community.		
Identify and become knowledgeable of submit to rate structures.		
Identify cause of submit to rate structure and analyze how to prevent non-compliant structures in the future.		
Inspect foundations at time of completion before framing to determine if lowest floor		
Require use of elevation certificates.		
Report any changes in the Special Flood hazard Area to FEMA within 180 days of		
Identify and keep track of LOMA/LOMR in the community.		
Gain familiarity with community's Flood Insurance Rate Maps.		
Address repetitive loss structures.		

Local Hazard Mitigation Committee Meeting #4: December 4, 2019

Local Hazard Mitigation Committee Meeting #4

DPW Engineering Conference Room
275 Old Lancaster Road
Sudbury, MA
December 4, 2019 9:00 AM – 12:00 PM

Agenda

1. Follow Up from Meeting #3
    a. Development Trends…
        i. Received multi-family development since 2010 plan
        ii. Remaining needs…other developments (commercial/industrial) since 2010 plan, map/lot information for all
    b. FEMA Disaster grant assistance…
        i. Main items for funding provider for?

2. Dams Summary…report out

3. Mitigation Strategy
    a. STAPLEE Prioritization

4. Next Steps
    a. Public Workshop #2
    b. Public comment period

Town of Sudbury, MA

Local Hazard Mitigation Committee Meeting #4

DPW Engineering Conference Room
275 Old Lancaster Road

December 4, 2019 9:00 AM - 12:00 PM

Name	Email Address
Chris Pereira	
Bill Barletta	BARLETTAW@SUDBURY.MA.US
Dan Nason	nasond@sudbury.ma.us
Bill Murphy	murphyb@sudbury.ma.us
Jeffrey Zukowski	jeffrey.zukowski@mass.gov
John Whalen	WhalenJ@Sudbury.ma.us
Tim Choate	choatet@Sudbury.MA.US
Bill O'Rourke	ORourkeW@SUDBURY.MA.US.
Andrew Lewis	LewisA@Sudbury.MA.us
Adam Duchesneau	DuchesneauA@Sudbury.MA.us
Ruth Siedmeyer	Siedmeyerb@sudbury.ma.us

Local Hazard Mitigation Committee Meeting #4

DPW Engineering Conference Room
275 Old Lancaster Road
Sudbury, MA
December 4, 2019 9:00 AM – 12:00 PM

Agenda

1. Follow Up from Meeting #3
    a. Development Trends…
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3. Mitigation Strategy
    a. STAPLEE Prioritization

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    a. Public Workshop #2
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Town of Sudbury, MA

Local Hazard Mitigation Committee Meeting #4

DPW Engineering Conference Room
275 Old Lancaster Road

December 4, 2019 9:00 AM - 12:00 PM

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Chris Pereira	
Bill Barletta	BARLETTAW@SUDBURY.MA.US
Dan Nason	nasond@sudbury.ma.us
Bill Murphy	murphyb@sudbury.ma.us
Jeffrey Zukowski	jeffrey.zukowski@mass.gov
John Whalen	WhalenJ@Sudbury.ma.us
Tim Choate	choatet@Sudbury.MA.US
Bill O'Rourke	ORourkeW@SUDBURY.MA.US.
Andrew Lewis	LewisA@Sudbury.MA.us
Adam Duchesneau	DuchesneauA@Sudbury.MA.us
Ruth Siedmeyer	Siedmeyerb@sudbury.ma.us

Horsley Witten Group

Memorandum of Meeting

To: Sudbury LHMC

From: Craig Pereira

Date: December 4, 2019

Re: Sudbury Hazard Mitigation Plan (LHMC) Meeting #4

In attendance:

John Whalen – Sudbury Fire Chief
William Barletta – Facilities Director
Beth Suedmeyer – Environmental Planner
Adam Duchesneau – Director, Planning and Community Development
Andrew Lewis – Building Inspector's Office
Tim Choate – Fire Dept.
Bill Murphy – Director of Health
Dan Nason – Director DPW
Bill O'Rourke – Deputy Director DPW
Jeff Zukowski – MEMA Representative

Consultant Team
Craig Pereira, Project Manager - Horsley Witten Group, Inc. (HW)

1. Follow up from LHMC Meeting #3:
   - Development Trends: Andrew provided listing of development in town since the 2010 plan, including Map/Lot.
   - FEMA Disaster Grant Assistance: **Chief Whalen** to provide summary of what funding was used for the following:

     FEMA has provided the Town of Sudbury with approximately $1,179,419 in grant assistance since 2010 for the following disasters:
     - March 2010 Flooding
       Disaster Number: DR-1895
       $64,783.40
     - January 2011 Snowstorm
       Disaster Number: DR-1959
       $81,454.61
     - August 2011 Tropical Storm Irene
       Disaster Number: NA
       $43,012.18
     - October 2011 Nor' Easter
       Disaster Number: DR-4051
       $6,458.16

Horsley Witten Group

Memorandum of Meeting

To: Sudbury LHMC

From: Craig Pereira

Date: December 4, 2019

Re: Sudbury Hazard Mitigation Plan (LHMC) Meeting #4

In attendance:

John Whalen – Sudbury Fire Chief
William Barletta – Facilities Director
Beth Suedmeyer – Environmental Planner
Adam Duchesneau – Director, Planning and Community Development
Andrew Lewis – Building Inspector's Office
Tim Choate – Fire Dept.
Bill Murphy – Director of Health
Dan Nason – Director DPW
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Consultant Team
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       $81,454.61
     - August 2011 Tropical Storm Irene
       Disaster Number: NA
       $43,012.18
     - October 2011 Nor' Easter
       Disaster Number: DR-4051
       $6,458.16

- February 2013 Snowstorm
  Disaster Number: DR-4100
  $99,297.32
- January 2015 Snowstorm
  Disaster Number: DR-4214
  $154,121.62
- March 2018 Snowstorm
  Disaster Number: DR-4379
  $730,291.91

- Sudbury Emergency Management Plan: **Chief Whalen/Tim Choate** to provide copy to Craig for review and incorporation into the Capability Assessment section of the update.

2. Dams Summary Update:
   - Craig has not been able to get requested information from MA Office of Dam Safety. Craig submitted an online records request (https://www.mass.gov/forms/dcr-public-records-request) and has followed up several times with Bridget Connelly, DCR Records Access Officer (617-626-1311). Also coordinating with Emily Caruso , Dam Safety Engineer (Emily.caruso@state.ma.us) who provided a link to complain about not getting any responses. Craig is looking for information regarding Hazard Rating, Last Inspection, Emergency Action Plans, Operation and Management Plans. Bill O'Rourke did provide some information (included below).

     Bill and Jeff to reach out to their contacts at Office of Dam Safety to try and get more information.
     - Grist Mill Dam:
       - Owned by Wayside Inn
     - Carding Mill Pond Dam
       - Owned by the Town
     - Stearns Mill Pond Dam
       - Owned by the Town…just completed rehabilitation.
     - Willis Pond Dam
       - Private owner confirmed no manmade structure at the outfall. Will be removed from list.
     - Cuttings Pond Dam
       - In Maynard…will be removed from the list.
     - DFW Pantry Brook Dam
       - Fish/Wildlife owns this structure.
   - Once received, Craig to share findings of research with LHMC.
3. Mitigation Strategy Prioritization:
   - No comments/additions were received since the last LHMC meeting when Craig presented mitigation actions from the 2010 plan for carryover (not yet completed), from the MVP process, and from the Code/Regulatory review process.
   - Craig provided an overview of FEMA's STAPLEE process (attached) and how the Committee will proceed to prioritize the mitigation actions.

- Craig also provided a list of mitigation actions (attached) with required information completed as a draft for confirmation by the LHMC (Responsible Department/Time Frame/Cost Estimate, etc.).
- Comments/Revisions **Craig** needs to make to the mitigation actions:
  - Action #1: 'Strengthen existing Earth Removal Bylaw by incorporation design standards to minimize vegetation, slope and land disturbance'
  - Action #3: Lead: Planning and Community Development, Supporting: Conservation Commission/DPW
  - Action #4: 'Incorporate latest science and climate projections as a consideration'
  - Action #6: Move to Capability Section as these efforts are ongoing
  - Action #7: Cost Estimate = Moderate
  - Action #9: 'Evaluate feasibility of removal, otherwise request repairs and development of Operations and Management Plan of Fish & Wildlife'
  - Action #10: Broaden statement to include catch basins, etc. Add in caveat statement that Culvert CIP data is fluid and subject to change.
  - Action #11: 'Install generators', $450,000 per site
  - Action #13: 'Training and communication protocol of hospitals and healthcare agencies'
  - Action #16: Check with Lori Capone to see if Conservation Commission is incurring these costs, or General Legal Fund
- Craig has developed a summary table of the STAPLEE prioritization (attached)

4. Next Steps…
   - Public Workshop #2…Confirmed for January 29, 2020, 6:30 – 8:30 PM, Sudbury Town Hall. **Craig** will make flyer and forward to Chief Whalen, Beth.
   - Public Comment Period: targeted for month of February 2020.

NATURAL RESOURCE PROTECTION

Action #2
Incorporate new regulations for runoff (roof) and hardscape (sidewalk) recharge into the Zoning Bylaw/Water Resource Protection District regulations.

2010 HMP Action #15
2019 MVP Code Review #4.A
2019 MVP Code Review Action #5.C

Roof Runoff Recharge:
Require roof runoff to be recharge within the Zone II. Add to prohibitions in Section 4242: Roofs of any primary structures that do not direct runoff to a system designed to recharge the roof runoff such that the annual volume of water recharged is equal to or greater than under natural vegetated site conditions. The following language to be considered with input from the Sudbury Water District and should be cross-referenced with MADEP's underground injection program prior to modification of the Sudbury Zoning Bylaw or Water Resource Protection District regulations.

a.) Add the following language as a prohibition within Section 4242 of the Sudbury Zoning Bylaw:

> "Residential roofs of any primary structures that do not direct runoff to a system designed to recharge the roof runoff."

b.) Add the following language as a requirement within *Section 2.2 of the Water Resource Protection District Rules and Regulations:*

> *"Rooftop Recharge Design and Calculations*
> Stormwater runoff collected from a residential rooftop shall be recharged directly into the ground, preferably through surface infiltration systems. Infiltration of runoff from a metal roof and/or at a non-residential site requires pretreatment by means of a BMP capable of removing metals, nutrients and bacteria, such as a sand filter, organic filter, filtering bioretention area or equivalent. Metal roofs are galvanized steel or copper.
>
> 1. The applicant shall provide a plan documenting location for rooftop runoff storage and infiltration. Infiltration recharge design criteria shall be based on recharge requirements as outlined within the Massachusetts Stormwater Handbook Standard 3.
> 2. For residential development, rooftop downspouts shall be designed to discharge to systems that will allow for natural infiltration. These systems may include surface or subsurface infiltration (e.g. drywells), but surface infiltration is preferable to allow for uptake of metals nutrients or other harmful pollutants within the surface soil profile. Drywells may be regulated as Underground Injection Systems and subject to additional regulations described by the Massachusetts Department of Environmental Protection under the Underground Injection Control program.
> 3. Use of drywells or other subsurface infiltration system will be prohibited where seasonal groundwater is within 4 feet of the bottom of the drywell. Otherwise

place drywells at least 10 feet from the building foundation or basement, 20 feet from any cesspool or septic system, and 5 feet from any property lines. Drywells must be at least 500 feet from private drinking water wells.

