Appendix A

Core Team Materials

Municipal Vulnerability Preparedness and Hazard Mitigation Planning Grant Project

Monday, November 18th, 2019
2:00 pm – 3:00 pm

1. Introductions
   Mark Haddad
   Takashi Tada
   Russell Burke
   Steve Roy
   Amanda Kohn

2. Project Overview
   - Concern about turnout to public listening session
   - Just finished open space and recreation plan
   - 2010 Nashua River cut off West Groton. Took municipal employees 2-3 hour to get home. Should have been 5 mins.
   - Currently doing dredging project near Broadmeadow St. could be an opportunity to leverage current project as town match for future action grants
   - 2010 Ice Storm
   - History of a microburst
   - Utility has done a lot of tree management, which reduces the impact on power outages
   - Town is serviced by its own electric utility
   - Most of the town is on sewer, except in the south near the Shaw's development
   - FEMA Maps (last updated 2010)
   - new Senior Center is an emergency shelter
   - Lawrence Academy sets aside $15,000 as a grant for the town plus $60,000 as a set aside)
   - 2009 HMP was completed just for Groton, 2014 was the regional plan '
   - GIS files: https://grotonma.mapgeo.io/datasets/properties?abuttersDistance=300&latlng=42.61631%2C-71.576977&modal=disclaimer

3. Schedule
   General
   - Jan warrant article will open and closes in Feb
   - Feb 27-Mar 11, Russ is out
   - April 29th is Town Meeting

   MVP
   - Dec 11th @ 10 AM in Meeting Room on Second Floor of Town Hall

4. Core Team
   Tentative List:
   - Con Comm
   - Fire

Weston & Sampson

- Police
- Public Works
- Earth Removal/Stormwater Committee
- Groton Schools (David Black)
- Lawrence Schools
- Planning Board
- Assistant Town Manager

Advisory Committee:

- Housing Authority
- Groton Electric- Kevin Kelly
- Sustainability Committee
- Conservation Trust (private land trust)
- Kim M.- Chamber/Business association
- Nashua River Watershed Association
- Water and Sewer Department
- Board of Health Assistant (no health department- part of a regional program)
- Council on Aging
- Recycling Committee- Tessa

5. Wrap Up and Next Steps

Action Items	W&S	Town
Request data files as needed for map	X	
Send photos and 2009 HMP		X
Prepare for Core Team Meeting	X	

Municipal Vulnerability Preparedness Planning Grant and Hazard Mitigation Plan Update

Core Team Meeting

Select Board Meeting Room, Town Hall

Wednesday, December 11th, 2019

10:00 am – 11:30 am

Introductions — 5 minutes

Project Overview — 15 minutes

1. MVP Program Overview
    a. Brief Introduction to Climate Change in Groton
    b. MVP Planning Process
    c. MVP Action Grants
    d. Hazard Mitigation Plan Overlap
    e. Master Plan Chapter

Core Team Role — 2 minutes

1. Develop/approve list of stakeholders
2. Active participants in the Community Resilience Building Workshop
3. Promote the listening session/attend listening session
4. Inform community priorities/Determine how decisions from Workshop will be used

Goal Setting and Endorsement — 15 minutes

1. Large group activity on what a successful hazard mitigation and climate preparedness plan means to them.
2. Presentation of goals and large group discussion on how to incorporate comments

Community Resilience Building Workshop and Review of Materials — 35 minutes

1. MVP Risk Matrix
    a. Discuss hazards and key features (infrastructure, society, environment)
2. Review map of key resources/assets
3. Prioritization Process MVP Key Actions
4. Workshop Schedule
    b. One 8-hour or two 4-hour meetings
    c. Weekday or weekend
    d. Day or evening
5. Presentation Feedback

W&S Action Item: Finalize Workshop materials based on Core Team input

Groton Action Item: Help to fill mapping and PowerPoint gaps

Data Sources — 3 minutes

1. Interviews with municipal officials
2. Applicable reports and materials
3. Ask:
    a. Other ongoing efforts?
    b. Local hazards/experiences to highlight? - previous flood events, issue areas

W&S Action Item: Review materials and incorporate into Workshop and Report(s)
Hopkinton Action Item: Identify and provide any additional resources

Workshop Participants — 10 minutes

1. Respond to a list of workshop invitees

W&S Action Item: Draft invitation to stakeholders
Hopkinton Action Item: Finalize list of invitees; send invitation and track RSVPs, assign participants to tables

Wrap Up and Next Steps — 5 minutes

1. Confirm draft schedule

12-11-19 Core Team SIGN-IN SHEET (GROTON)

Michael L. Luitt — Police Chief

Tom Delaney — DPW Director

Takashi Tada — Land Use Director/Town Planner

Steele McCurdy — Fire Chief/EMD

MARK HADDAD - TOWN MANAGER

Michelle Collette — Stormwater/ADA coordinator Inspector

RUSSELL BURKE — PLANNING BOARD, CHAIR

HMP – MVP Plan Goals

The following goals were drafted to incorporate climate resilience and were based on the previous HMP ("Montachusett Region Natural Hazard Mitigation Plan 2015 Update"). The goal and objectives from the previous HMP are available on the next page.

Groton Overall Goal Statement:

To protect public health, property, infrastructure, the environment, and cultural resources through a hazard mitigation and climate adaptation program that involves increased coordination, planning, education, and capital improvements.

1. Shelters: To provide adequate shelter, water, food, and basic first aid to displaced residents in the event of a natural disaster.

2. Coordination: To increase coordination between departments, surrounding communities, regional efforts, and state agencies in pre-disaster planning and the implementation of hazard mitigation and climate adaptation projects.

3. Education: To increase awareness of hazard mitigation and climate adaptation among town officials, private organizations, businesses, and the general public.

4. Notification: To provide adequate information to residents in the event of a natural disaster.

5. Infrastructure: To protect public infrastructure, buildings, and essential services such as electric power, drinking water, and the sewer system from climate change impacts.

6. Vulnerable Populations: To building community and individual resilience, specifically focusing on vulnerable populations.

7. Natural Environment: To develop hazard mitigation and climate adaptation measures that employ nature-based solutions and protect the natural environment.

8. Development: To ensure that future development meets federal, state, and local standards for preventing and reducing the impacts of natural hazards under climate change projections.

9. Finance: Identify potential funding sources to support the implementation of climate adaptation strategies.

The following goals were developed for the previous HMP ("Montachusett Region Natural Hazard Mitigation Plan 2015 Update").

2015 Groton Overall Goal Statement:

To prepared to reduce the loss of life, property, infrastructure and cultural resources throughout the town of Groton from natural disasters through a multiple hazard mitigation program that involves increased coordination, planning, education, and capital improvements.

1. Objective: To organize and prepare to provide adequate shelter, water, food, and basic first aid to displaced residents in the event of a natural disaster, and to provide adequate notification and information regarding evacuation procedures, *etc.*, to residents in the event of a natural disaster.

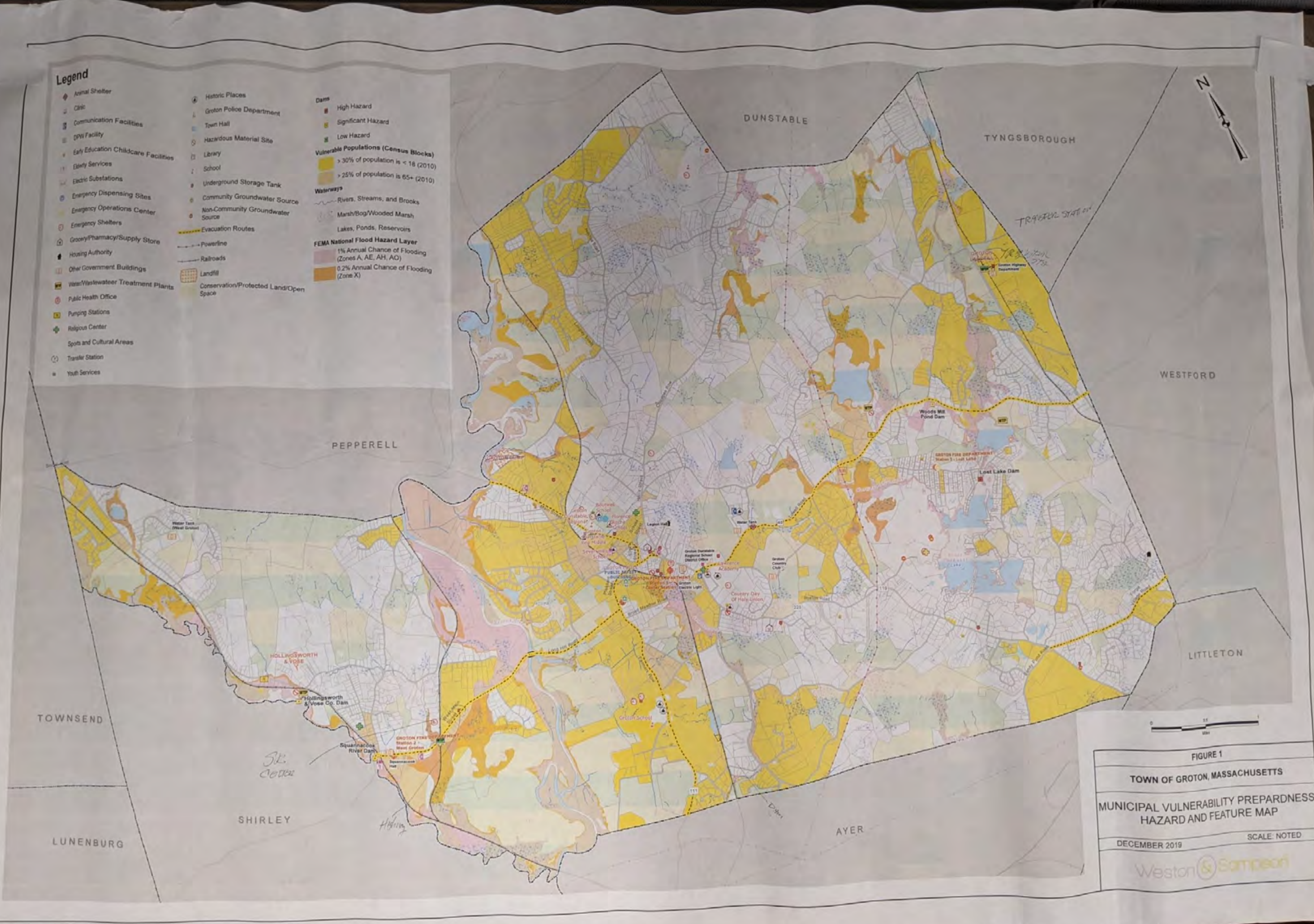
2. Objective: To inventory supplies at existing shelters and develop a needs list and storage requirements; and to establish arrangements with local or neighboring vendors for supplying shelters with food and first aid supplies in the event of a natural disaster.

3. Objective: To have the Emergency Management Director (EMD) lead an effort to increase coordination between inter-departments in pre-disaster planning and implementation of hazard mitigation projects including holding monthly meetings. *This action item was completed and is ongoing.*

4. Objective: Increase awareness of hazard mitigation among town officials, private organizations, businesses, and the general public.

5. Objective: To examine and update the current notification system including development of a local Reverse 911 system. *This action item was completed.*

6. Objective: To collect, periodically update, and disseminate information on which local radio stations provide emergency information, what to include in a "home survival kit, how to prepare homes and other structures to withstand flooding and high winds, and the proper evacuation procedures to follow during a natural disaster.


Legend
Animal Shelter
Clinic
Communication Facilities
DPW Facility
Early Education Childcare Facilities
Elderly Services
Electric Substations
Emergency Dispensing Sites
Emergency Operations Center
Emergency Shelters
Grocery/Pharmacy/Supply Store
Housing Authority
Other Government Buildings
Water/Wastewateer Treatment Plants
Public Health Office
Pumping Stations
Religious Center
Sports and Cultural Areas
Transfer Station
Youth Services
Historic Places
Groton Police Department
Town Hall
Hazardous Material Site
Library
School
Underground Storage Tank
Community Groundwater Source
Non-Community Groundwater Source
Evacuation Routes
Powerline
Railroads
Landfill
Conservation/Protected Land/Open Space
Dams
High Hazard
Significant Hazard
Low Hazard
Vulnerable Populations (Census Blocks)
> 30% of population is < 18 (2010)
> 25% of population is 65+ (2010)
Waterways
Rivers, Streams, and Brooks
Marsh/Bog/Wooded Marsh
Lakes, Ponds, Reservoirs
FEMA National Flood Hazard Layer
1% Annual Chance of Flooding (Zones A, AE, AH, AO)
0.2% Annual Chance of Flooding (Zone X)
N
DUNSTABLE
TYNGSBOROUGH
WESTFORD
PEPPERELL
LITTLETON
TOWNSEND
SHIRLEY
LUNENBURG
AYER
HOLLINGSWORTH & VOSE
Hollingsworth & Vose Co. Dam
Squannacook River Dam
GROTON FIRE DEPARTMENT Station 2 - West Groton
Woods Mill Pond Dam
GROTON FIRE DEPARTMENT Station 3 - Lost Lake
Lost Lake Dam
Groton Country Club
Groton Dunstable Regional School District Office
Country Day School of Holy Union
Legion Hall
Water Tank
FIGURE 1
TOWN OF GROTON, MASSACHUSETTS
MUNICIPAL VULNERABILITY PREPARDNESS HAZARD AND FEATURE MAP
DECEMBER 2019
SCALE: NOTED
Weston & Sampson

Town of Groton
Municipal Vulnerability Preparedness Planning Grant Project
Key Expert Interview Questions

1. What are some of Groton's greatest strengths?

2. What are some of Groton's greatest vulnerabilities?

3. In general, how prepared do you feel Groton is for climate change? Why?

4. How does the goal of improving Groton's climate resilience overlap with your department's mission or objectives?

5. Which climate hazard is likely to have the greatest impact on your department? In other words, which hazard impacts your department's operations most frequently, and what kind of impacts typically occur?