4. Building projects involving additions greater than 25% of the existing building footprint but less than 50% of the existing building footprint shall collect the entire runoff from the roof of the addition plus runoff from the roof on the side of the existing structure that contains the addition.
5. Building projects involving additions that are 50% or greater than the existing building footprint shall capture the stormwater runoff from the entire roof.
6. The property must be located within an area of suitable soils for infiltration as defined during evaluation for Wastewater Disposal Plan outlined in 2.2.5. and as documented by on-site soil test pits.
7. An As-Built drawing showing all stormwater management systems shall be submitted to the regulatory authority prior to the issuance of an Occupancy Permit.
8. The as-built (certified) Plot Plan showing the improvements to the property shall be stamped by a Massachusetts Registered Land Surveyor."

Hardscape (Sidewalk) Recharge:
Allow sidewalks in the Village Business District to be constructed of pervious/porous materials.

a.) Revise Section 3561 of the Zoning Bylaw to include:

"In Village Business Districts, sidewalks shall be constructed of brick, stone, concrete, porous/pervious concrete or porous/pervious pavers, and be maintained by the owner."

- Action Type: Planning, Pre-Disaster
- Priority Score:
- Lead: Planning and Community Development
- Supporting: Sudbury Water District
- Time Frame: Short term
- Financing Options: N/A
- Cost Estimate: Staff time
- Benefit: Reduced environmental contamination, Improved public safety
- Vulnerable Area: Wetlands/Resource Areas

Action #3
Devote more resources to monitoring privately-owned drainage facilities.

2010 HMP Action #27

- Action Type: Planning, Pre-Disaster
- Priority Score:
- Lead: Department of Public Works
- Supporting: Sudbury Conservation Commission
- Time Frame: Medium term
- Financing Options: Sudbury Capital Improvement Plan
- Cost Estimate: Moderate

- Benefit: Reduced damages/costs to private property and environmental contamination, Improved public safety
- Vulnerable Area: Local roads subject to flooding, Water Supply

Action #4

Incorporate latest science and climate change projections into existing regulations to reduce flooding and water quality impacts, in addition to protecting water supply during periods of drought.

2019 MVP top priority
2019 MVP Code Review #2.B

The Commonwealth of Massachusetts has established a Massachusetts-specific climate data clearing house, resilientma.org, to easily enable municipalities and stakeholders to access regional data for use in climate preparedness planning. Overall, an emphasis on future projections for temperature and precipitation served as the two primary focus areas under this program.

Stormwater Bylaw:

Investigate options for increasing the design volumes to which stormwater practices and conveyances are designed to anticipate increases due to climate change. Currently, Section 8.0 defines the SMP Standards and Requirements, and Section 8.A.3.f defines the design storm events that the project must use in sizing its stormwater management systems. In order to provide the permitting agency with the ability to incorporate input from the DPW requiring that the applicant design to a higher standard for projects draining to areas where the municipal drainage system is already stressed, the following revised language is recommended:

> "In areas identified by the DPW in a publicly available list or map as having frequent flooding or an otherwise strained municipal drainage system, these design volumes may be adjusted up by as much as 25% at the request of the DPW upon review of the project."
>
> Similar language might be considered within the standards presented in Section 6.J for GSMPs, which apply to smaller projects.
>
> In support of this language, the DPW will need to maintain a list or map of areas with frequent flooding or otherwise strained stormwater systems.

Outdoor Water Use Bylaw:

Utilize the MassDEP Model Outdoor Water Use Bylaw to limit non-essential outdoor water use through the declaration of a local "State of Water Supply Conservation", "State of Drought" or "State of Water Supply Emergency" during periods of extended drought. This Model also includes additional language that towns can choose to incorporate into their outdoor water use by-law if they want the ability to regulate outdoor water use from private wells, or if they want to regulate the installation of in-ground irrigation systems.

- Action Type: Planning, Pre-Disaster
- Priority Score:
- Lead: Planning and Community Development
- Supporting: Department of Public Works
- Time Frame: Medium term

- Financing Options: N/A
- Cost Estimate: Staff time
- Benefit: Reduced damages/costs to private property and environmental contamination, Minimize impacts to water supply, Improved public safety
- Vulnerable Area: Local roads subject to flooding/Wetlands/Resource Areas/Water Supply

Action #5

Incorporate standards for tree preservation into the Zoning Bylaw (Tree Preservation Bylaw) and Subdivision Rules and Regulations (Site Plan Review) to maximize tree preservation/limit site disturbance and character throughout the community.

2019 MVP Code Review Action #9.A

Establish a Tree Preservation Bylaw - an effective mechanism to regulate tree preservation on both public property as well as private property. This bylaw would apply to all existing properties and trees across the town. In general, development approvals such as site plan review or subdivision approval will include their own standards and conditions addressing tree preservation, and these approvals can be essentially exempted from the general bylaw. However, the general bylaw can serve to define the tree preservation standard, establish a tree commission or tree warden with enforcement powers and master planning responsibilities, and create mitigation requirements, including a tree fund or tree bank. The tree preservation standards and mitigation requirements can be incorporated into the development approval regulations, either by reference or by directly incorporating the language of the standards or incorporated within the conditions of approval as appropriate.

- Action Type: Planning, Pre-Disaster
- Priority Score:
- Lead: Planning and Community Development
- Supporting: Department of Public Works, Building Department
- Time Frame: Medium term
- Financing Options: N/A
- Cost Estimate: Staff time
- Benefit: Reduced damages/costs to public/private property, Improved public safety, Continuity of essential services, Preservation of community character
- Vulnerable Area: Wetlands/Resource Areas/Site Disturbance

Action #6

Invasive Species Eradication Programs

The Town should increase community awareness and participation in hazard mitigation activities to include hazardous vegetation abatement and forest management projects (New England Wild Flower Society – Sudbury/Assabet/Concord River Watershed Cooperative Invasive Species Management Association).

- Action Type: Mitigation, Pre-Disaster
- Priority Score:
- Lead: Conservation Commission
- Supporting: Department of Public Works
- Time Frame: Short Term

- Financing Options: N/A
- Cost Estimate: Staff Time
- Benefit: Protection of stream/riverbanks (minimized erosion), protection of drainage infrastructure.
- Vulnerable Area: Wetland/Resource Areas

Action #7
Develop a Tree Maintenance and Forest Management Plan.

2010 HMP Action #8
2019 MVP top priority

Given the projected increase in severe weather events due to climate change, and the existing amount of natural tree coverage, a plan for regular tree trimming, dead tree removal and re-forestation plan (due to projected species migration) is needed. The plan should address the following:

a.) Maintaining trees at roadways and utility rights-of-way
b.) Preserving existing tree canopy and plan for future species changes
    i. Identify/Remove dead and falling trees
    ii. Develop plan for re-planting (native species, size, shape, and placement)
c.) Purchase bucket truck for DPW
d.) Public Education around trimming and planting

- Action Type: Planning, Pre-Disaster
- Priority Score:
- Lead: Department of Public Works
- Supporting: Conservation Commission
- Time Frame: Medium term
- Financing Options: N/A
- Cost Estimate: Staff time
- Benefit: Maintain resource areas, Reduced damages to private property, Minimized cleanup costs
- Vulnerable Area: Wetlands/Resource Areas/Emergency Response

STRUCTURAL PROJECTS

Action #8
Elevate the grade of Concord Road two feet in three separate locations:
- *Between Lincoln Road and old Sudbury Road*
- *Eastern end of the roadway*

2010 HMP Actions #15/#4/#22

Water Row Road (Concord Road between Lincoln Rd. and Old Sudbury Rd.):
The project would require an initial compensatory storage study as wetland resources near Lincoln Road and Route 27 would be impacted, in addition to the actual elevation of Water Row itself.

Eastern end of Concord Road:
Sheet flow back up may be related to water releases at DFW Pantry Brook Dam.

Near Nashawtuc Country Club:
Flooding occurs once every five years on average and impacts the country club area.

- Action Type: Mitigation, Pre-Disaster
- Priority Score:
- Lead: Department of Public Works
- Supporting: Engineering
- Time Frame: Medium term
- Financing Options: Sudbury Capital Improvement Plan
- Cost Estimate: $450,000/$150,000/$150,000 respectively
- Benefit: Improved public safety, Maintain viable evacuation routes, Reduced damages to private property, Minimized cleanup costs
- Vulnerable Area: Local roads subject to flooding

Action #9
Complete repairs and develop an Operations & Management Plan for Pantry Brook Dam.

2010 HMP Action #21

Owned and operated by Mass Fish and Wildlife, the structure is in need of repairs and the establishment of a regular maintenance program.

- Action Type: Planning, Pre-Disaster
- Priority Score:
- Lead: Mass Fish & Wildlife
- Supporting: Department of Public Works
- Time Frame: Medium term
- Financing Options: MA Fish & Wildlife budget
- Cost Estimate: Moderate
- Benefit: Reduced damages to private property, Minimized economic impacts
- Vulnerable Area: Dams

Action #10
Improve/Upgrade drainage infrastructure and capacity.

2010 HMP Action #23
2019 MVP top priority

The Department of Public Works has developed a Culvert Capital Improvement Plan to address deficient drainage systems throughout the town. The Town should consider Low Impact Development (LID) and Green Infrastructure (GI) techniques when implementing this plan.

The following culverts are listed by priority for rehabilitation, replacement or still to be determined:

High Priority:

Roadway/Crossing ID	Rehabilitation/Replacement	Probable Cost
Concord Road/Crossing #11	Replacement	$445,000

Summary of recommended work:
- Replace crossing

Willard Grant Rd./Crossing #46	Replacement	$215,000

Summary of recommended work:
- Replace crossing

Old Sudbury Rd./Crossing #110/149	Replacement/TBD	$515,000

Summary of recommended work:
- Replace crossing/headwalls
- Replace pipe
- Perform H & H analysis to determine if crossing is necessary

Morse Road Bridge/Crossing #7	Replacement	$900,000

Summary of recommended work:
- Seek MassDOT Bridge Grant Funds
- Replace bridge

Old Garrison Rd./Crossing #150	Replacement	$260,000

Summary of recommended work:
- Replace pipe
- Install headwalls approx. 5 – 8 feet from roadway
- Install guardrail

Maynard Farm Rd./Crossing #26	Replacement	$170,000

Summary of recommended work:
- Replace crossing

Hopestill Brown Rd./Crossing #165	Rehabilitation/TBD	$105,000

Summary of recommended work:
- Replace downstream headwall
- Upstream headwall in unknown condition
- Brush/debris needs to be cleared to assess

Powers Road/Crossing #31	Replacement	$140,000

Summary of recommended work:
- Replace crossing
- Construct new headwalls
- Add new guardrail

Bent Road/Crossing #91	Rehabilitation	$155,000

Summary of recommended work:
- Replace upstream/downstream headwalls

Medium Priority:

Roadway/Crossing ID	Rehabilitation/Replacement	Probable Cost
Wayside Inn Rd./Crossing #34	Rehabilitation	$100,000

Summary of recommended work:

- Replace granite portion of crossing
- Replace upstream headwall
- Repoint downstream headwall

Loker Rd./Crossing #61	Rehabilitation	$90,000

Summary of recommended work:

- Replace inlet headwall with cast in place concrete
- Repair end of pipe
- Mortar outlet headwall
- Remove vegetation
- Install guardrail

Nobscott Rd./Crossing #161	Rehabilitation	$135,000

Summary of recommended work:

- Replace corrugated metal pipe (left barrel)
- Repair downstream headwall

Maynard St./Crossing #136	Replacement	$70,000

Summary of recommended work:

- Reconstruct inlet and outlet headwalls with mortared stone masonry via reuse of existing stones

Peakham Rd./Crossing #58	Replacement	$360,000

Summary of recommended work:

- Evaluate H & H for lining
- Repoint mortar
- Grout inject scour holes
- Replace pipe

Pantry Brook/Crossing #60	Rehabilitation	$45,000

Summary of recommended work:

- Remove overgrowth
- Stabilize embankments
- Plug seepage paths with concrete
- Install guardrail

Dutton Rd./Crossing #70	Rehabilitation	$120,000

Summary of recommended work:

- Monitor gaps between precast units
- Replace downstream wingwalls

Low Priority:

Roadway/Crossing ID	Rehabilitation/Replacement	Probable Cost
French Rd./Crossing #78	Rehabilitation	$20,000

Summary of recommended work:

- Repoint downstream headwall
- Remove two trees at downstream end

Haynes Rd./Crossing #22 Rehabilitation $100,000

Summary of recommended work:

- Replace upstream embankment with headwall
- Raise and extend guardrail
- Reconstruct downstream headwall, install guardrail

Austin Rd./Crossing #57 Rehabilitation $45,000

Summary of recommended work:

- Remove seven trees
- Spot repointing of masonry and reconstruction of headwalls

Goodnow Rd./Crossing #99 Rehabilitation $25,000

Summary of recommended work:

- Repair inlet control structure via mortar and reconstruction of collapsed stones
- Reconstruct outlet headwall with mortar

Concord Rd./Crossing # 74 Rehabilitation $85,000

Summary of recommended work:

- Remove trees at downstream
- Install riprap to prevent further upstream erosion
- Inject grout in scour areas

Water Row/Crossing # 1 Replacement/TBD $5,000 – 10,000 evaluation
$110,000 for replacement

Summary of recommended work:

- Perform a larger watershed evaluation due to the crossing location in flood prone area

Old Framingham Rd./Crossing #63 Rehabilitation $30,000

Summary of recommended work:

- Fence-off upstream end from pedestrians
- Repoint mortared headwall

Not Ranked:

Roadway/Crossing ID	Rehabilitation/Replacement	Probable Cost
Sherman Bridge/Crossing #16	TBD	

Summary of recommended work:

- Review recent inspections and/or perform new inspection to determine replacement/repair

Old Sudbury Rd./Crossing #146 TBD $150,000

Summary of recommended work:

- Jet line
- Dig out downstream end

Unnamed Rd./Crossing #64 TBD

Summary of recommended work:

- Repair downstream channel walls
- Evaluate crossing after debris are jetted

Brimstone Lane/Crossing #160 TBD

Summary of recommended work:

- Evaluate crossing after debris are jetted

Union Ave./Crossing #95 TBD

Summary of recommended work:

- Follow MassDOT recommendations

    - Action Type: Planning, Pre-Disaster
    - Priority Score:
    - Lead: Department of Public Works
    - Supporting: Engineering/MassDOT
    - Time Frame: Long term
    - Financing Options: Sudbury Capital improvement Plan
    - Cost Estimate: Significant
    - Benefit: Improved public safety, Maintain viable evacuation routes, Reduced damages to private property, Minimized cleanup costs
    - Vulnerable Area: Drainage Infrastructure, Water Supply

EMERGENCY SERVICES

Action #11

Reconfigure generators at Lincoln-Sudbury High School to include heating capability.

2010 HMP Action #12

Reconfigure generators at Lincoln-Sudbury High School to include heating. Fit all school buildings with stationary, multi-fuel generators to allow for emergency use as evacuation shelters Estimated cost for reconfiguration would be approximately $50,000 per site.

- Action Type: Mitigation, Pre-Disaster
- Priority Score:
- Lead: Emergency Management/Fire
- Supporting: Department of Public Works
- Time Frame: Medium term
- Financing Options: Sudbury Capital Improvement Plan
- Cost Estimate: Significant
- Benefit: Improved public safety, Enhanced emergency response
- Vulnerable Area: Emergency Response

Action #12
Install a large-capacity, multi-fuel generator at the Curtis Middle School.

2010 HMP Action #13

Install a large capacity, multi-fuel generator at the Curtis Middle School, an Emergency Evacuation Center.

- Action Type: Mitigation, Pre-Disaster
- Priority Score:
- Lead: Emergency Management/Fire
- Supporting: Department of Public Works
- Time Frame: Medium term
- Financing Options: Sudbury Capital Improvement Plan
- Cost Estimate: Significant
- Benefit: Improved public safety, Enhanced emergency response
- Vulnerable Area: Emergency Response

Action #13
Improve emergency response planning and communication.

2019 MVP top priority

a.) Increase capacity and support for Citizen's Emergency Response team (CERT) and Medical Reserve Corps (MRC) recruitment
b.) Training and communication protocol for hospitals and healthcare agencies
c.) Educate community on Reverse 911
d.) Assess needs of vulnerable populations to understand sheltering needs (Know Your Neighbor)
e.) Maintain database of vulnerable populations and address data privacy/sharing challenges

- Action Type: Mitigation, Pre-Disaster
- Priority Score:
- Lead: Emergency Management/Fire
- Supporting: Department of Public Works
- Time Frame: Medium term
- Financing Options: N/A
- Cost Estimate: Staff time
- Benefit: Improved public safety, Enhanced emergency response
- Vulnerable Area: Communications/Emergency Response

Action #14
Strengthen Emergency Shelters (Schools, Libraries, Community Center).

2019 MVP top priority

a.) Install air conditioning
b.) Install charging stations (cell phones)

- Action Type: Mitigation, Pre-Disaster
- Priority Score:
- Lead: Emergency Management/Fire
- Supporting: Department of Public Works
- Time Frame: Medium term
- Financing Options: Sudbury Capital Improvement Plan
- Cost Estimate: Significant
- Benefit: Improved public safety, Enhanced emergency response
- Vulnerable Area: Communications/Emergency Response

Action #15
Address the necessary expansion/improvements of Fire Stations No. 2 and No. 3.

2019 MVP

Originally constructed in the early 1960's, both Stations create challenges to modern firefighting. Both do not fit modern fire trucks, which are longer, wider and taller. The apparatus bays are too narrow for equipment and create difficult paths for firefighters to maneuver, and the current design of both makes it difficult to house firefighters of both genders (one restroom/shower facility and one bunkroom that accommodates two beds).

Over the past 25 years, Sudbury's population has grown significantly. The Department estimates an additional 348 calls per year, a 15% increase. Over time, the Department has added additional personnel, vehicles and equipment to handle these increases.

- Action Type: Planning, Pre-Disaster
- Priority Score:
- Lead: Emergency Management/Fire
- Supporting: Department of Public Works
- Time Frame: Long term
- Financing Options: Sudbury Capital Improvement Plan
- Cost Estimate: Significant
- Benefit: Improved public safety, Enhanced emergency response
- Vulnerable Area: Fire Management, Emergency Response

PLANNING AND PREVENTION

Action #16
Enhance Flood Plain Bylaw enforcement assistance.

2010 HMP Action #1

The Conservation Commission has been dealing with a flood plain filling case at 1030 Concord Road. Currently, the Commission must pay all enforcement and legal fees associated with such cases using only Notice of Intent filing fees and it has requested that the town consider adding a legal funding mechanism under either the Wetlands Bylaw or the Flood Plain and Water Resource Protection Bylaws.

- Action Type: Mitigation, Pre-Disaster

- Priority Score:
- Lead: Planning and Community Development
- Supporting: Conservation Commission
- Time Frame: Short term
- Financing Options: N/A
- Cost Estimate: Staff time
- Benefit: Minimized municipal costs
- Vulnerable Area: Wetlands/Resource Areas

Action #17
Relocate overhead electrical/cable lines underground.

2010 HMP Action #28
2019 MVP top priority

Complementing the need for a Tree Maintenance and Forest Management Plan discussed previously, projected increases in severe weather events due to climate change, and the existing amount of natural tree coverage, the Town should consider relocating overhead electrical and cable lines underground. The plan should address the following:

a.) Burying lines underground as roads are repaved
b.) Establishing tree/buffer management
c.) Evaluating funding resources
    i. Rate-payer funding
    ii. MA Surcharge Program
    iii. Solar facilities

- Action Type: Mitigation, Pre-Disaster
- Priority Score:
- Lead: Department of Public Works
- Supporting: Building Department
- Time Frame: Long term
- Financing Options: Sudbury Capital Improvement Plan, Rate-Payer funding, MA Surcharge Program, Solar facilities
- Cost Estimate: Significant
- Benefit: Improved public safety, Enhanced emergency response
- Vulnerable Area: Emergency Response, Communications

Action #18
Conduct feasibility study to investigate options for all public buildings to be earthquake proof.

2010 HMP Action #29

- Action Type: Mitigation, Pre-Disaster
- Priority Score:
- Lead: Department of Public Works
- Supporting: Fire Department
- Time Frame: Long term

- Financing Options: Sudbury Capital Improvement Plan
- Cost Estimate: Moderate
- Benefit: Public safety, Minimize economic/social damages
- Vulnerable Area: Municipally owned structures

STAPLEE ANALYSIS Findings

2019 Action Number	Title	Cost/ Benefit	Social	Technical	Administrative	Political	Legal	Economic	Environmental	Total	Prioritization
PROPERTY PROTECTION											
2019 - 1	Design Standards - Earth Removal Bylaw	Cost	2	2	2	2	2	2	0	12	
		Benefit	1	1	2	1	2	2	2	11	**23**
NATURAL RESOURCE PROTECTION											
2019 - 2	New Regulations for Roof Runoff and Sidewalk Recharge	Cost	2	1	2	1	2	1	0	9	
		Benefit	2	1	2	1	2	1	2	11	**20**
2019 - 3	Devote Resources to Monitoring Privately-Owned Drainage Facilities	Cost	-1	-1	-1	0	0	0	0	-3	
		Benefit	1	1	1	1	1	1	1	7	**4**
2019 - 4	Incorporate Science/Climate Change Projections Into Existing Regulations	Cost	-1	0	-1	-1	0	0	0	-3	
		Benefit	2	1	1	1	1	1	1	8	**5**
2019 - 5	Tree Preservation Bylaw	Cost	1	0	-1	1	0	0	0	1	
		Benefit	2	1	1	2	-1	1	2	8	**9**
2019 - 6	Tree Maintenance and Forest Management Plan	Cost	1	0	-1	1	0	-1	0	0	
		Benefit	2	2	1	2	1	2	2	12	**12**
STRUCTURAL PROJECTS											
2019 - 7	Elevate Concord Road Two Feet (3 Locations)	Cost	2	1	-1	0	-1	1	-1	1	
		Benefit	2	2	2	1	0	1	-1	7	**8**
2019 - 8	Pantry Brook Dam Removal/Repairs/Operations and Management Plan	Cost	0	-1	0	0	-1	0	0	-2	
		Benefit	2	1	0	0	-1	1	1	4	**2**
2019 - 9	Improve/Upgrade Drainage Infrastructure/Capacity	Cost	1	0	-1	1	-1	1	2	3	
		Benefit	2	2	0	2	0	2	2	10	**13**
EMERGENCY SERVICES											
2019 - 10	Install Generators at Lincoln-Sudbury High School to Include Heating	Cost	0	2	1	1	-1	2	0	5	
		Benefit	2	2	2	2	0	2	0	10	**15**
2019 - 11	Install Large Capacity Generator at Curtis Middle School	Cost	0	2	1	2	2	2	0	9	
		Benefit	2	2	2	2	2	2	0	12	**21**
2019 - 12	Improve Emergency Response Planning	Cost	2	2	-1	1	0	0	0	4	
		Benefit	2	2	1	1	2	2	0	10	**14**
2019 - 13	Strengthen Emergency Shelters	Cost	2	0	2	2	2	1	0	9	
		Benefit	2	2	2	2	2	2	0	12	**21**