6. What (and where) are your department's critical facilities, infrastructure, or assets? (Review with map and Attachment A: Critical Facilities List).

7. Does your department have a Standard Operating Procedure or Emergency Plan to respond and recover after hazards occur? This could be a formal or informal plan.

8. How has your department taken steps to reduce vulnerabilities to climate change in your operations or to protect the public health and safety in the community? (Review with Attachment B: Existing Protections from "Montachusett Regional Natural Hazard Mitigation Plan 2015 Update"). Please provide updates and additional information related to the existing protection identified in the previous HMP.

9. How could Groton adapt to climate change today? In the next five years? In the next 20 years? (Review with Attachment C: Priority Mitigation Actions from "Montachusett Regional Natural Hazard Mitigation Plan 2015 Update"). Please provide updates and additional information related to the proposed mitigation actions identified in the previous HMP.

10. How should Groton prioritize its climate adaptation measures (i.e., based on funding, time frame, asset type, or other considerations)? Which adaptation strategies discussed previously should be a top priority?

11. What tools, resources, knowledge, or data would your department need to better mitigate, prepare, respond, recover, or adapt to climate change?

12. How can your department promote resilience within the community or directly with community members?

13. Do you currently coordinate with surrounding communities, state agencies, or regional organizations? What's currently working and what could improve? Examples of regional coordination include:
    a. Receiving water, electric, or other public utilities from another town
    b. Memoranda of understanding between Town departments (for example, between Groton's Fire Department and the Fire Department in an adjacent town)
    c. Participation in regional groups, conferences, or meetings

Key Experts:

Groton Skype Interviews

1. Planning & Town Manager:
   Michelle Collette, Stormwater Inspector & ADA Coordinator (and former Land Use Director/Town Planner) (Core Team)
   Mark Haddad, Town Manager
2. Police & Fire Department:
   Michael Luth, Chief of Police (Core Team)
   Steele McCurdy, Fire Chief (Core Team)
3. DPW, Water, Sewer, Electric:
   Tom Orcutt, Water Superintendent (Advisory Committee)
4. Schools:
   Dr. David Black, Teaching Chair of Groton Schools
   Bob Kramer, Lawrence Academy
5. Housing:
   Fran Stanley, Housing Coordinator
6. Conservation:
   John Smigelski, Conservation Commission Chair
   Nikolis Gualco, Conservation Administrator
   Ted Lapres, President, Groton Conservation Trust

Appendix B

Additional Hazard Data

Legend

- Animal Shelter
- Clinic
- Communication Facilities
- DPW Facility
- Early Education Childcare Facilities
- Elderly Services
- Electric Substations
- Emergency Dispensing Sites
- Emergency Operations Center
- Emergency Shelters
- Grocery/Pharmacy/Supply Store
- Housing Authority
- Other Government Buildings
- Water/Wastewateer Treatment Plants
- Public Health Office
- Pumping Stations
- Religious Center
- Sports and Cultural Areas
- Transfer Station
- Youth Services
- Historic Places
- Groton Police Department
- Town Hall
- Hazardous Material Site
- Library
- School
- Underground Storage Tank
- Community Groundwater Source
- Non-Community Groundwater Source
- Evacuation Routes
- Powerline
- Railroads
- Landfill
- Open Space
- Conservation/Protected Land

Dams

- High Hazard
- Significant Hazard
- Low Hazard

Vulnerable Populations (Census Blocks)

- > 30% of population is < 18 (2010)
- > 25% of population is 65+ (2010)

Waterways

- Rivers, Streams, and Brooks
- Marsh/Bog/Wooded Marsh
- Lakes, Ponds, Reservoirs

FEMA National Flood Hazard Layer

- 1% Annual Chance of Flooding (Zones A, AE, AH, AO)
- 0.2% Annual Chance of Flooding (Zone X)

DUNSTABLE
TYNGSBOROUGH
WESTFORD
LITTLETON
AYER
SHIRLEY
PEPPERELL
TOWNSEND
LUNENBURG

Massapoag Pond
Groton-Dunstable Regional High School Conservation Area
Meadowbrook Conservation Area
Whispering Brook Conservation Area
Lake Massapoag Conservation Area
Unkety Brook WMA
Cronin Land
Wattles Pond Conservation Area
Dan Parker Road Conservation Area
Blood Road Conservation Area
Nashua River Shoreline
Still Meadow CR
Conservation Area
Northwoods
Hawtree Conservation Area
Cow Pond Brook WCE
GROTON LANDFILL
Groton Highway Department
Longley Estates I
Brown Lane/Watson Way Conservation Area
Floyd Hill Conservation Area
Harrison S. Ripley Forest
Cronin Conservation Area
Sampas Conservation Woods
McClains Woods Conservation Area
Unkety Brook Conservation Area
Nashua Road
Longley Street
Fitch Woods Conservation Area
Baddacook Pond Conservation Area
Wharton Plantation
Fritz and Helen Walker Conservation Area
Groton Hills
Baddacook Conservation Area
Baddacook Pond Access
Baddacook Pond II
Cow Pond Brook Conservation Area
Chicopee Row
J. Harry Rich State Forest
Longley Estates II
Shepley Hill Farm CR
Williams Conservation Area
Chicopee Row Conservation Area
Deerhaven Estates Conservation Area
Woods Mill Pond Dam
Chestnut Hill Water Storage Tank
Allens Trail Conservation Area
Baddacook
GROTON DUMP
Petapawag Canoe Launch
Martins Brook Pond Conservation Area II
Heron Ridge
GROTON FIRE DEPARTMENT Station 3 - Lost Lake
Skitapet Conservation Area
Lost Lake Dam
Skinner Forest
Flavell Crossing Conservation Area
Martins Pond Brook
Gamlin Picnic Site
Boutwell School
Florence Roche School
Groton Dunstable Regional
Groton Dunstable Reg Middle
Seven Hills School
Legion Hall
Groton Fire Tower
Water Tank
Gibbet Hill Water Storage Tank
Knops Pond Access
Duck Pond Cons Area
Groton Meadows Conservation Area
Wilson Moose Trail CR
Lost Lake Conservation Area
Knops Pond/Lost Lake
Groton Terrace Estates Conservation Area
Carmichael Swamp Conservation Area
Sargisson Beach Conservation Area
Carmichael Estates Conservation Area
Richard F Priest Memorial Conservation Area
Woodland Pond Conservation Area
Forge Village
Road Conservation Area
Forge Pond
Stonebridge
Rocky Hill Conservation Area
Rocky Hill CR
Rock Hill CR
Fletcher Hill Conservation Area
Rocky Hill Wildlife Sanctuary
Sandy Pond Road
Pond View Estates CR
Long Pond
Nate Nutting Road Conservation Area
Nathan Nutting Road Conservation Area
Indian Hill Road CR
Half Moon Swamp Conservation Area
Ridgewood Estates CR
Gilson Cons Land
Boston Road
Groton Country Club
Lawrence Academy
Country Day Of Holy Union
Groton Electric Light
Groton Dunstable Regional School District Office
Brookside Place
Lowell Road
Pleasant Street
Hollis Street
School Street
Main Street
Broad Meadow Road
Bates-Blackman Conservation Area
Hurd Property
James Brook
Lawrence Homestead CR
Stoddart CR
Long Hill Road
Lawrence Woods
Stone Estate CR
Lawrence Woods CR
Taisey CR
Neshua River
Trail Easement Poirier CR
Hayes Woods
Groton Police Public Safety Building
Groton Fire Department Station 1 - Center Station
Groton Place
Phoebe R Keyes Woods
Sabine Memorial Woods
Sabine Woods
Allen Cons Area
Pritchard Road
West Main Street
Groton School
Hemlock Grove
Lawrence Park Cons Area
Charles Bixby Conservation Area
Squannacook Hall
Squannacook River Dam
GROTON FIRE DEPARTMENT Station 2 - West Groton
Executive Estates Open Space
Surrenden Farm West WCE
Surrenden Farm CR
Groton Town Forest WCE
Squannacook River WCE
Ayer Game Farm
Valentine Hollingsworth Conservation Area
Hollingsworth &Vose Co. Dam
HOLLINGSWORTH & VOSE
Westridge Common Conservation Area
Southern Groton James Brook CR
Flat Pond
Academy Hill Estates Conservation Area
Water Tank (West Groton)
Crosswinds Conservation Area
Academy Hill Conservation Area
Throne Hill WCE
Throne Hill Conservation Area III
Throne Hill Conservation Area II
Throne Hill CR
P Bertozzi Wildlife Management Area
Squannacook River WMA
Bertozzi Farm Estates Conservation Area
Lyman CR
Squannacook Picnic Area
Farmers And Mechanics Club
South Street
Main Street
111
119
225

0 0.5 1 Miles

FIGURE 1

TOWN OF GROTON, MASSACHUSETTS

MUNICIPAL VULNERABILITY PREPARDNESS HAZARD AND FEATURE MAP

April 2020 SCALE: NOTED

Weston & Sampson

Groton Critical Facilities

Feature Type	*Name*	*Address*
Emergency Response Facilities		
Fire	Groton Center Fire Station	45 Farmers Road
	Groton- Station 2	46 West Main Street
Police	Groton Public Safety Building Primary	99 Pleasant Street
Town Facilities	Groton Town Hall	173 Main Street
	Groton Highway Department	600 Cow Pond Brook Road
	Groton Dunstable Regional School District Office	145 Main Street
	Groton Electric Light	23 Station Avenue
	Groton Public Library	99 Main Street
	Squannacook Hall	33 West Main Street
	Groton Country Club	94 Lovers Lane
	Groton Board of Health	173 Main Street
Emergency Shelters	Florence Roche School	342 Main Street
	Groton Dunstable Regional High School	703 Chicopee Row
	Groton Dunstable Regional Middle School (North)	346 Main Street
	Groton Center	163 West Main Street
	Grotonwood Baptist Camp and Conference Center	167 Prescott Street
	Legion Hall	75 Hollis Street
	Groton School, New Hockey Rink #1	282 Farmers Row
	Groton School, Pratt Hockey Rink #2	282 Farmers Row
	Lawrence Academy, Grant Rink	56 Powder House Rd.
Emergency Dispensing Sites	Groton Dunstable Regional Middle School (North)	346 Main Street
Communication Infrastructure	Blood Cell Tower	94 West Main Street
	Cell Tower Lease Acquisition Co	149 Lowell Road
	Groton Telephone Building	17 Hollis Street
	Jeffery Crowley/Cell Tower	550 Main Street
	Cell site	600 Cow Pond
Critical Bridges	West Main Street Bridge over the Nashua River	Route 225
Evacuation Routes		Route 111
		Route 40
		Route 225
Hospitals	Seven Hills Pediatric Hospital	22 Hillside Avenue
Animal Shelters	Groton Veterinary Hospital	171 Lowell Rd

Non-Emergency Response Facilities (Still Essential for Town Operations)		
Public Water and Sewer Infrastructure	Baddacook Pond Water Treatment Plant	541 Lowell Road
	Town Forest Well Site #18	160 West Main Street
	Whitney Well Water Treatment Plant	864 Lowell Road
	Water Tank	143 Lowell Road
	Water Tank (West Groton)	700 Townsend Road
	Baddacook Pond Dug Well	541 Lowell Road
	Proposed Shattuck Road Brook Well #1	138 Martins Pond Road
	Proposed Shattuck Road Brook Well #2	138 Martins Pond Road
	Rock Well #1	West Groton
	Shattuck Well	138 MARTINS Pond Road
	Town Forest Gp Well	West Groton
	Tubular Well Field (47 X 2.5")	West Groton
	Whitney Pond Well #1	861 Lowell Road
	Whitney Pond Well #2	861 Lowell Road
	Baddacook Pond Pumping Station	541 Lowell Road
	West Groton Pumping Station	309 Townsend Road
	Partridgeberry Woods Sewer Pump Station	51 Wintergreen Drive
	Nod Road Sewer Pump Station	99 Nod Road
	Whitney Well	864 Lowell Road
	Chestnut Hill Water Storage Tank	30 Orchard Lane
	Gibbet Hill Water Storage Tank	155 Lowell Road
Transfer Station	Groton Transfer Station	600 Cow Pond Road
Electric Substations	Groton Electric Sub Station	444 Lowell Road
Hazardous Materials and Facilities		
Hazmat Sites	Baddacook Pond Water Treatment Plant	541 Lowell Road
	Blood Cell Tower	94 West Main Street
	Cell Tower Lease Acquisition Co	149 Lowell Road
	Groton Highway Department	600 Cow Brook Pond Road
	Groton Telephone Building	17 Hollis Street
	Grotonwood Baptist Camp & Conference Center (stores fuel on-site)	167 Prescott Street
	Insco Corp.	412 Main Street
	Hollingsworth & Vose Paper Hill	219 Townsend Road
	Jeffery Crowley/Cell Tower	550 Main Street
	Town Forest Well Site 18	160 West Main Street
	Groton Town Hall	173 Main Street
	Whitney Well Water Treatment Plant	864 Lowell Road