2019 Action Number	Title	Cost/ Benefit	Social	Technical	Administrative	Political	Legal	Environmental	Economic	Total	Prioritization
EMERGENCY SERVICES											
2019 - 14	Address Expansion/Improvements to Fire Stations 2, 3	Cost	1	1	-1	1	0	1	0	3	
		Benefit	2	2	2	2	2	1	1	12	**15**
PLANNING AND PREVENTION											
2019 - 15	Enhance Flood Plain Bylaw Enforcement Assistance	Cost									
		Benefit									
2019 - 16	Relocate Overhead Electrical/Cable Lines Underground	Cost	2	-1	-1	-1	-1	-1	-1	-4	
		Benefit	2	-1	1	0	0	-1	0	1	**-3**
2019 - 17	Feasibility Study for Earthquake Proof Public Buildings	Cost	-1	2	-1	1	2	-1	0	2	
		Benefit	-1	1	0	0	2	1	0	3	**5**

Part 2: Prioritize Actions – Quantitative Method
Method C – Simple Score

Criterion:	Cost	Benefit
Social: Is the action compatible with present and future local community needs and values? - Is the proposed action socially acceptable to the community? - Are there equity issues involved that would mean that one segment of a community is treated unfairly? - Will the action cause social disruption?		
Technical: Is the action feasible with available local resources (or as supplement by outside resources as necessary)? - Will the proposed action work? - Will it create more problems than it solves? - Does it solve a problem or a symptom? - Is it the most useful action in light of other community goals?		
Administrative: Does the community have the administrative capacity to implement the action? - Can the community implement the action? - Is there someone to coordinate and lead the effort? - Is there sufficient funding, staff, and technical support available? - Are there ongoing administrative requirements that need to be met?		
Political: Is there strong public support to implement and maintain the action? - Is the action politically acceptable? - Is there public support both to implement and to maintain the project?		
Legal: Does the community have the legal authority to implement the action? - Are there legal side effects (taking)? - Is the action allowed via Comprehensive Plan, or does it need to be amended? - Will the community be liable for the action? - Will the activity be challenged?		
Economic: Is the action cost-effective? - What are the costs and benefit of the action? - Do the benefits exceed the costs? - Are initial, maintenance, and administrative costs taken into account? - Has funding been secured for the proposed action? - What burden will this action place on the tax base of local economy? - Does the action contribute to other community goals?		
Environmental: Does the action impact environmental resources, and is the impact positive, negative, or neutral? - Will the action need environmental regulatory approvals? - Will it meet local and state regulatory requirements?		
Sub-total		
Priority/Total Score		

Ranking Descriptions:
Very Beneficial: 2
Favorable: 1
Not Applicable: 0
Not Favorable: -1

Public Workshop #2: January 29, 2020

WEDNESDAY
JANUARY 29, 2020
6:30 – 8:30 PM

Sudbury Town Hall
322 Concord Road
Sudbury, MA

JANUARY 29, 2020
PUBLIC WORKSHOP

Public Workshop – Hazard Mitigation Plan Update

The Town is currently updating the 2010 Hazard Mitigation Plan. This plan is important because it helps the Town remain eligible to receive funding for projects that reduce the risk of injury or damage to property from future natural hazard events such as flooding and hurricanes. Please join us to hear about the progress on the plan's update, learn about the mitigation actions for inclusion in the plan's update and contribute to the process.

For more information on the hazard mitigation plan update, please visit: https://sudbury.ma.us/fire/hazard-mitigation-plan/.

Sudbury Hazard Mitigation Plan

Public Workshop #2

Sudbury Town Hall
322 Concord Road
Sudbury, MA

Agenda

1. Overview
2. Why Hazard Mitigation Planning?
3. Mission Statement/Goals
4. Hazard Index
5. Hazard Vulnerabilities
6. Mitigation Actions
7. Questions/Comments

Town of Sudbury, MA

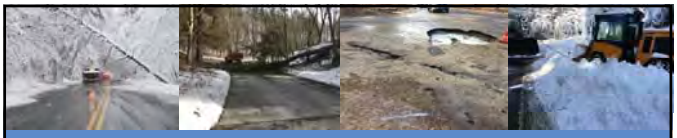
Hazard Mitigation Plan Public Workshop #2

Sudbury Town Hall
322 Concord Road

January 29, 2020 6:30 AM - 8:30 PM

Name	Email Address
DAN NASON	nasond@sudbury.ma.us
John Whalen	WhalenJ@Sudbury.ma.us.
Bill Barletta	BarlettaW@sudbury.MA.US
Tim Choate	Choatet@Sudbury.MA.US
Beth Suedmeyer	suedmeyerb@sudbury.ma.us
Chris Pereira	cpereira@horsleywitten.com
ANDREW LEWIS	LEWISA@Sudbury.MA.US
MARIE ROYEA	@GMAIL
Charlie Russo	charlierusso@gmail.com

Horsley Witten Group
www.horsleywitten.com



Sudbury, MA
2010 Hazard Mitigation Plan Update
Public Workshop

Craig Pereira, CFM
Project Manager – Horsley Witten Group

January 29, 2020 6:30 PM
Sudbury Town Hall

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Sudbury
Local Hazard Mitigation Committee

- John Whalen, Sudbury Fire Chief
- Beth Suedmeyer, Environmental Planner
- Adam Duchesneau, Director of Planning and Community Development
- Dan Nason, Director of Public Works
- Bill Murphy, Health Director
- Bill O'Rourke, Deputy Director of Public Works
- Bill Barletta, Facilities Director
- Andrew Lewis, Building Inspector
- Vin Roy, Executive Director Sudbury Water District
- Marie Royea, Citizen's Emergency Response Team
- Heather Tecce, Sustainable Sudbury/MEMA
- Jeff Zukowski, MEMA
- Craig Pereira, Project Manager – Horsley Witten Group

2

Why Hazard Mitigation Planning

Disaster Mitigation Act of 2000, Interim Final Rule, 44 CFR Parts 201 and 206 states, "All communities must have an approved Multiple Hazards Mitigation Plan in order to qualify for future federal disaster mitigation grants".

Reduction or elimination of long-term risk to life, property, and the environment.

3

Mission Statement

The purpose of the Sudbury Hazard Mitigation Plan is to preserve the quality of life, property values, natural and historic resources by identifying all potential natural hazards impacting the community and mitigating their effects to reduce loss of life, as well as, losses of economic, natural, and historic resources.

4

Mitigation Process

- Assess Risks
- Establish Goals
- Identify Projects/Actions
- Update/Maintain Plan

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Risk Assessment…Hazards

- Flood-Related
- Winter-Related
- Wind-Related
- Geologic-Related
- Drought-Related
- Urban Fire/Wildfire-Related
- Invasive Species-Related

Climate Change…

As one of the most pressing issues with both direct and indirect impacts on the range of natural hazards the town is vulnerable to, it has been included as a 'climate change impacts on' section to each natural hazard profiled.

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Hazard Index

Natural Hazard	Frequency (i.e. Very Low, Low, Medium, High)	Location (i.e. small/local, medium/regional, large/multiple communities)	Severity (i.e. minor, serious, extensive, catastrophic)	Hazard Index (i.e. ranked by combining frequency and severity, 10 - high, 1 - low)
Flood-Related Hazards				
• Riverine/Flash Flooding	Low	Medium/Regional	Serious	3
• Inland/Urban Flooding/Heavy Rain	High	Medium/Regional	Extensive	7
• Climate Change	Medium	Large/Multiple	Serious	6
• Dam Failures	Low	Small/Local	Serious	4
Winter-Related Hazards				
• Blizzards/ Snow/Ice/ Sleet	High	Large/Multiple	Extensive	7
• Ice	Low	Medium/Regional	Serious	4
• Extreme Cold	Low	Medium/Regional	Serious	4
Wind-Related Hazards				
• Hurricanes	High	Large/Multiple	Extensive	7
• Tornadoes/ High Winds	High	Medium/Regional	Serious	6
• Lightning/ Thunderstorms	High	Local	Minor	5
• Hail	High	Local	Minor	5
Geologic-Related Hazards				
• Earthquakes	Low	Medium/Regional	Extensive	4
• Landslides	Low	Local	Minor	3
Drought				
• Drought	High	Medium/Regional	Serious	6
• Extreme Heat	Low	Medium/Regional	Serious	4
Urban Fire/Wildfire				
• Urban Fire/Wildfire	Medium	Small/Local	Minor	4
Invasive Species				
• Multiple	Low	Small/Local	Minor	1

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Risk Assessment…Vulnerability

- Economic
- Social
- Environmental

Hazard	Frequency	Severity
Flood-Related Hazards	High	Extensive
Winter-Related Hazards	High	Extensive/Serious
Wind-Related Hazards	High	Extensive/Serious
Geologic-Related Hazards	Low	Extensive
Drought	High	Serious
Urban Fire/Wildfire	Medium	Minor
Invasive Species	Low	Minor

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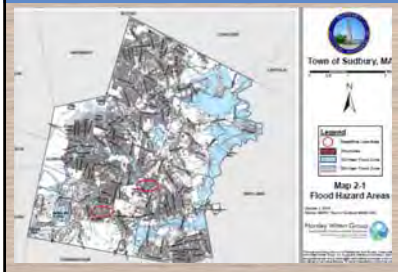
Economic Vulnerability



FEMA 100-Year Flood Zone Impacts
- Number of Parcels: 882
- Economic Impacts: $566,333,882

FEMA 500-Year Flood Zone Impacts
- Number of Parcels: 1,270
- Economic Impacts: $795,974,100

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Social Vulnerability

- Public Infrastructure and Emergency Lifelines
  - There are a number of public buildings and structures located in the flood plain.
  - Various access roads for these buildings and structures also flood from time to time.
- Evacuation and Population at Risk
  - Fairbank Center: Primary shelter for heating, cooling, phone charging and evacuation point, with capability to provide food services.
  - St. Anselm's Church – Secondary shelter (no generator)
- Town is currently working with Concord and Wayland to develop MOUs for backup shelters (Harvey Wheeler Community Center/Wayland Middle School)

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Environmental Vulnerability

Direct Impacts
- Loss of habitat
- Salinization of land and groundwater

Indirect Impacts
- Inland damage to the built environment
- Threats to ecosystems and species
- Contamination of potable water

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Capability Assessment

- Planning and Regulatory
  - Sudbury Master Plan, Open Space and Recreation Plan, Subdivision Regulations, Stormwater Management Bylaw, Flood Plain Overlay District, Wetlands Protection Bylaw and State Building Code
- Administrative and Technical
  - Local Emergency Planning Committee, Medical Reserve Corps, Community Emergency Response Team, Comprehensive Emergency Management Plan, Municipal Staff/Website, MVP Working Group, coordination with neighboring communities and the Sudbury/Assabet/Concord River Watershed Cooperative Invasive Species Management Association
- Financial (grants)
  - Federal/State opportunities

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Goals

- Protect the public's health, safety and welfare.
- Reduce property damages caused by hazard impacts.
- Minimize social distress and economic losses/business disruption.
- Provide an ongoing forum for the education and awareness of natural hazard mitigation issues, programs, policies, projects and resources.

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Mitigation Strategy

- Carry Over from Existing Plan
- MVP Process
- Regulatory Review Process
- LHMC Actions

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Prioritization of Actions...STAPLEE

- **Social**...is the action socially acceptable?
- **Technical**...is the action technically feasible and provide appropriate level of protection?
- **Administrative**...does the Town have the capability to complete the action?
- **Political**...will the Town support or oppose the project?
- **Legal**...does the Town have the legal authority to complete the action?
- **Economic**...is the action cost-effective?
- **Environmental**...will the action affect the natural environment?

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Mitigation Actions

Categories

- Public Education and Awareness
- Property Protection
- Natural Resource Protection
- Structural Projects
- Emergency Services
- Planning and Prevention

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Mitigation Actions

Time Frames

- Short Term: 0 – < 6 months
- Medium Term: > 6 – < 18 months
- Long Term: 18 months – 5 years

Cost Ranges

- Staff Time: Municipal personnel time
- Minimal: < $5,000
- Moderate: > $5,000 but < $25,000
- Significant: > $25,000

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Mitigation Actions

PROPERTY PROTECTION

Action #1

Incorporate design standards for earth removal into the Zoning Bylaw (strengthen Earth Removal Bylaw) and Subdivision Rules and Regulations (Site Plan Review) to minimize vegetation, slope and land disturbance.

Incorporate design standards into the Zoning Bylaw and Subdivision Rules and Regulations that limit the area of alteration, prohibit alteration of steep slopes, and limit the removal of existing vegetation or trees on a site.

Action Type: Planning, Pre-Disaster
Priority Score: 23...2010 HMP/2019 MVP Code Review

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Mitigation Actions

NATURAL RESOURCE PROTECTION

Action #2

Incorporate new regulations for runoff (roof) and hardscape (sidewalk) recharge into the Zoning Bylaw/Water Resource Protection District regulations.

Roof Runoff Recharge:
Require roof runoff to be recharged within the Zone II.
Hardscape (Sidewalk) Recharge:
Allow sidewalks in the Village Business District to be constructed of pervious/porous materials.

Action Type: Planning, Pre-Disaster
Priority Score: 20…2010 HMP/2019 MVP Code Review

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Mitigation Actions

NATURAL RESOURCE PROTECTION

Action #3

Devote more resources to monitoring privately-owned drainage facilities.

Action Type: Planning, Pre-Disaster
Priority Score: 4…2010 HMP

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Mitigation Actions

NATURAL RESOURCE PROTECTION

Action #4

Incorporate latest science and climate change projections as a consideration into existing regulations to reduce flooding and water quality impacts, in addition to protecting water supply during periods of drought.

Stormwater Bylaw
Investigate options for increasing design volumes for stormwater practices/conveyances design.
Outdoor Water Use Bylaw
Limit non-essential outdoor water use during periods of drought.

Action Type: Planning, Pre-Disaster
Priority Score 5…2019 MVP/MVP Code Review

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Mitigation Actions

NATURAL RESOURCE PROTECTION

Action #5

Incorporate standards for tree preservation into the Zoning Bylaw (Tree Preservation Bylaw) and Subdivision Rules and Regulations (Site Plan Review) to maximize tree preservation/limit site disturbance and character throughout the community.

Establish a Tree Preservation Bylaw - an effective mechanism to regulate tree preservation on both public property as well as private property.

Action Type: Planning, Pre-Disaster
Priority Score 9…2019 MVP Code Review

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Mitigation Actions

NATURAL RESOURCE PROTECTION

Action #6

Develop a Tree Maintenance and Forest Management Plan.

Given the projected increase in severe weather events due to climate change, and the existing amount of natural tree coverage, a plan for regular tree trimming, dead tree removal and re-forestation plan is needed.

Action Type: Planning, Pre-Disaster
Priority Score 12…2010 HMP/2019 MVP

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Mitigation Actions

STRUCTURAL PROJECTS

Action #7

Elevate the grade of Concord Road two feet in three separate locations:

Water Row Road (Concord Road between Lincoln Rd. and Old Sudbury Rd.):
The project would require an initial compensatory storage study as wetland resources near Lincoln Road and Route 27 would be impacted, in addition to the actual elevation of Water Row itself.
Eastern end of Concord Road:
Sheet flow back up may be related to water releases at DFW Pantry Brook Dam.
Near Nashawtuc Country Club:
Flooding occurs once every five years on average and impacts the country club area.

Action Type: Mitigation, Pre-Disaster
Priority Score: 8…2010 HMP

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Mitigation Actions

STRUCTURAL PROJECTS

Action #8

Evaluate the potential removal of Pantry Brook Dam first, then, if not deemed appropriate, complete repairs and develop an Operations & Management Plan.

Owned and operated by Mass Fish and Wildlife, the structure is in need of repairs and the establishment of a regular maintenance program.

Action Type: Planning, Pre-Disaster
Priority Score: 2…2010 HMP

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Mitigation Actions

STRUCTURAL PROJECTS

Action #9

Improve/Upgrade drainage infrastructure and capacity.

The Department of Public Works has developed a Culvert Capital Improvement Plan to address deficient drainage systems throughout the town. The Town should consider Low Impact Development (LID) and Green Infrastructure (GI) techniques when implementing this plan.

Action Type: Planning, Pre-Disaster
Priority Score: 13…2010 HMP/2019 MVP

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Mitigation Actions

EMERGENCY SERVICES

Action #10

Install generators at Lincoln-Sudbury High School to include heating capability.

Reconfigure generators at Lincoln-Sudbury High School to include heating. Fit all school buildings with stationary, multi-fuel generators to allow for emergency use as evacuation shelters.

Action Type: Mitigation, Pre-Disaster
Priority Score: 15…2010 HMP

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Mitigation Actions

EMERGENCY SERVICES

Action #11

Install a large-capacity, multi-fuel generator at the Curtis Middle School.

Install a large capacity, multi-fuel generator at the Curtis Middle School, to serves as an additional Emergency Evacuation Center.

Action Type: Mitigation, Pre-Disaster
Priority Score: 21…2010 HMP

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Mitigation Actions

EMERGENCY SERVICES

Action #12

Improve emergency response planning and communication.

- Increase capacity and support for Citizen's Emergency Response team (CERT) and Medical Reserve Corps (MRC) recruitment
- Training and communication protocol of hospitals and healthcare agencies
- Educate community on Reverse 911
- Assess needs of vulnerable populations to understand sheltering needs (Know Your Neighbor)
- Maintain database of vulnerable populations and address data privacy/sharing challenges

Action Type: Mitigation, Pre-Disaster
Priority Score: 14…2019 MVP

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Mitigation Actions

EMERGENCY SERVICES

Action #13

Strengthen Emergency Shelters (Schools, Libraries, Community Center).

- Install air conditioning
- Install charging stations (cell phones)

Action Type: Mitigation, Pre-Disaster
Priority Score: 21…2019 MVP

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Mitigation Actions

EMERGENCY SERVICES

Action #14
Address the necessary expansion/improvements of Fire Stations No. 2 and No. 3.

- Existing stations do not fit modern fire trucks
- Apparatus bays are too narrow to maneuver
- Existing design does not permit housing both genders
- A 15% increase in calls

Action Type: Planning, Pre-Disaster
Priority Score: 15…2019 MVP

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Mitigation Actions

PLANNING AND PREVENTION

Action #15
Relocate overhead electrical/cable lines underground.

Complementing the need for a Tree Maintenance/Forest Management Plan, the Town should consider relocating overhead electrical and cable lines underground.

Action Type: Mitigation, Pre-Disaster
Priority Score: -3…2010 HMP/2019 MVP

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Mitigation Actions

PLANNING AND PREVENTION

Action #16
Conduct feasibility study to investigate options for all public buildings to be earthquake proof.

Action Type: Mitigation, Pre-Disaster
Priority Score: 5…2010 HMP

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Project Schedule

Draft Update available for public comment – **February 2020**

Draft Update to MEMA – **March 2020**

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Contact Us…

Questions and/or comments about the Hazard Mitigation Plan Update, please contact:

John M. Whalen – Fire Chief
Town of Sudbury
77 Hudson Road
Sudbury, MA 01776
WhalenJ@Sudbury.ma.us
Phone: (978) 440-5311

Craig Pereira—Project Manager
Horsley Witten Group
55 Dorrance Street, Suite 200
Providence, RI 02903
cpereira@horsleywitten.com
Phone: (401) 272-1717

Thank You!

Horsley Witten Group

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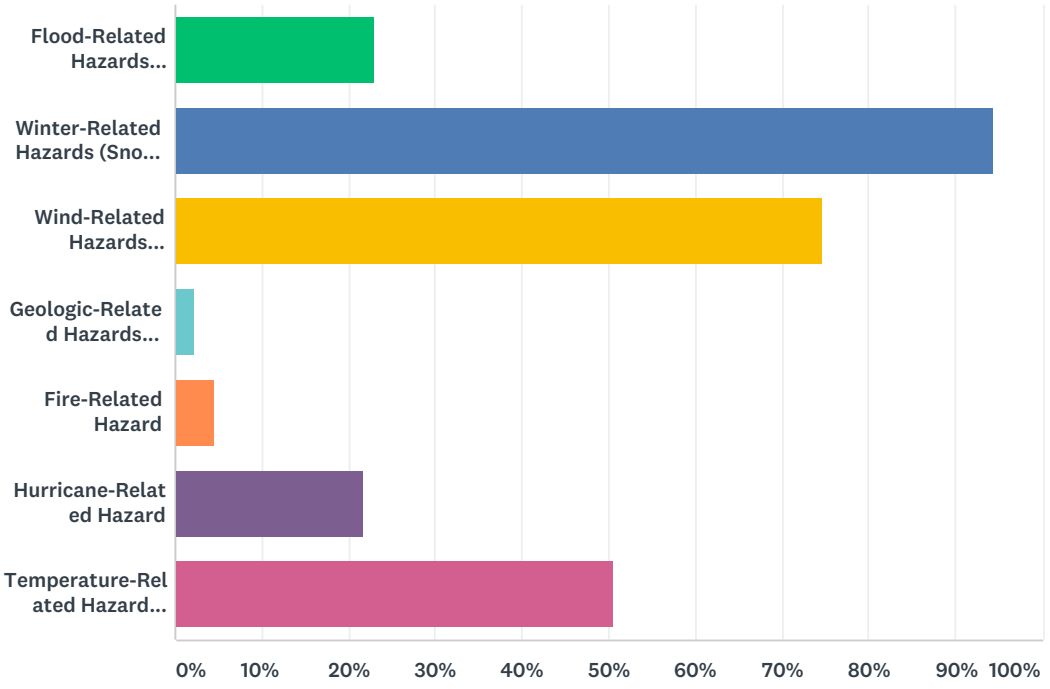
On-Line Survey

Q1 Which of the following hazard events have you or has anyone in your household and/or business experienced in the past 20 years within the Town of Sudbury? (Check all that apply)