Vulnerable Populations and Community Facilities		
Childcare Facilities	Country Kids Preschool	501 Main St
	Donaghue, Luzdari	600 Boston Rd
	Grant, Patricia	96 Pleasant St
	Groton Community School	110 Boston Rd
	Sunshine School	1 Powderhouse Rd.
	The Children's Center at Groton, Inc.	20 Joy Lane
	Peter Twomey Youth Ctr Extended Day	348 Main Street
School	Boutwell School	78 Hollis Street
	Lawrence Academy South	14 Main Street
	Country Kids	501 Main Street
	Florence Roche School	342 Main Street
	Groton Community School	110 Boston Road
	Groton Dunstable Regional High School	703 Chicopee Row
	Groton Dunstable Regional Middle School	344 Main Street
	Groton School	282 Farmers Row
	Lawrence Academy	26 Powder House Road
	Sunshine School	1 Powderhouse Road
Housing Authority	Groton Commons (low income senior/disabled housing, managed by RCAP Solutions)	74 Willowdale Road
	Petapawag Place (low income senior/disabled housing, low income family housing, managed by Groton Housing Authority)	19 Lowell Road
	Sandy Pond Apartments (moderate income family housing, managed by Groton Housing Authority, nine housing units)	34-38 Sandy Pond Road
	Winthrop Place (low income housing, includes senior housing, managed by Dementian Guschov, Jr.)	371-375 Main Street
	River Court Residences (low income and market rate senior housing, long-term care facility, private ownership)	8 West Main Street
	Seven Hills Group Home (disability housing for adults, long-term care facility, managed by Seven Hills Foundation)	Sand Hill Road
	Seven Hills at Groton (group home)	22 Hillside Avenue
	Brookfield Commons	12 Brookfield Drive
	Meadow Brook	411 Nashua Road
Long-Term Care Facility	Cooperative Elder Services	8 West Main Street
Art Centers	Groton Dunstable Performing Arts	344 Main Street
	Indian Hill Music Center (under construction)	Ayer Road
Camps	Grotonwood Baptist Camp & Conference Center	167 Prescott Street
	YMCA Camp Massapoag	234 Hall Street in Dunstable (on the border

		of Groton)
Religious Centers	First Baptist Church of Groton	365 Main Street
	First Parish Unitarian Church	1 Powderhouse Road
	Sacred Heart & Saint James Church	29 Saint James Avenue
	Union Congregational Church	218 Main Street
Grocery/Supply Stores	CVS	110 Boston Road
	Shaw's	760 Boston Road

Vulnerable Population Census Blocks in the 100- and 500-Year Floodplains

Census Block Number	Vulnerable Populations	Total Area (acres)	Area in 100 Year Flood Plain	Percent in 100 Year Flood Plain	Area in 500 Year Flood Plain	Percent in 500 Year Flood Plain
250173261011002	Minor	73.5992	7.118342899	9.671766676	11.80851073	16.04434658
250173261011005	Minor	8.5603	0.116124289	1.356544619	0.443372061	5.179398635
250173261011013	Minor and Elderly	25.4803	12.54594573	49.23782581	0.790318489	3.101684395
250173261011014	Minor	58.5345	21.80605414	37.2533363	1.309266307	2.236742958
250173261011027	Minor	360.3232	6.428501891	1.78409325	1.301484375	0.361199161
250173261011037	Minor	38.1576	0.814152906	2.133658578	0.087922171	0.230418503
250173261011039	Minor	13.2658	0.174129524	1.312619853	0.621827539	4.687448471
250173261011049	Minor	33.6441	0.000451358	0.001341567	0.065936545	0.195982491
250173261012001	Minor	4.9279	0.70124394	14.23007651	0.278047875	5.642319746
250173261012008	Elderly	10.7596	0	0	0.03467053	0.322228802
250173261012014	Minor	117.9934	27.1831325	23.03784152	3.590361414	3.042849358
250173261012034	Minor	106.5221	10.29528895	9.664932393	0.378403316	0.355234562
250173261012036	Minor	16.9124	14.99888682	88.68573842	0.796451831	4.7092774
250173261012038	Minor	457.1505	111.2764566	24.34131793	33.12762256	7.246546281
250173261012040	Minor	45.978	8.663708511	18.84316088	5.23057702	11.37626043
250173261012041	Minor	83.1459	79.30054517	95.37517204	2.323037785	2.793929448
250173261012047	Minor	414.9151	41.1514431	9.918039402	10.82299433	2.60848408
250173261012053	Minor	521.5206	217.4619841	41.69767869	20.11734279	3.857439722
250173261012054	Minor	60.7249	0.480072073	0.790568734	36.69827234	60.43364804
250173261012060	Elderly	103.7376	19.12080498	18.4318945	23.55487861	22.70621126
250173261012064	Elderly	12.3195	0	0	0.424510681	3.445843431
250173261012069	Elderly	37.8786	0.725552145	1.915467165	22.06915888	58.26286842
250173261012076	Elderly	29.0945	24.72016825	84.96509048	2.148246567	7.383686149
250173261012083	Minor and Elderly	452.7629	49.4311312	10.91766379	7.372910175	1.628426308
250173261021022	Minor	200.2331	16.65130328	8.31595939	7.116526449	3.554120896
250173261021027	Minor	463.0396	8.471319701	1.829502207	3.735714507	0.806780782
250173261021029	Minor	93.0906	13.15057455	14.12664066	9.881421566	10.61484357
250173261021034	Elderly	317.6434	8.485485291	2.671387251	83.36915381	26.24614704
250173261021039	Minor	220.8476	0.889074234	0.402573645	0	0
250173261021059	Minor	51.6512	29.71849598	57.53689359	0	0
250173261021078	Minor	55.5671	0.287676426	0.517709987	0	0
250173261021079	Minor	5.6846	0.021878721	0.384877049	0	0
250173261022010	Minor	15.9552	11.41549422	71.54717097	0.326965235	2.049270674
250173261022034	Minor	9.2172	0.421811285	4.576349489	0	0
250173261022038	Minor	65.2086	3.940256262	6.042540803	23.63749691	36.2490483
250173261022040	Elderly	4.8071	0	0	0.026603167	0.553414047
250173261022043	Minor	66.9795	0	0	4.824416401	7.202825343
250173261022067	Minor	13.8855	0	0	4.232321407	30.48015128
250173261022069	Minor	42.001	0	0	2.690377559	6.405508343
250173261023003	Minor	16.4266	0.221662319	1.349410826	0	0
250173261023005	Minor	78.5556	2.553908552	3.251084012	0	0
250173261023006	Minor	28.9547	0.001772253	0.006120779	0	0
250173261023009	Minor	96.4297	5.311664503	5.50832835	0	0
250173261023016	Minor	347.5412	0	0	10.37548139	2.985396087
250173261023023	Minor	23.2629	0	0	0.813302441	3.496135223
250173261023030	Minor	156.1399	0	0	6.271065284	4.016311836

Hazus: Hurricane Global Risk Report

Region Name: Groton_HMP

Hurricane Scenario: Probabilistic 100-year Return Period

Print Date: Tuesday, April 28, 2020

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

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

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General Description of the Region

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

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

- Massachusetts

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

The geographical size of the region is 33.76 square miles and contains 2 census tracts. There are over 3 thousand households in the region and a total population of 10,646 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 4 thousand buildings in the region with a total building replacement value (excluding contents) of 2,234 million dollars (2014 dollars). Approximately 92% of the buildings (and 78% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 4,106 buildings in the region which have an aggregate total replacement value of 2,234 million (2014 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

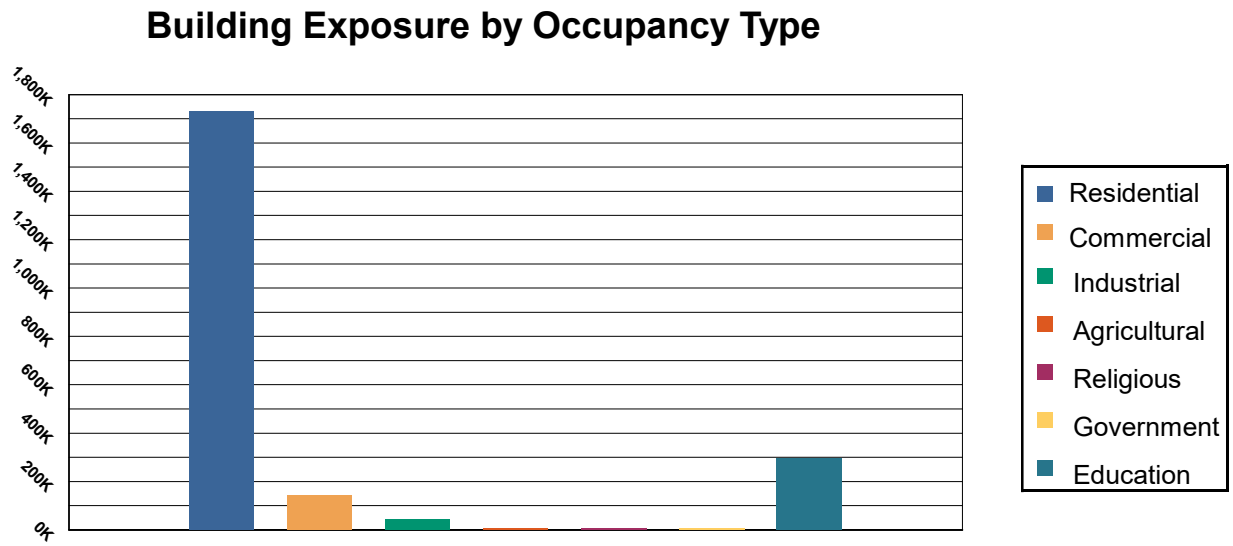


Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	1,732,230	77.53 %
Commercial	143,859	6.44%
Industrial	42,909	1.92%
Agricultural	4,999	0.22%
Religious	8,566	0.38%
Government	7,868	0.35%
Education	293,964	13.16%
Total	**2,234,395**	**100.00%**

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 9 schools, 1 fire stations, 1 police stations and no emergency operation facilities.

Hurricane Scenario

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

Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

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

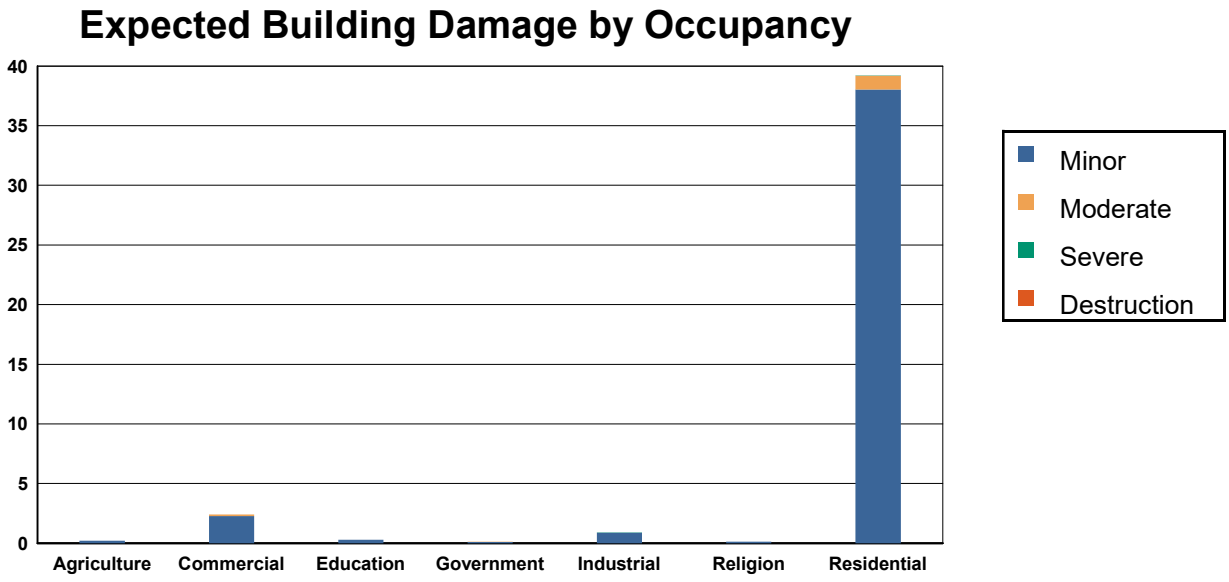


Table 2: Expected Building Damage by Occupancy : 100 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	16.79	98.74	0.19	1.14	0.02	0.09	0.00	0.02	0.00	0.00
Commercial	202.59	98.82	2.28	1.11	0.13	0.06	0.00	0.00	0.00	0.00
Education	25.71	98.89	0.28	1.10	0.00	0.02	0.00	0.00	0.00	0.00
Government	8.89	98.77	0.11	1.22	0.00	0.02	0.00	0.00	0.00	0.00
Industrial	75.11	98.83	0.86	1.14	0.02	0.03	0.00	0.01	0.00	0.00
Religion	10.88	98.91	0.12	1.06	0.00	0.03	0.00	0.00	0.00	0.00
Residential	3,722.79	98.96	38.03	1.01	1.15	0.03	0.02	0.00	0.00	0.00
Total	**4,062.76**		**41.88**		**1.33**		**0.03**		**0.00**	

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

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	20	98.61	0	1.38	0	0.01	0	0.00	0	0.00
Masonry	189	98.30	3	1.52	0	0.18	0	0.01	0	0.00
MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	147	98.80	2	1.17	0	0.04	0	0.00	0	0.00
Wood	3,578	99.04	34	0.94	1	0.02	0	0.00	0	0.00

Essential Facility Damage

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

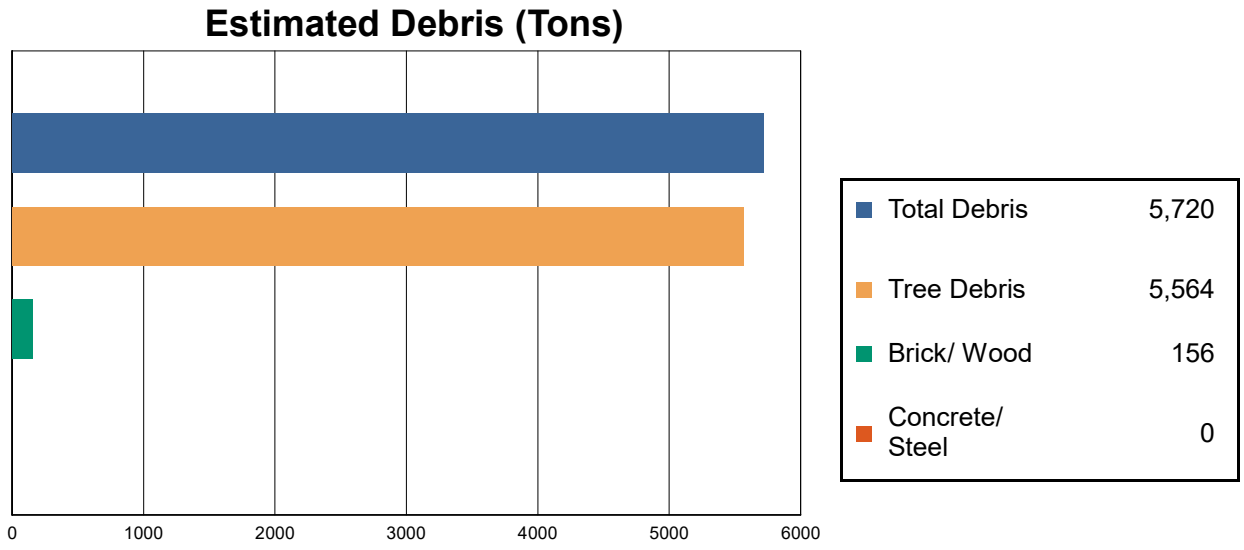
Thematic Map of Essential Facilities with greater than 50% moderate

Table 4: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**Probability of at Least Moderate Damage > 50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 day**
Fire Stations	1	0	0	1
Police Stations	1	0	0	1
Schools	9	0	0	9

Induced Hurricane Damage

Debris Generation

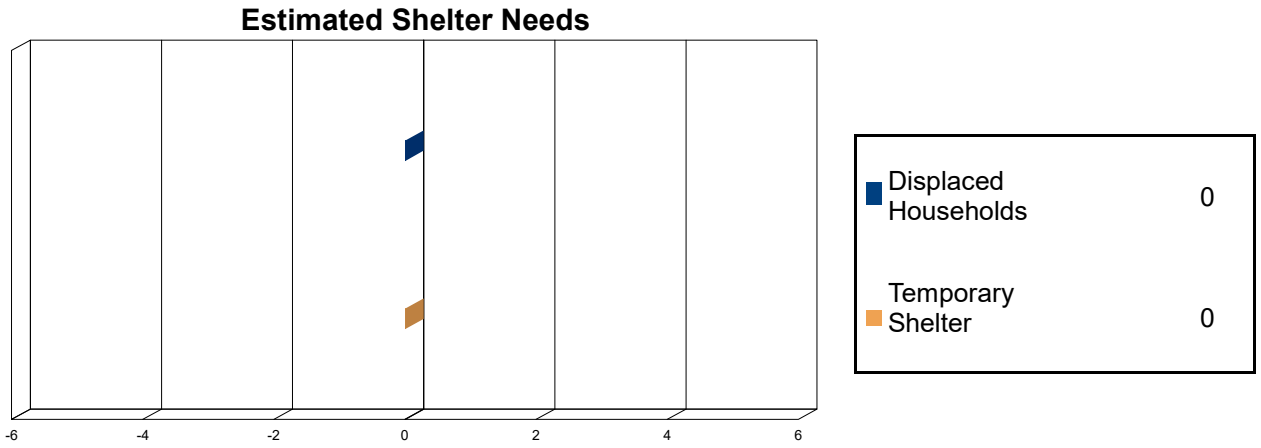


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling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

The model estimates that a total of 5,720 tons of debris will be generated. Of the total amount, 4,659 tons (81%) is Other Tree Debris. Of the remaining 1,061 tons, Brick/Wood comprises 15% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 6 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 905 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

Social Impact

Shelter Requirement



Hazus estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the hurricane. Of these, 0 people (out of a total population of 10,646) will seek temporary shelter in public shelters.

Economic Loss

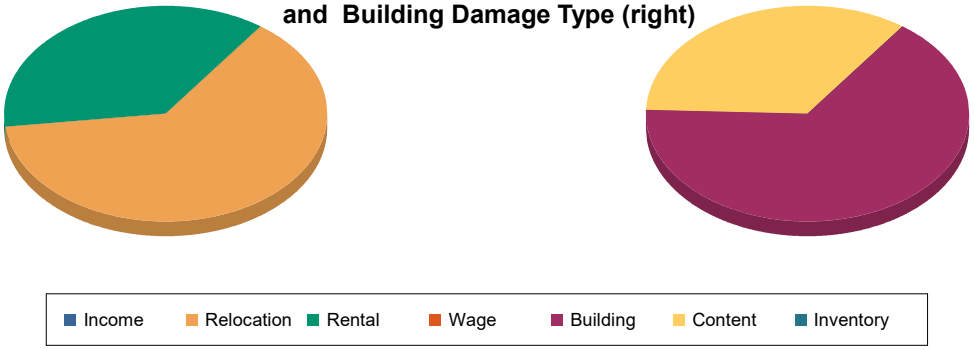
The total economic loss estimated for the hurricane is 9.5 million dollars, which represents 0.42 % of the total replacement value of the region's buildings.

Building-Related Losses

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

The total property damage losses were 9 million dollars. 0% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 98% of the total loss. Table 5 below provides a summary of the losses associated with the building damage.

Loss by Business Interruption Type (left) and Building Damage Type (right)



Loss Type by General Occupancy

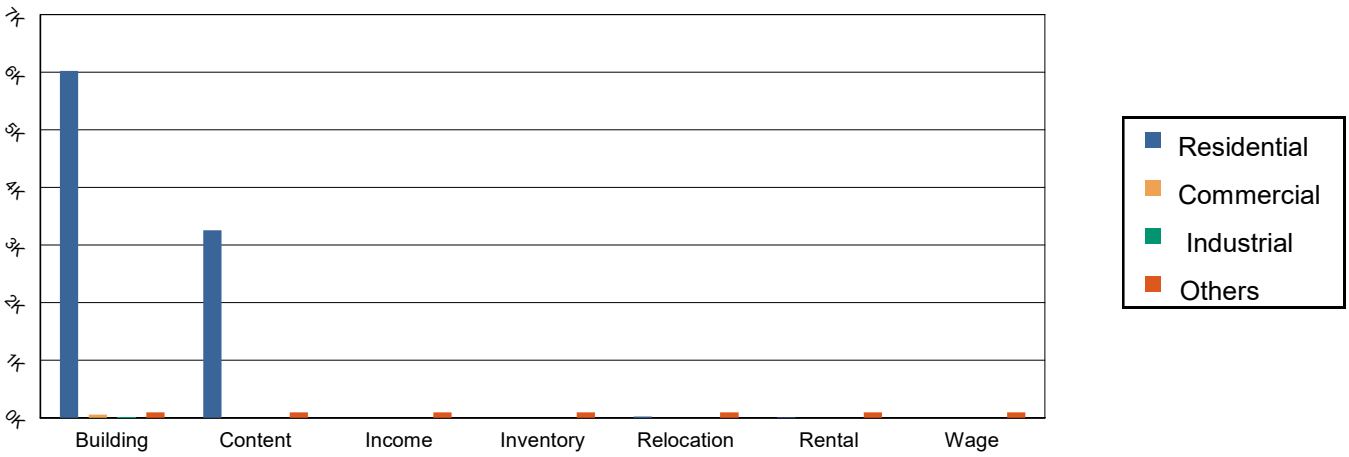


Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	6,019.57	55.41	11.18	94.49	6,180.66
	Content	3,255.15	1.38	0.03	0.15	3,256.71
	Inventory	0.00	0.00	0.01	0.01	0.02
	Subtotal	**9,274.72**	**56.80**	**11.22**	**94.66**	**9,437.40**
Business Interruption Loss						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	22.75	0.60	0.03	0.32	23.70
	Rental	13.90	0.00	0.00	0.00	13.90
	Wage	0.00	0.00	0.00	0.00	0.00
	Subtotal	**36.65**	**0.60**	**0.03**	**0.32**	**37.60**

Total

Total	**9,311.37**	**57.40**	**11.25**	**94.98**	**9,475.00**

Appendix A: County Listing for the Region

Massachusetts
- Middlesex

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
Massachusetts				
Middlesex	10,646	1,732,230	502,165	2,234,395
Total	**10,646**	**1,732,230**	**502,165**	**2,234,395**
Study Region Total	**10,646**	**1,732,230**	**502,165**	**2,234,395**

Hazus: Hurricane Global Risk Report

Region Name: Groton_HMP

Hurricane Scenario: Probabilistic 500-year Return Period

Print Date: Tuesday, April 28, 2020

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

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

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

- Massachusetts

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

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There are an estimated 4 thousand buildings in the region with a total building replacement value (excluding contents) of 2,234 million dollars (2014 dollars). Approximately 92% of the buildings (and 78% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 4,106 buildings in the region which have an aggregate total replacement value of 2,234 million (2014 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

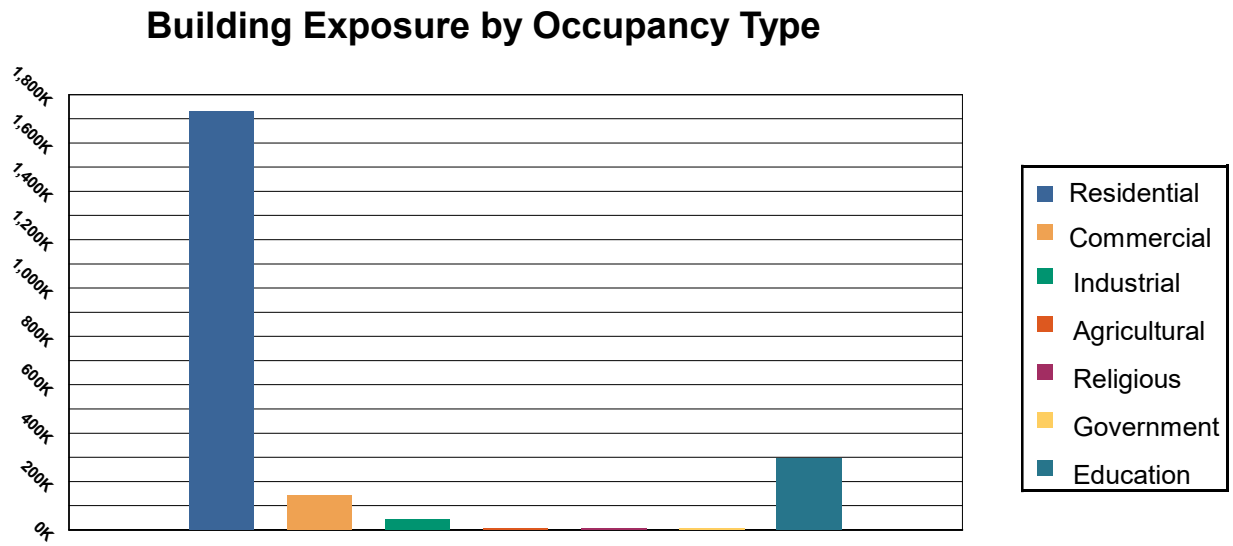


Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	1,732,230	77.53 %
Commercial	143,859	6.44%
Industrial	42,909	1.92%
Agricultural	4,999	0.22%
Religious	8,566	0.38%
Government	7,868	0.35%
Education	293,964	13.16%
Total	**2,234,395**	**100.00%**

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 9 schools, 1 fire stations, 1 police stations and no emergency operation facilities.