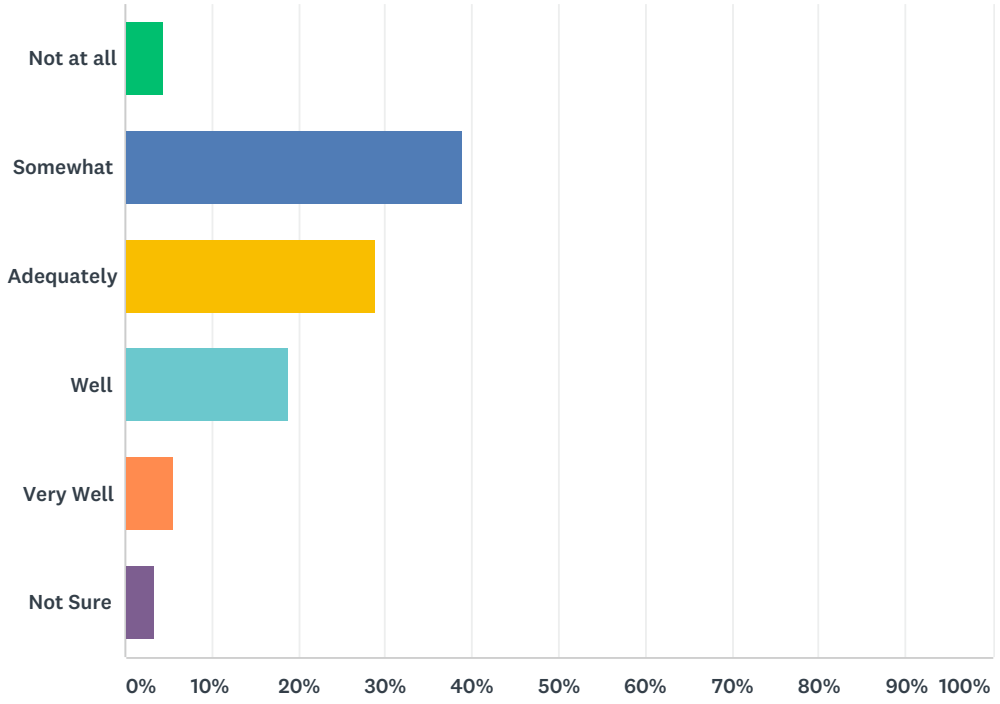
Answered: 87 Skipped: 3



ANSWER CHOICES	RESPONSES	
Flood-Related Hazards (Riverine/Flash Flooding, Inland/Urban Flooding)	22.99%	20
Winter-Related Hazards (Snow, Ice, Extreme Cold)	94.25%	82
Wind-Related Hazards (Tornadoes, High Winds, Lightning/Thunderstorms, Hail)	74.71%	65
Geologic-Related Hazards (Earthquakes)	2.30%	2
Fire-Related Hazard	4.60%	4
Hurricane-Related Hazard	21.84%	19
Temperature-Related Hazard (Extreme Heat, Drought, Extreme Cold)	50.57%	44
Total Respondents: 87		

Q2 In your opinion, how prepared is your household and/or business to deal with a natural hazard event?

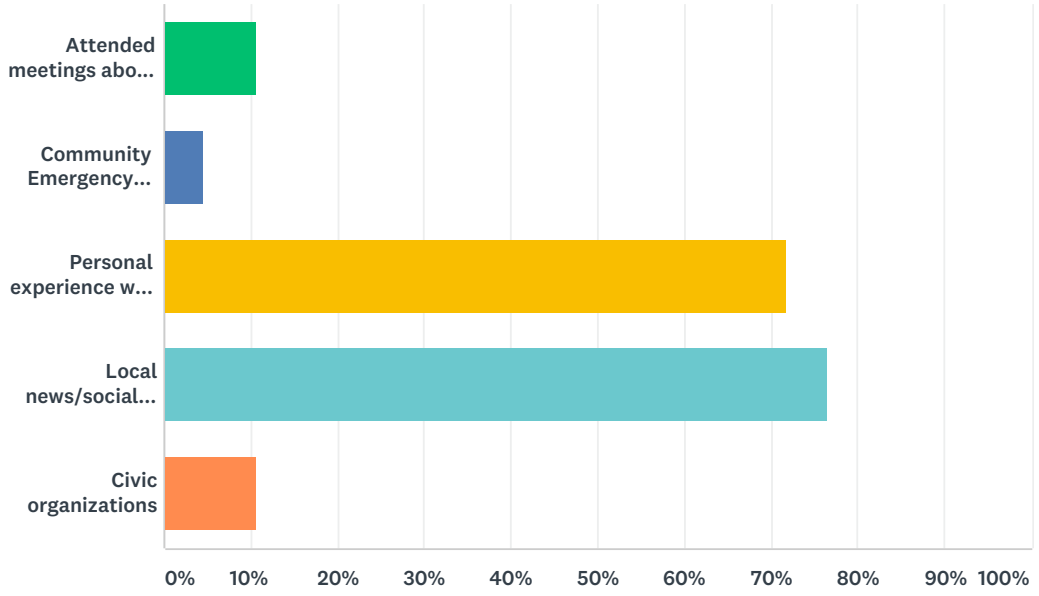
Answered: 90 Skipped: 0



ANSWER CHOICES	RESPONSES	
Not at all	4.44%	4
Somewhat	38.89%	35
Adequately	28.89%	26
Well	18.89%	17
Very Well	5.56%	5
Not Sure	3.33%	3
TOTAL		90

Q3 Which of the following have provided you with useful information to help you prepare for a hazard event? (Check all that apply)

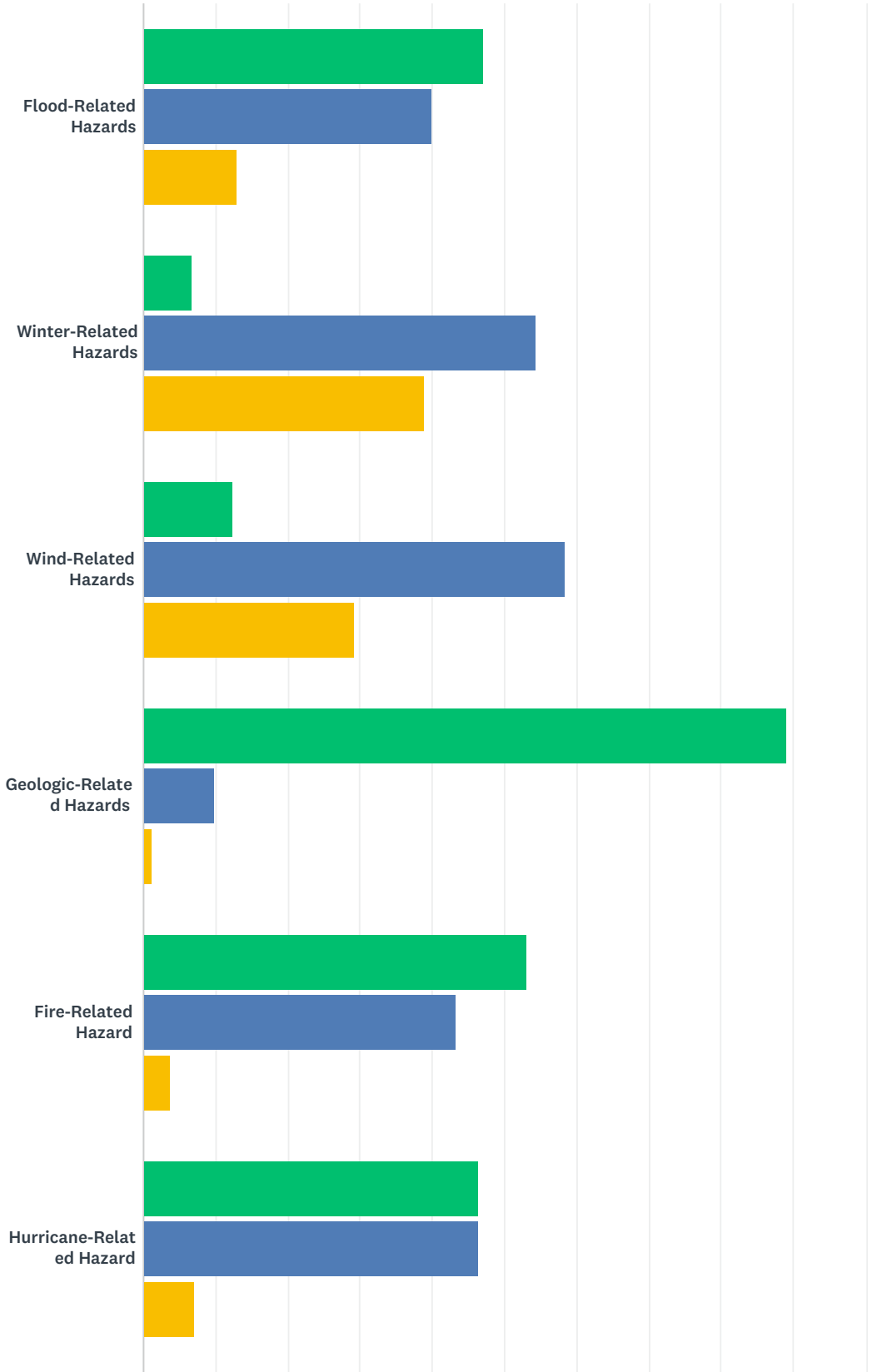
Answered: 85 Skipped: 5

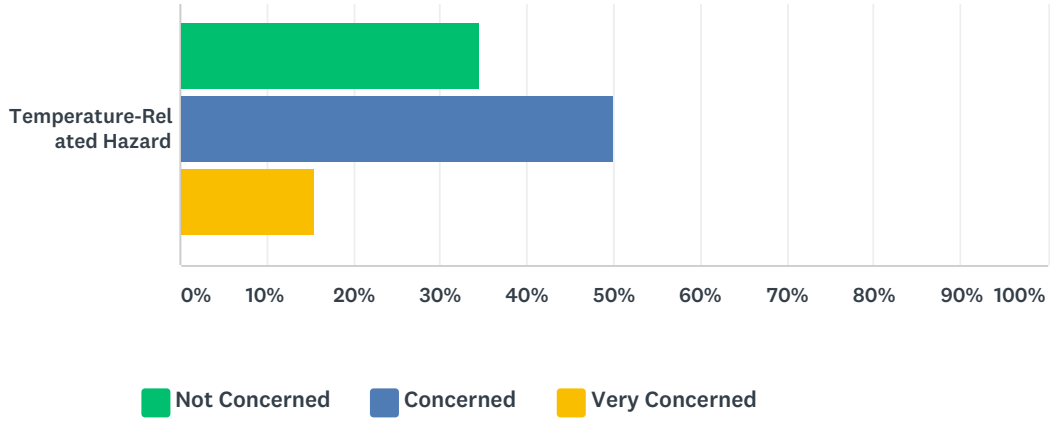


ANSWER CHOICES	RESPONSES	
Attended meetings about disaster preparedness	10.59%	9
Community Emergency Response Training (CERT)	4.71%	4
Personal experience with one or more natural hazards/disasters	71.76%	61
Local news/social media	76.47%	65
Civic organizations	10.59%	9
Total Respondents: 85		

Q4 How concerned are you about the following hazards in the Town of Sudbury? (Check one response for each hazard)