Hurricane Scenario

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

Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 39 buildings will be at least moderately damaged. This is over 1% of the total number of buildings in the region. There are an estimated 1 buildings that will be completely destroyed. The definition of the 'damage states' is provided in the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

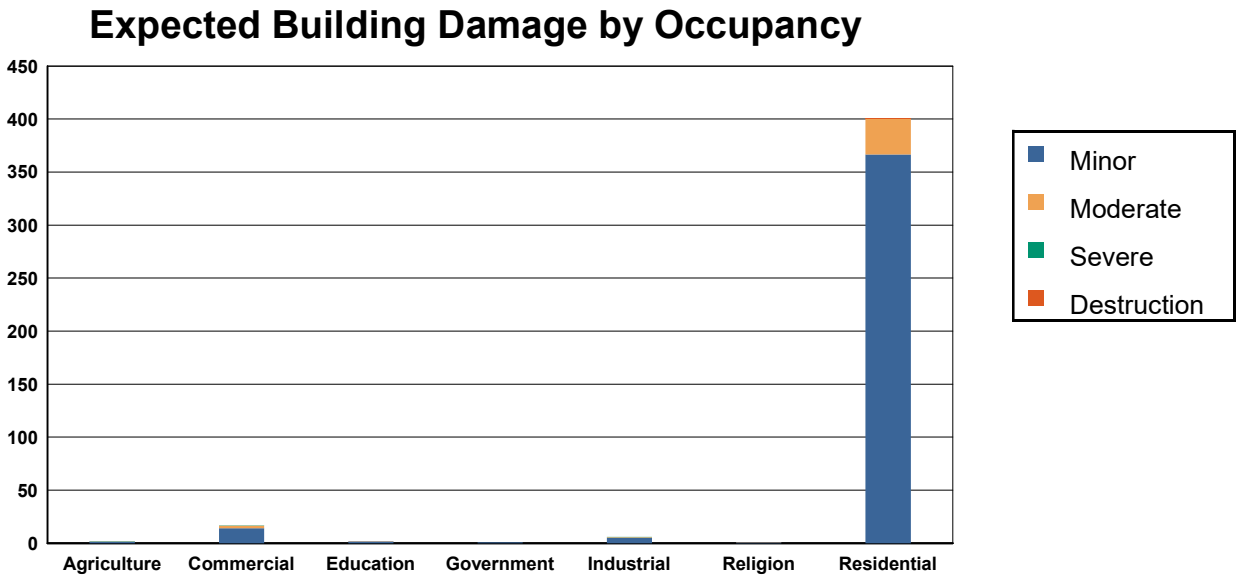


Table 2: Expected Building Damage by Occupancy : 500 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	15.13	89.00	1.43	8.39	0.30	1.77	0.13	0.78	0.01	0.06
Commercial	188.32	91.86	14.22	6.94	2.28	1.11	0.18	0.09	0.00	0.00
Education	24.10	92.70	1.70	6.54	0.19	0.74	0.01	0.02	0.00	0.00
Government	8.25	91.68	0.66	7.30	0.09	0.99	0.00	0.03	0.00	0.00
Industrial	70.18	92.34	4.90	6.44	0.74	0.98	0.17	0.23	0.01	0.01
Religion	10.01	90.96	0.89	8.09	0.10	0.91	0.00	0.04	0.00	0.00
Residential	3,360.89	89.34	366.59	9.74	33.53	0.89	0.47	0.01	0.52	0.01
Total	**3,676.87**		**390.38**		**37.24**		**0.97**		**0.54**	

Table 3: Expected Building Damage by Building Type : 500 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	18	91.58	1	7.38	0	1.02	0	0.02	0	0.00
Masonry	171	89.05	17	8.60	4	2.18	0	0.16	0	0.01
MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	138	92.54	9	6.36	1	1.00	0	0.09	0	0.00
Wood	3,236	89.58	349	9.65	27	0.74	1	0.02	0	0.01

Essential Facility Damage

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

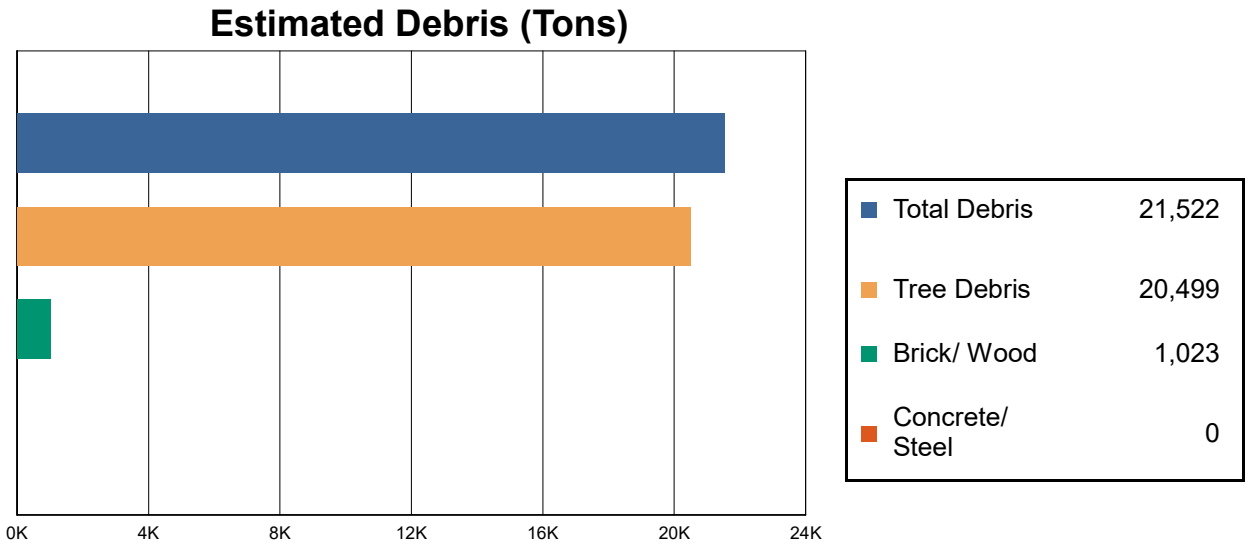
Thematic Map of Essential Facilities with greater than 50% moderate

Table 4: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**Probability of at Least Moderate Damage > 50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 day**
Fire Stations	1	0	0	1
Police Stations	1	0	0	1
Schools	9	0	0	9

Induced Hurricane Damage

Debris Generation

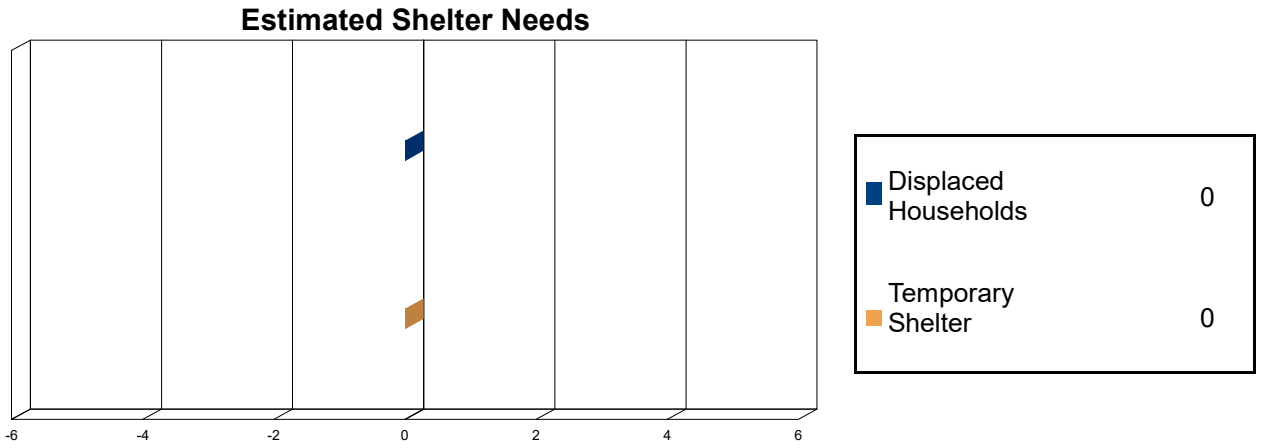


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling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

The model estimates that a total of 21,522 tons of debris will be generated. Of the total amount, 17,182 tons (80%) is Other Tree Debris. Of the remaining 4,340 tons, Brick/Wood comprises 24% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 41 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 3,317 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

Social Impact

Shelter Requirement



Hazus estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the hurricane. Of these, 0 people (out of a total population of 10,646) will seek temporary shelter in public shelters.

Economic Loss

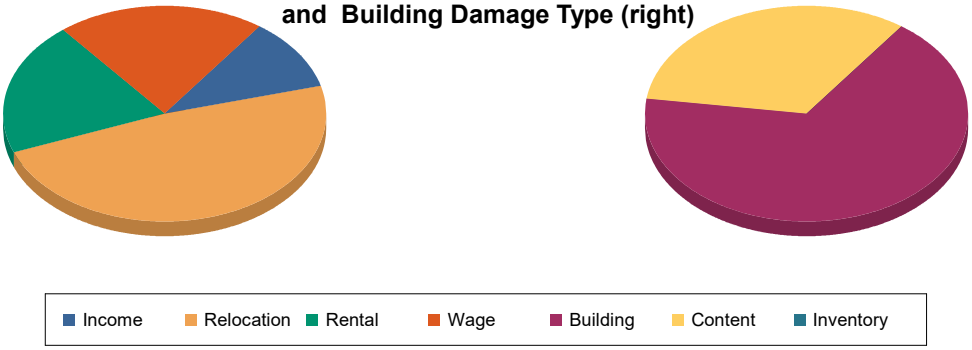
The total economic loss estimated for the hurricane is 34.4 million dollars, which represents 1.54 % of the total replacement value of the region's buildings.

Building-Related Losses

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

The total property damage losses were 34 million dollars. 3% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 95% of the total loss. Table 5 below provides a summary of the losses associated with the building damage.

Loss by Business Interruption Type (left) and Building Damage Type (right)



Loss Type by General Occupancy

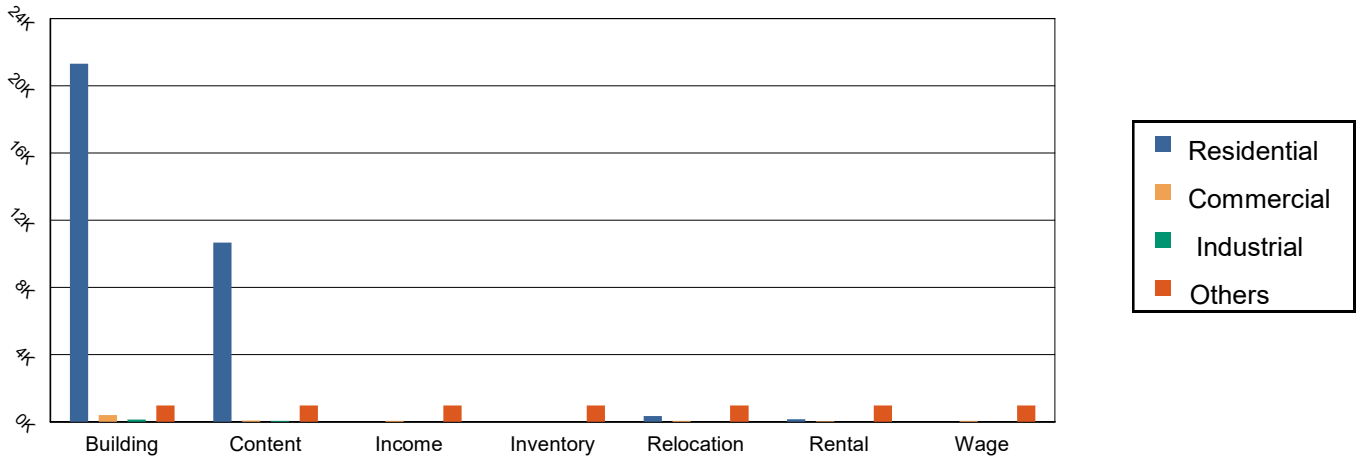


Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	21,319.30	411.49	127.82	621.80	22,480.40
	Content	10,659.97	72.57	62.85	111.58	10,906.98
	Inventory	0.00	0.76	9.92	0.82	11.50
	Subtotal	**31,979.27**	**484.82**	**200.59**	**734.20**	**33,398.88**
Business Interruption Loss						
	Income	0.00	59.49	1.28	42.71	103.48
	Relocation	340.82	54.96	4.94	60.76	461.47
	Rental	153.09	33.93	0.96	2.90	190.89
	Wage	0.00	57.25	2.16	140.60	200.01
	Subtotal	**493.91**	**205.63**	**9.33**	**246.98**	**955.85**

Total

Total	**32,473.18**	**690.45**	**209.92**	**981.17**	**34,354.73**

Appendix A: County Listing for the Region

Massachusetts
- Middlesex

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
Massachusetts				
Middlesex	10,646	1,732,230	502,165	2,234,395
Total	**10,646**	**1,732,230**	**502,165**	**2,234,395**
Study Region Total	**10,646**	**1,732,230**	**502,165**	**2,234,395**

Hazus: Earthquake Global Risk Report

Region Name	Groton_HMP
Earthquake Scenario:	Groton Magnitude 5.0 Earthquake
Print Date:	February 18, 2020

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

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

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General Description of the Region

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

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

Massachusetts

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

The geographical size of the region is 33.75 square miles and contains 2 census tracts. There are over 3 thousand households in the region which has a total population of 10,646 people (2010 Census Bureau data). The distribution of population by Total Region and County is provided in Appendix B.