Answered: 90 Skipped: 0

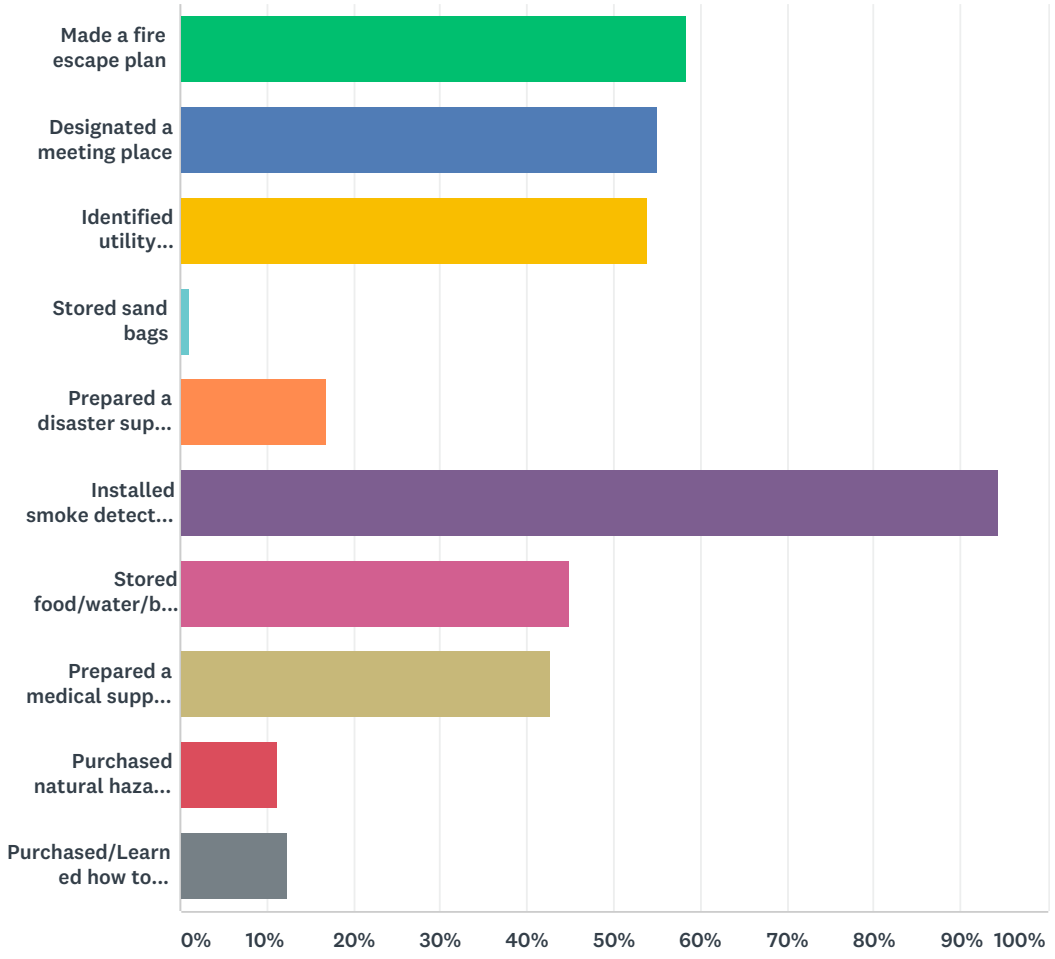




	NOT CONCERNED	CONCERNED	VERY CONCERNED	TOTAL
Flood-Related Hazards	47.06% 40	40.00% 34	12.94% 11	85
Winter-Related Hazards	6.67% 6	54.44% 49	38.89% 35	90
Wind-Related Hazards	12.36% 11	58.43% 52	29.21% 26	89
Geologic-Related Hazards	89.02% 73	9.76% 8	1.22% 1	82
Fire-Related Hazard	53.09% 43	43.21% 35	3.70% 3	81
Hurricane-Related Hazard	46.43% 39	46.43% 39	7.14% 6	84
Temperature-Related Hazard	34.52% 29	50.00% 42	15.48% 13	84

Q5 Which of the following steps has your household and/or business taken to prepare for a hazard event? (Check all that apply)

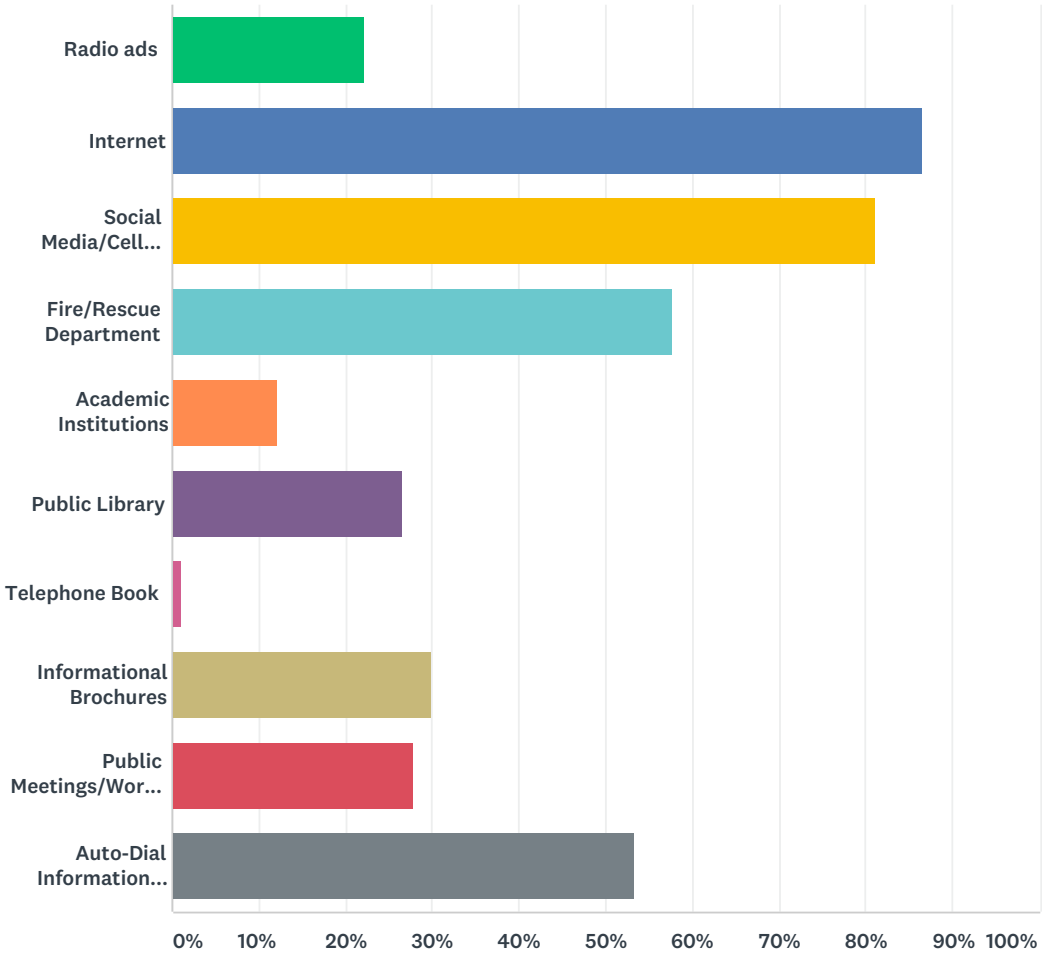
Answered: 89 Skipped: 1



ANSWER CHOICES	RESPONSES	
Made a fire escape plan	58.43%	52
Designated a meeting place	55.06%	49
Identified utility shut-offs	53.93%	48
Stored sand bags	1.12%	1
Prepared a disaster supply kit	16.85%	15
Installed smoke detectors on each level of the house	94.38%	84
Stored food/water/batteries	44.94%	40
Prepared a medical supply kit	42.70%	38
Purchased natural hazard insurance	11.24%	10
Purchased/Learned how to program a NOAA Weather Radio	12.36%	11

Q6 In your opinion, which of the following methods do you think are most effective for providing hazard and disaster information? (Check all that apply)

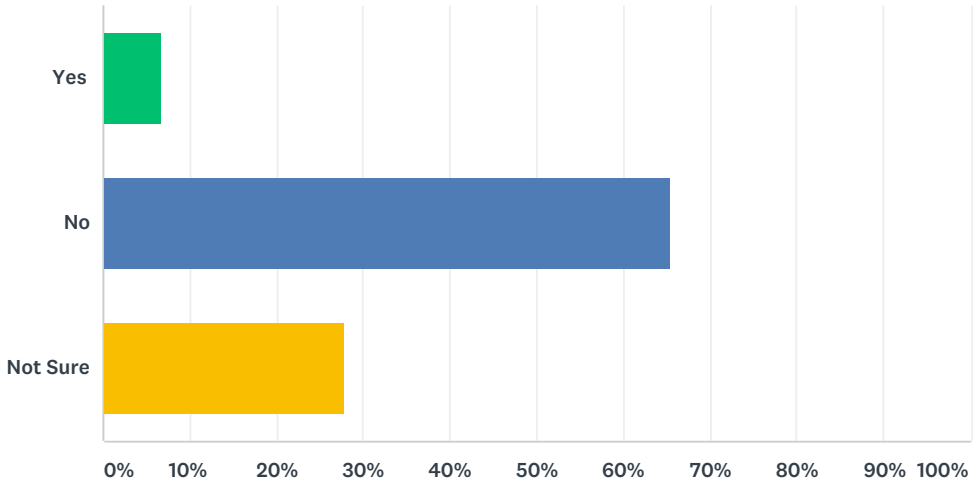
Answered: 90 Skipped: 0



ANSWER CHOICES	RESPONSES	
Radio ads	22.22%	20
Internet	86.67%	78
Social Media/Cell phone apps.	81.11%	73
Fire/Rescue Department	57.78%	52
Academic Institutions	12.22%	11
Public Library	26.67%	24
Telephone Book	1.11%	1
Informational Brochures	30.00%	27
Public Meetings/Workshops	27.78%	25
Auto-Dial Information (Code Ready or similar)	53.33%	48

Q7 Is your property located in or near a FEMA designated floodplain?

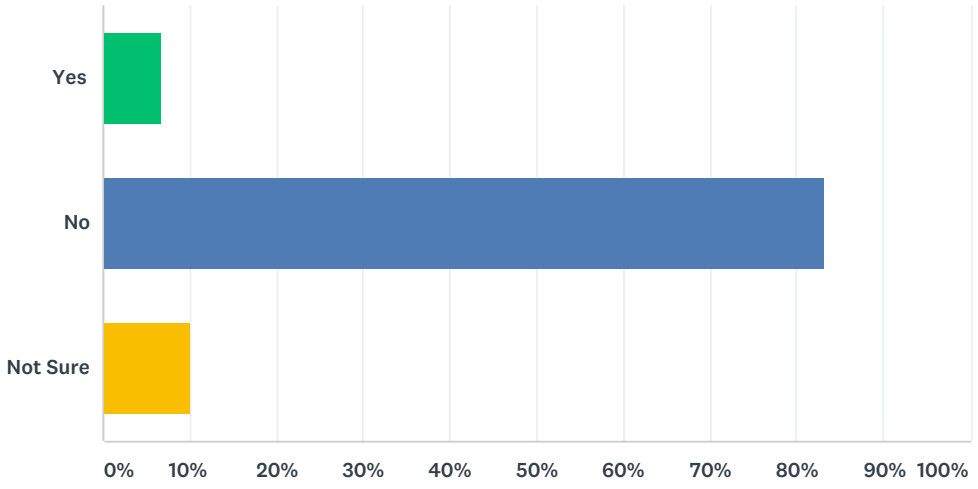
Answered: 90 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	6.67%	6
No	65.56%	59
Not Sure	27.78%	25
TOTAL		90

Q8 Do you have flood insurance?

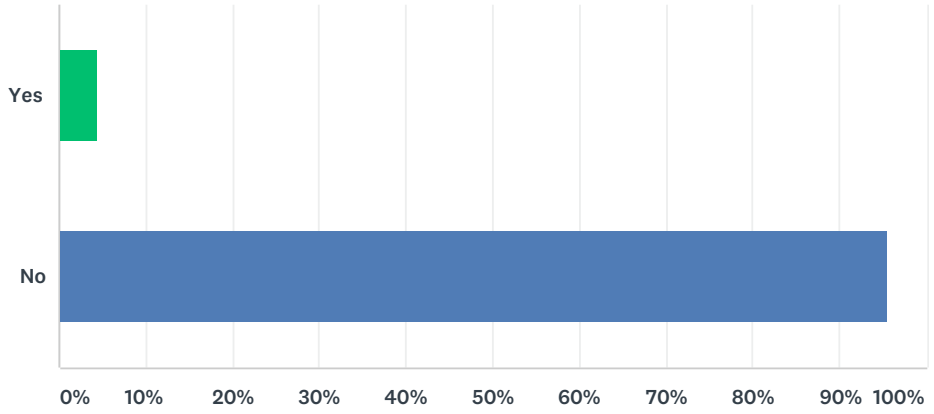
Answered: 90 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	6.67%	6
No	83.33%	75
Not Sure	10.00%	9
TOTAL		90

Q9 Do you have any special access or functional needs within your household and/or business that would require early warning or specialized response during disasters?

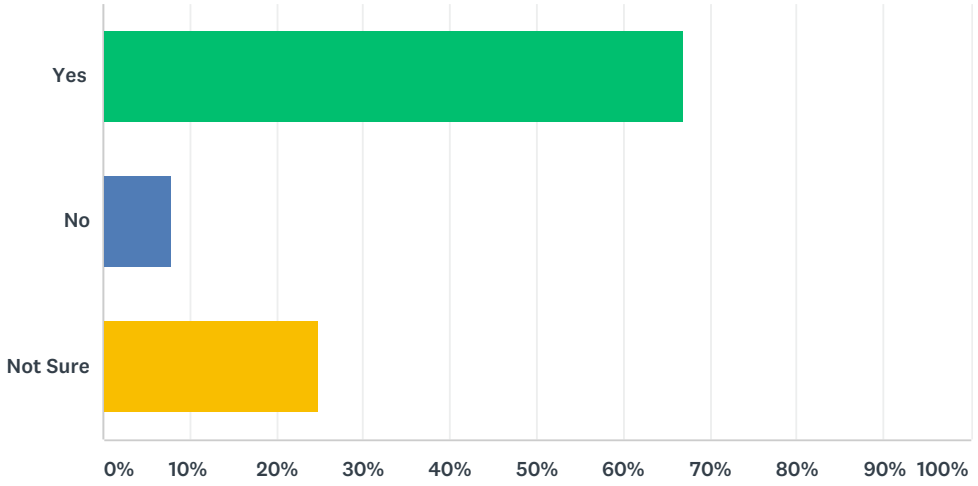
Answered: 90 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	4.44%	4
No	95.56%	86
TOTAL		90

Q10 Are you interested in making your home, business or neighborhood more resistant to hazards?

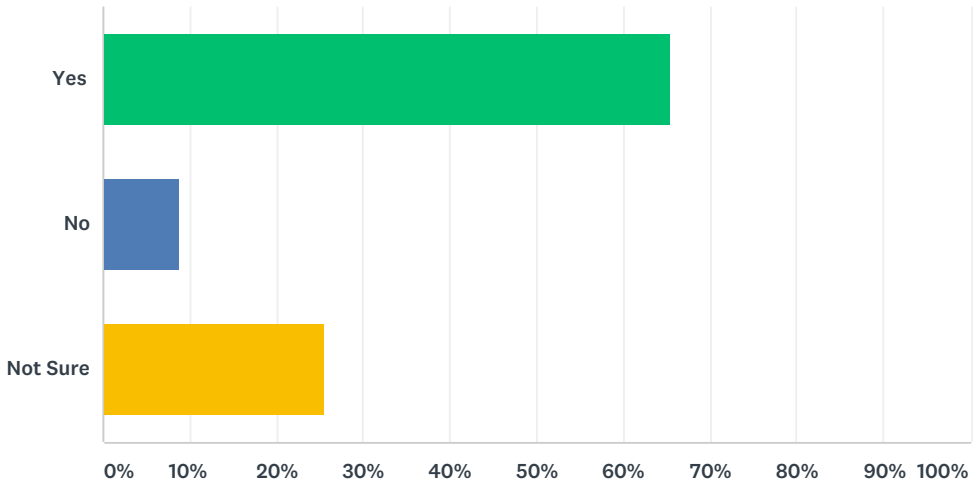
Answered: 88 Skipped: 2



ANSWER CHOICES	RESPONSES	
Yes	67.05%	59
No	7.95%	7
Not Sure	25.00%	22
TOTAL		88

Q11 Would you be willing to spend your own money on your current home and/or business to help protect it from impacts of potential future natural disasters within the community? Examples could include: Elevating a flood-prone home; Elevating utilities in flood-prone basements; Strengthening your roof, siding, doors, or windows to withstand high winds; Removing trees/low branches.

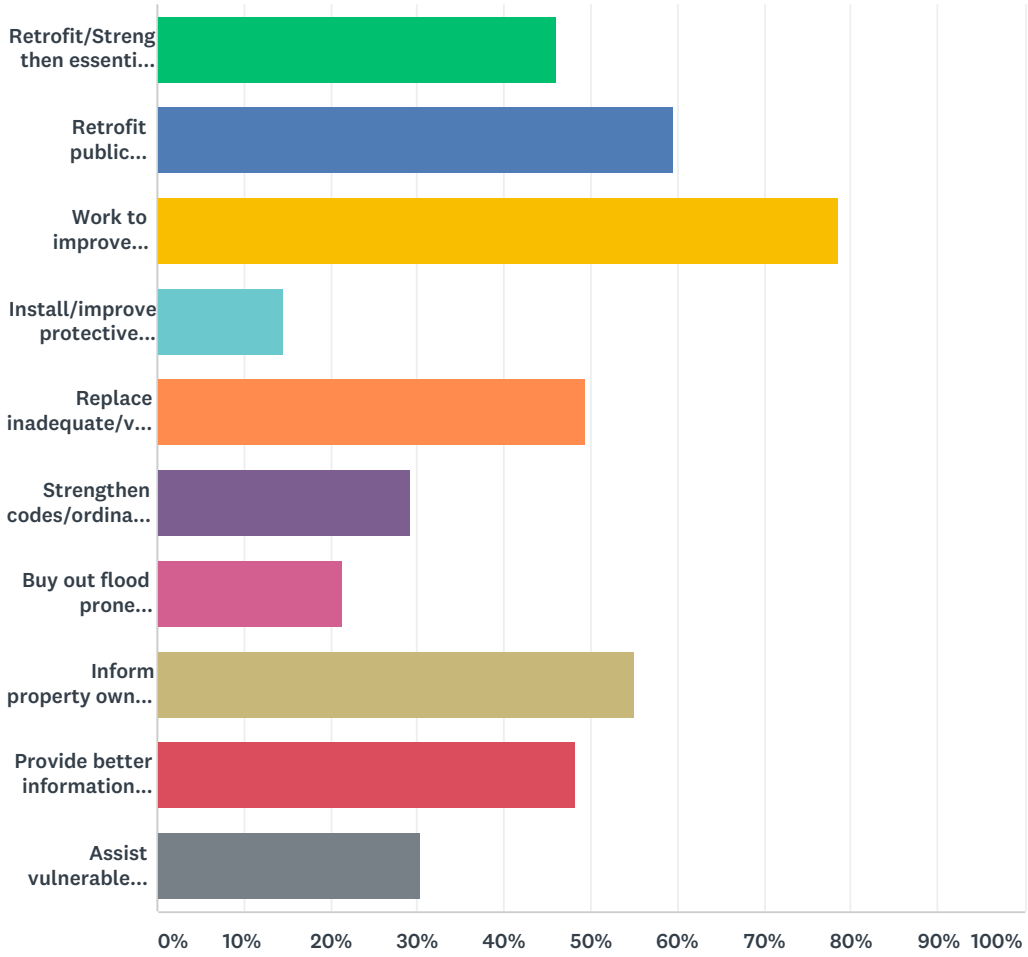
Answered: 90 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	65.56%	59
No	8.89%	8
Not Sure	25.56%	23
TOTAL		90

Q12 In your opinion, what types of projects do you believe local, county, state or federal government agencies could be doing to reduce the damage and disruption of natural disasters in Sudbury? (Select your top three choices)

Answered: 89 Skipped: 1



ANSWER CHOICES	RESPONSES	
Retrofit/Strengthen essential public facilities such as police, fire/emergency, schools	46.07%	41
Retrofit public infrastructure, such as elevating roadways and improving drainage systems	59.55%	53
Work to improve utilities resiliency (electric, communications, water/wastewater facilities)	78.65%	70
Install/improve protective structures (floodwalls)	14.61%	13
Replace inadequate/vulnerable bridges	49.44%	44
Strengthen codes/ordinances to require higher hazard risk management standards and/or provide greater control over development in high hazard areas	29.21%	26
Buy out flood prone properties and maintain as open space	21.35%	19
Inform property owners of ways they can reduce the damage caused by natural events	55.06%	49

Provide better information about hazard risks and high hazard areas	48.31%	43
Assist vulnerable property owners with securing funding to make their properties more resilient	30.34%	27
Total Respondents: 89		

Q13 Additional comments?

Answered: 13 Skipped: 77

#	RESPONSES	DATE
1	You have said nothing about education regarding food and water storage!	9/26/2019 8:22 AM
2	Main concern in Sudbury is downed trees and limbs. Tree maintenance is highly needed throughout the town. Especially in areas with invasive species killing large trees along roadways...	9/20/2019 3:17 PM
3	The old trees in Sudbury are a huge concern. There are several trees near roadways that are rotting and at risk for falling during even minor storms.	9/17/2019 10:30 AM
4	No	9/17/2019 9:54 AM
5	Our public areas flood very quickly. We have several sidewalks that flood and then freeze over with ice, especially by the parks which are walked or used for recreation creating hazards for a large portion of the year and potential injury but no additional drainage has been added when paving was done. It seems planning was done poorly.	9/17/2019 9:54 AM
6	Tree work so dead trees and branches are removed from public roads!	9/17/2019 9:37 AM
7	Sudbury should focus on identifying and removing potentially hazardous trees. I think trees are one of the biggest hazards for Sudbury as we usually have issues year round with trees coming down in storms.	9/17/2019 9:29 AM
8	We replaced our roof from hail damage about 5 years ago (covered by homeowners), and trim tree branches to avoid hitting our house during storms. We have not installed our generator, so we are prepared to live without power /heat in the winter (and have stayed in our house during power outages with no heat - our heat is electric- as we buy firewood each Fall). It's not fun but we do keep both fireplaces going and we have sleeping bags to sleep warmly so we stay with our pets overnight. We check flashlight batteries & keep basic non perishable food on hand. Reminders to the community to prepare or determine who they can stay with during power / utility outages is important. It's great that Sudbury is thinking ahead to help our neighbors best prepare - thank you!	9/17/2019 9:18 AM
9	I wish the town would do a better job assessing dead trees on town property that are likely to come down during a storm.	9/17/2019 9:15 AM
10	More needs to be done to take down trees and branches so they don't take down power lines. Also sidewalks are needed on main roads, especially Pantry Road.	9/17/2019 9:12 AM
11	I am very concerned about climate change, and the impact it has on weather and storms - which seem to be more erratic and powerful than they used to be. As a community we should seek to put more power lines under ground. We have many trees and are very vulnerable to power outages.	9/4/2019 12:43 PM
12	Develop a quick and easy way for elderly and people with disabilities to contact public safety when in distress - is 911 adequate in an regional emergency? Develop neighborhood networks of volunteers trained to help when hazardous conditions arise.	9/4/2019 9:25 AM
13	Burying existing above ground utilities would have a huge impact on the town's resiliency..	8/21/2019 7:13 PM

Appendix C – Correspondences

Availability of Draft Plan – Municipal Posting

Availability of Draft Plan – Adjacent Communities

Availability of Draft Plan – Municipal Departments