There are an estimated 4 thousand buildings in the region with a total building replacement value (excluding contents) of 2,234 (millions of dollars). Approximately 92.00 % of the buildings (and 78.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 399 and 19 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 4 thousand buildings in the region which have an aggregate total replacement value of 2,234 (millions of dollars) . Appendix B provides a general distribution of the building value by Total Region and County.

In terms of building construction types found in the region, wood frame construction makes up 88% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

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

For essential facilities, there are 0 hospitals in the region with a total bed capacity of beds. There are 9 schools, 1 fire stations, 1 police stations and 0 emergency operation facilities. With respect to high potential loss facilities (HPL), there are no dams identified within the inventory. The inventory also includes 4 hazardous material sites, no military installations and no nuclear power plants.

Transportation and Utility Lifeline Inventory

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

The total value of the lifeline inventory is over 418.00 (millions of dollars). This inventory includes over 57.79 miles of highways, 1 bridges, 592.79 miles of pipes.

Table 1: Transportation System Lifeline Inventory

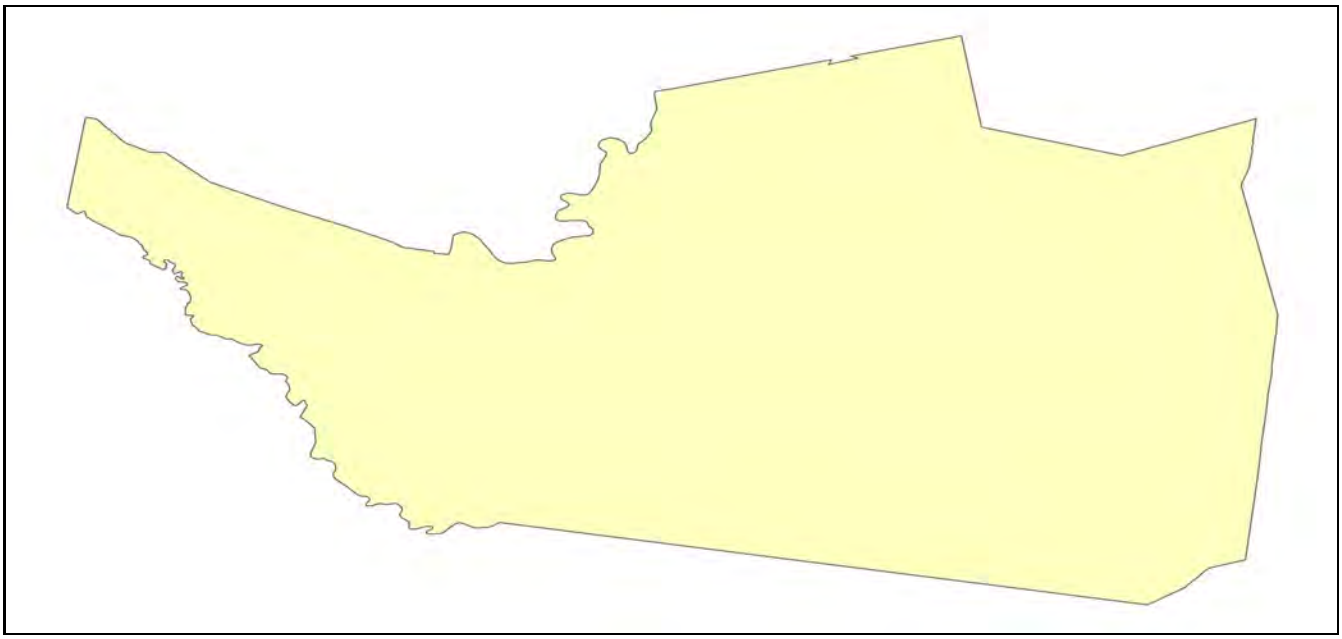
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	1	5.6090
	Segments	34	343.5654
	Tunnels	0	0.0000
		Subtotal	**349.1744**
Railways	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	28	37.4926
	Tunnels	0	0.0000
		Subtotal	**37.4926**
Light Rail	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	2	13.1193
	Tunnels	0	0.0000
		Subtotal	**13.1193**
Bus	Facilities	0	0.0000
		Subtotal	**0.0000**
Ferry	Facilities	0	0.0000
		Subtotal	**0.0000**
Port	Facilities	0	0.0000
		Subtotal	**0.0000**
Airport	Facilities	0	0.0000
	Runways	0	0.0000
		Subtotal	**0.0000**
		Total	**399.80**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	9.5489
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**9.5489**
Waste Water	Distribution Lines	NA	5.7293
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**5.7293**
Natural Gas	Distribution Lines	NA	3.8196
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**3.8196**
Oil Systems	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**0.0000**
Electrical Power	Facilities	0	0.0000
		Subtotal	**0.0000**
Communication	Facilities	0	0.0000
		Subtotal	**0.0000**
		Total	**19.10**

Earthquake Scenario

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



Scenario Name	Groton Magnitude 5.0 Earthquake
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-71.57
Latitude of Epicenter	42.61
Earthquake Magnitude	5.00
Depth (km)	10.00
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	Central & East US (CEUS 2008)

Direct Earthquake Damage

Building Damage

Hazus estimates that about 813 buildings will be at least moderately damaged. This is over 20.00 % of the buildings in the region. There are an estimated 37 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Damage Categories by General Occupancy Type

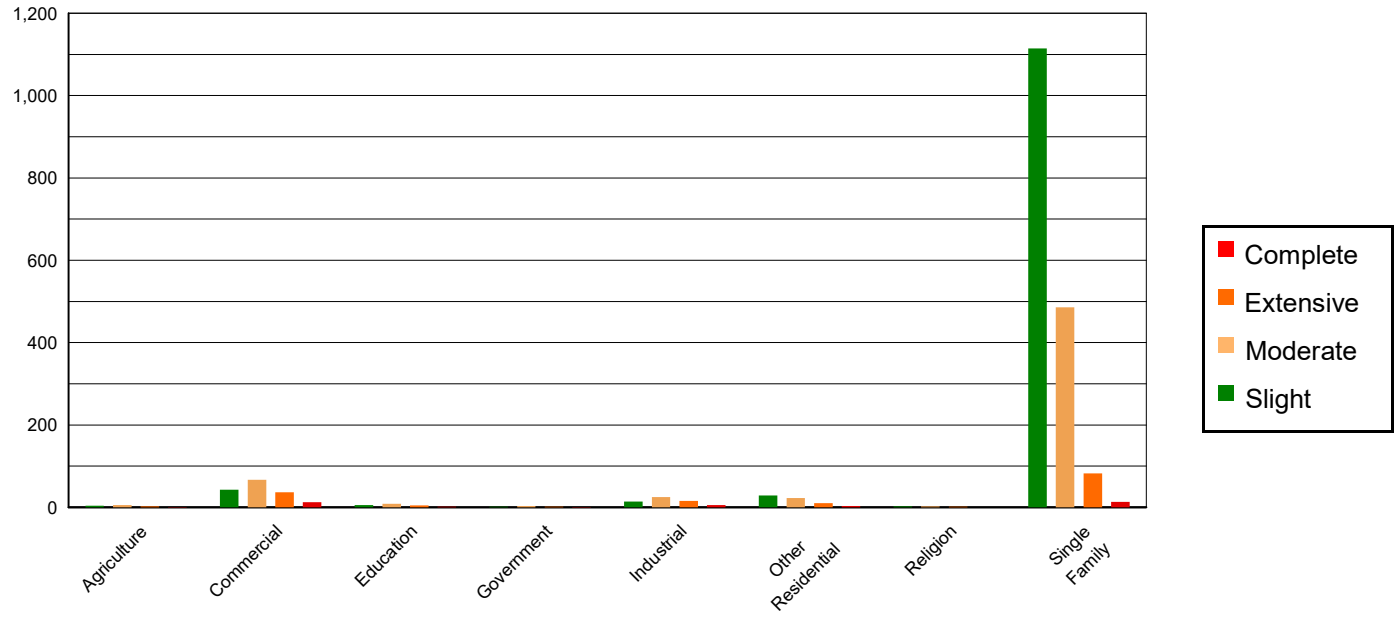


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	3.73	0.18	4.13	0.34	5.66	0.91	2.61	1.68	0.88	2.33
Commercial	46.05	2.22	43.08	3.55	66.65	10.75	36.75	23.62	12.47	33.15
Education	6.14	0.30	5.28	0.44	8.46	1.36	4.60	2.95	1.52	4.05
Government	1.92	0.09	1.67	0.14	2.99	0.48	1.81	1.16	0.61	1.62
Industrial	16.05	0.77	14.11	1.16	25.18	4.06	15.42	9.91	5.23	13.91
Other Residential	46.57	2.24	28.54	2.35	22.66	3.65	10.20	6.55	3.03	8.05
Religion	3.93	0.19	2.60	0.21	2.62	0.42	1.40	0.90	0.45	1.21
Single Family	1954.26	94.02	1114.58	91.81	485.93	78.36	82.81	53.23	13.42	35.68
Total	**2,079**		**1,214**		**620**		**156**		**38**	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	1967.02	94.63	1120.86	92.33	474.83	76.57	65.60	42.16	4.89	13.01
Steel	30.30	1.46	25.90	2.13	54.18	8.74	34.83	22.38	12.36	32.86
Concrete	4.88	0.23	4.29	0.35	10.05	1.62	6.40	4.12	1.94	5.16
Precast	1.96	0.09	1.42	0.12	3.65	0.59	3.64	2.34	1.10	2.93
RM	10.73	0.52	5.14	0.42	10.71	1.73	8.59	5.52	1.52	4.05
URM	63.77	3.07	56.37	4.64	66.73	10.76	36.53	23.48	15.79	41.98
MH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**2,079**		**1,214**		**620**		**156**		**38**	

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

Essential Facility Damage

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

Table 5: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	0	0	0	0
Schools	9	8	0	0
EOCs	0	0	0	0
PoliceStations	1	1	0	0
FireStations	1	1	0	0

Transportation Lifeline Damage

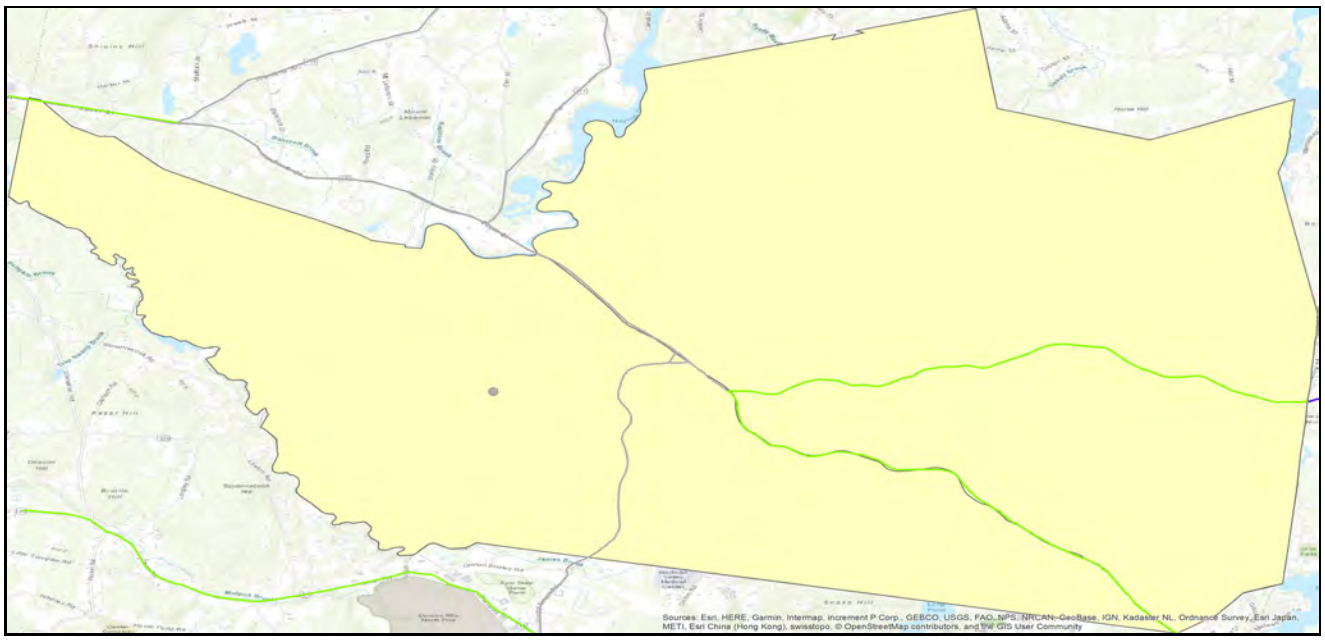


Table 6: Expected Damage to the Transportation Systems

System	Component		Number of Locations			
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	34	0	0	33	33
	Bridges	1	1	0	0	1
	Tunnels	0	0	0	0	0
Railways	Segments	28	0	0	10	10
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	2	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	0	0	0	0	0
	Runways	0	0	0	0	0

Table 6 provides damage estimates for the transportation system.

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

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

Table 7 : Expected Utility System Facility Damage

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

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

System	Total Pipelines Length (miles)	Number of Leaks	Number of Breaks
Potable Water	297	77	19
Waste Water	178	39	10
Natural Gas	119	13	3
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	3,753	0	0	0	0	0
Electric Power		3,147	2,079	862	153	4

Induced Earthquake Damage

Fire Following Earthquake

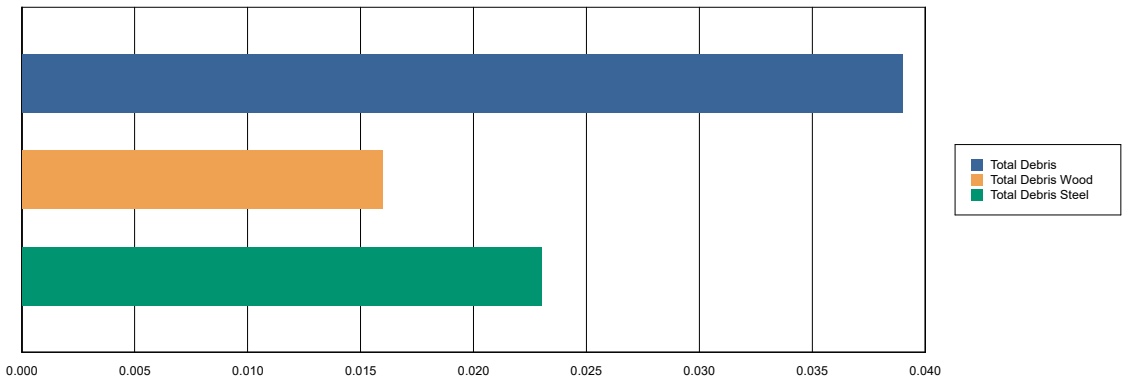
Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 0 ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (millions of dollars) of building value.

Debris Generation

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

The model estimates that a total of 39,000 tons of debris will be generated. Of the total amount, Brick/Wood comprises 41.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 1,560 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Earthquake Debris (millions of tons)



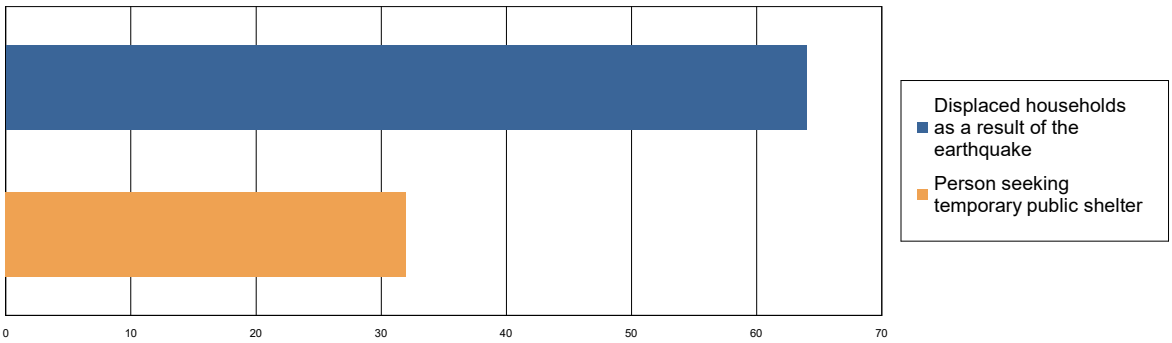
Brick/ Wood	Reinforced Concrete/Steel	Total Debris	Truck Load
0.02	0.02	0.04	1,560 (@25 tons/truck)

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 64 households to be displaced due to the earthquake. Of these, 32 people (out of a total population of 10,646) will seek temporary shelter in public shelters.

Displaced Households/ Persons Seeking Short Term Public Shelter



Displaced households as a result of the earthquake	Persons seeking temporary public shelter
64	32

Casualties

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

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

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

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

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0.64	0.16	0.02	0.04
	Commuting	0.00	0.01	0.01	0.00
	Educational	0.00	0.00	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	1.19	0.30	0.04	0.08
	Other-Residential	4.89	1.24	0.19	0.37
	Single Family	11.68	2.00	0.21	0.40
	Total	**18**	**4**	**0**	**1**
2 PM	Commercial	35.91	8.83	1.22	2.37
	Commuting	0.04	0.05	0.09	0.02
	Educational	20.23	5.14	0.76	1.48
	Hotels	0.00	0.00	0.00	0.00
	Industrial	8.79	2.20	0.31	0.61
	Other-Residential	0.80	0.20	0.03	0.06
	Single Family	1.89	0.34	0.04	0.07
	Total	**68**	**17**	**2**	**5**
5 PM	Commercial	26.73	6.60	0.92	1.76
	Commuting	0.68	0.80	1.49	0.28
	Educational	1.32	0.34	0.05	0.10
	Hotels	0.00	0.00	0.00	0.00
	Industrial	5.49	1.38	0.20	0.38
	Other-Residential	1.93	0.50	0.08	0.14
	Single Family	4.59	0.81	0.09	0.17
	Total	**41**	**10**	**3**	**3**

Economic Loss

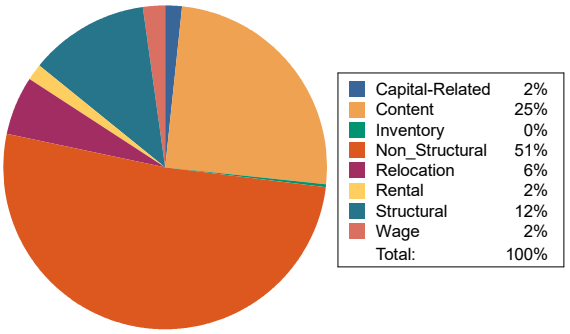
The total economic loss estimated for the earthquake is 280.17 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

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

The total building-related losses were 278.43 (millions of dollars); 12 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 55 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Earthquake Losses by Loss Type ($ millions)



Earthquake Losses by Occupancy Type ($ millions)

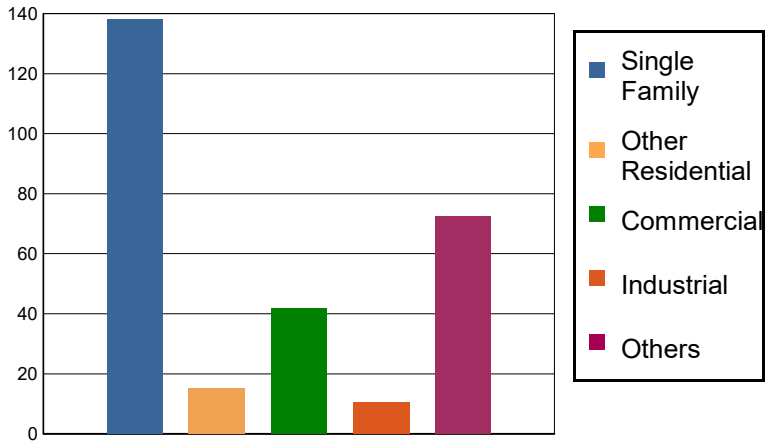


Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	0.7159	3.9963	0.2263	1.6357	6.5742
	Capital-Related	0.0000	0.3032	3.7138	0.1322	0.5793	4.7285
	Rental	1.3347	0.8989	2.1560	0.0590	0.4065	4.8551
	Relocation	4.7807	0.4110	3.1580	0.3403	7.3320	16.0220
	Subtotal	**6.1154**	**2.3290**	**13.0241**	**0.7578**	**9.9535**	**32.1798**
Capital Stock Losses							
	Structural	13.2747	1.9664	5.0984	1.4034	11.1468	32.8897
	Non_Structural	80.0606	8.5238	15.4017	4.7555	34.1131	142.8547
	Content	38.5282	2.4765	8.3314	3.0962	17.3772	69.8095
	Inventory	0.0000	0.0000	0.1104	0.5537	0.0324	0.6965
	Subtotal	**131.8635**	**12.9667**	**28.9419**	**9.8088**	**62.6695**	**246.2504**
	Total	**137.98**	**15.30**	**41.97**	**10.57**	**72.62**	**278.43**

Transportation and Utility Lifeline Losses

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

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

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	343.5654	0.0000	0.00
	Bridges	5.6090	1.1576	20.64
	Tunnels	0.0000	0.0000	0.00
	Subtotal	**349.1744**	**1.1576**	
Railways	Segments	37.4926	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**37.4926**	**0.0000**	
Light Rail	Segments	13.1193	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**13.1193**	**0.0000**	
Bus	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Ferry	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Port	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Airport	Facilities	0.0000	0.0000	0.00
	Runways	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
	Total	**399.79**	**1.16**	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Line	9.5489	0.3485	3.65
	Subtotal	**9.5489**	**0.3485**	
Waste Water	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Line	5.7293	0.1750	3.05
	Subtotal	**5.7293**	**0.1750**	
Natural Gas	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Line	3.8196	0.0600	1.57
	Subtotal	**3.8196**	**0.0600**	
Oil Systems	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Electrical Power	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Communication	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
	Total	**19.10**	**0.58**	

Appendix A: County Listing for the Region

Middlesex,MA

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Massachusetts					
	Middlesex	10,646	1,732	502	2,234
Total Region		**10,646**	**1,732**	**502**	**2,234**

Hazus: Earthquake Global Risk Report

Region Name	Groton_HMP
Earthquake Scenario:	Groton Magnitude 7.0 Earthquake
Print Date:	April 28, 2020

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

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

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For essential facilities, there are 0 hospitals in the region with a total bed capacity of beds. There are 9 schools, 1 fire stations, 1 police stations and 0 emergency operation facilities. With respect to high potential loss facilities (HPL), there are no dams identified within the inventory. The inventory also includes 4 hazardous material sites, no military installations and no nuclear power plants.

Transportation and Utility Lifeline Inventory

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

The total value of the lifeline inventory is over 418.00 (millions of dollars). This inventory includes over 57.79 miles of highways, 1 bridges, 592.79 miles of pipes.

Table 1: Transportation System Lifeline Inventory

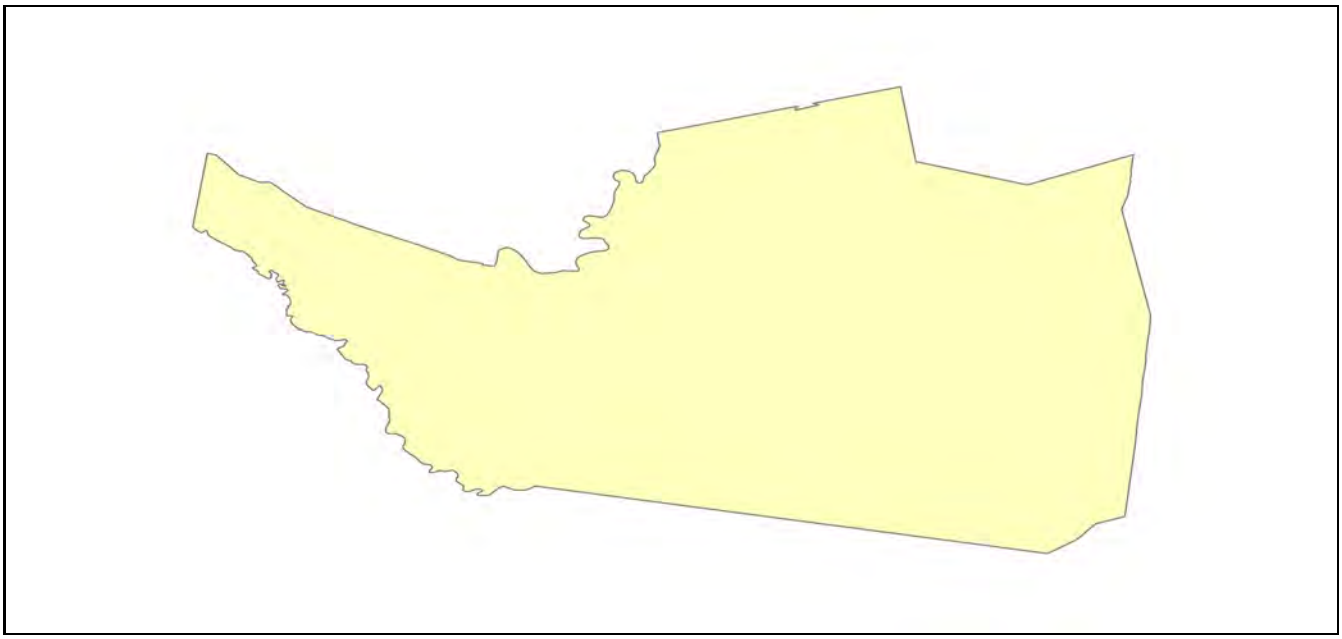
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	1	5.6090
	Segments	34	343.5654
	Tunnels	0	0.0000
		Subtotal	**349.1744**
Railways	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	28	37.4926
	Tunnels	0	0.0000
		Subtotal	**37.4926**
Light Rail	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	2	13.1193
	Tunnels	0	0.0000
		Subtotal	**13.1193**
Bus	Facilities	0	0.0000
		Subtotal	**0.0000**
Ferry	Facilities	0	0.0000
		Subtotal	**0.0000**
Port	Facilities	0	0.0000
		Subtotal	**0.0000**
Airport	Facilities	0	0.0000
	Runways	0	0.0000
		Subtotal	**0.0000**
		Total	**399.80**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	9.5489
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**9.5489**
Waste Water	Distribution Lines	NA	5.7293
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**5.7293**
Natural Gas	Distribution Lines	NA	3.8196
	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**3.8196**
Oil Systems	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**0.0000**
Electrical Power	Facilities	0	0.0000
		Subtotal	**0.0000**
Communication	Facilities	0	0.0000
		Subtotal	**0.0000**
		Total	**19.10**

Earthquake Scenario

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



Scenario Name	Groton Magnitude 7.0 Earthquake
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-71.56
Latitude of Epicenter	42.61
Earthquake Magnitude	7.00
Depth (km)	12.00
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	Central & East US (CEUS 2008)

Direct Earthquake Damage

Building Damage

Hazus estimates that about 3,976 buildings will be at least moderately damaged. This is over 97.00 % of the buildings in the region. There are an estimated 1,906 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Damage Categories by General Occupancy Type

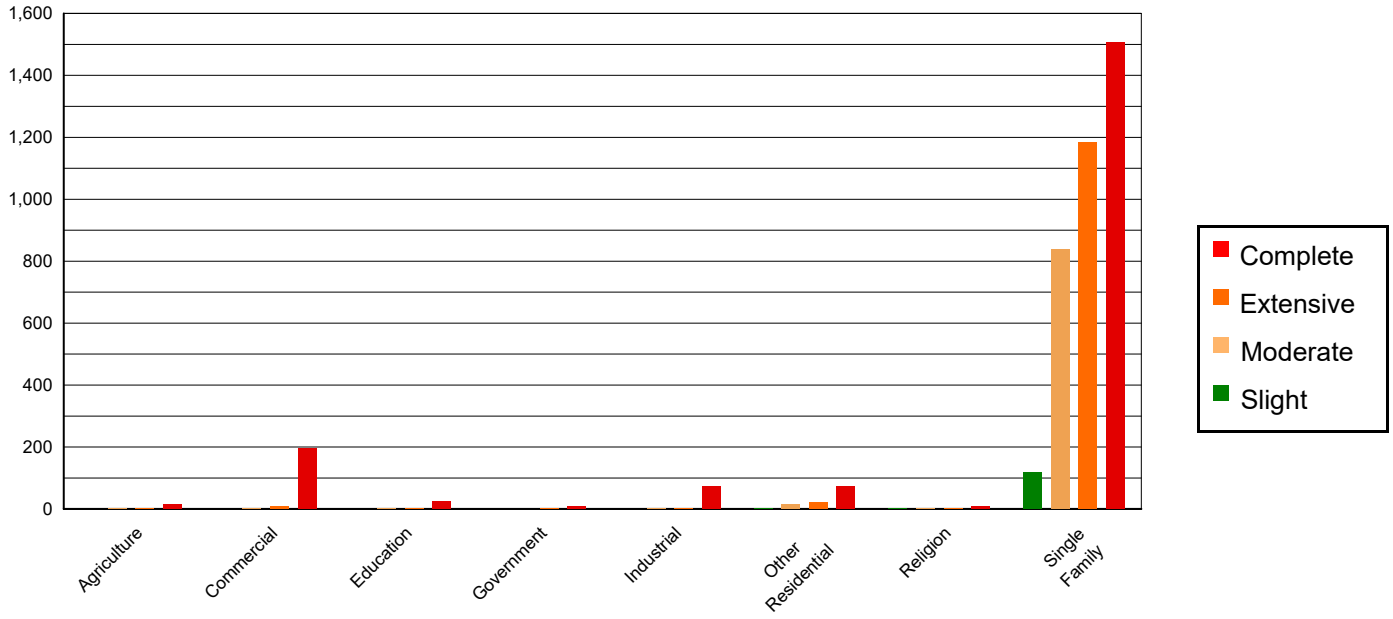


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	0.00	0.01	0.00	0.00	0.08	0.01	0.90	0.07	16.01	0.84
Commercial	0.01	0.10	0.05	0.04	0.79	0.09	7.23	0.59	196.92	10.33
Education	0.00	0.02	0.01	0.01	0.09	0.01	0.81	0.07	25.09	1.32
Government	0.00	0.01	0.00	0.00	0.02	0.00	0.21	0.02	8.76	0.46
Industrial	0.00	0.04	0.01	0.01	0.19	0.02	1.91	0.16	73.88	3.88
Other Residential	0.13	1.66	2.06	1.70	14.79	1.73	21.92	1.80	72.10	3.78
Religion	0.01	0.12	0.14	0.11	0.97	0.11	1.49	0.12	8.38	0.44
Single Family	7.90	98.06	119.12	98.13	836.79	98.02	1182.10	97.17	1505.09	78.96
Total	**8**		**121**		**854**		**1,217**		**1,906**	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	8.04	99.80	121.23	99.86	851.90	99.78	1205.39	99.08	1446.66	75.89
Steel	0.01	0.10	0.01	0.01	0.14	0.02	2.66	0.22	154.76	8.12
Concrete	0.00	0.00	0.00	0.00	0.03	0.00	0.37	0.03	27.16	1.42
Precast	0.00	0.00	0.00	0.00	0.02	0.00	0.08	0.01	11.68	0.61
RM	0.01	0.10	0.01	0.01	0.16	0.02	0.48	0.04	36.04	1.89
URM	0.00	0.00	0.14	0.12	1.49	0.17	7.62	0.63	229.94	12.06
MH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**8**		**121**		**854**		**1,217**		**1,906**	

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

Essential Facility Damage

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

Table 5: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	0	0	0	0
Schools	9	9	9	0
EOCs	0	0	0	0
PoliceStations	1	1	1	0
FireStations	1	1	1	0

Transportation Lifeline Damage

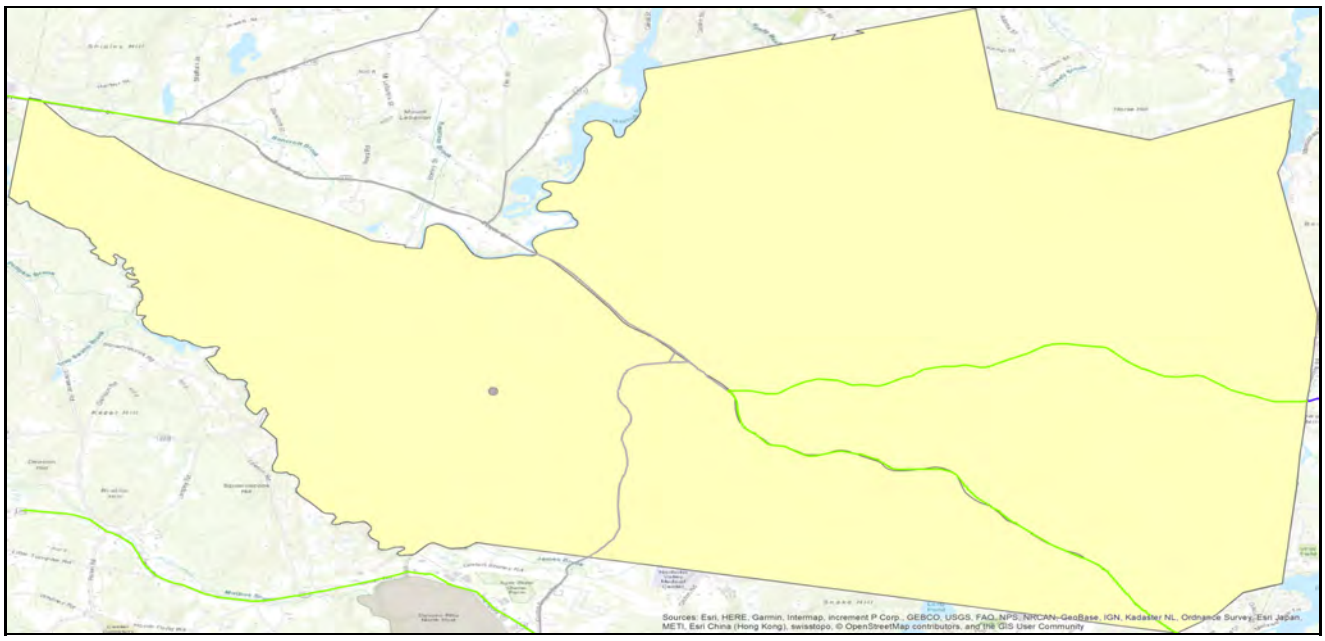


Table 6: Expected Damage to the Transportation Systems

System	Component		Number of Locations			
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	34	0	0	33	33
	Bridges	1	1	1	0	0
	Tunnels	0	0	0	0	0
Railways	Segments	28	0	0	10	10
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	2	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	0	0	0	0	0
	Runways	0	0	0	0	0

Table 6 provides damage estimates for the transportation system.

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

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

Table 7 : Expected Utility System Facility Damage

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

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

System	Total Pipelines Length (miles)	Number of Leaks	Number of Breaks
Potable Water	297	2506	626
Waste Water	178	1259	315
Natural Gas	119	431	108
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	3,753	3,747	3,745	3,737	0	0
Electric Power		3,618	3,414	2,821	1,196	4

Induced Earthquake Damage

Fire Following Earthquake

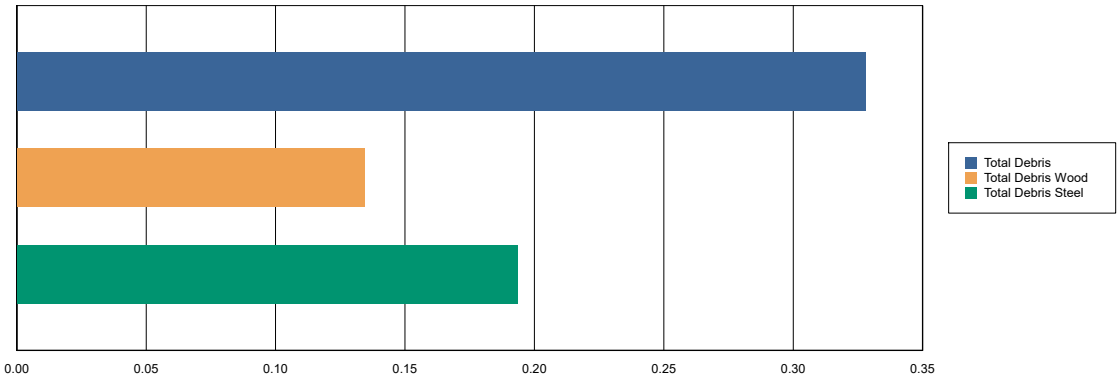
Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 0 ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (millions of dollars) of building value.

Debris Generation

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

The model estimates that a total of 328,000 tons of debris will be generated. Of the total amount, Brick/Wood comprises 41.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 13,120 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Earthquake Debris (millions of tons)



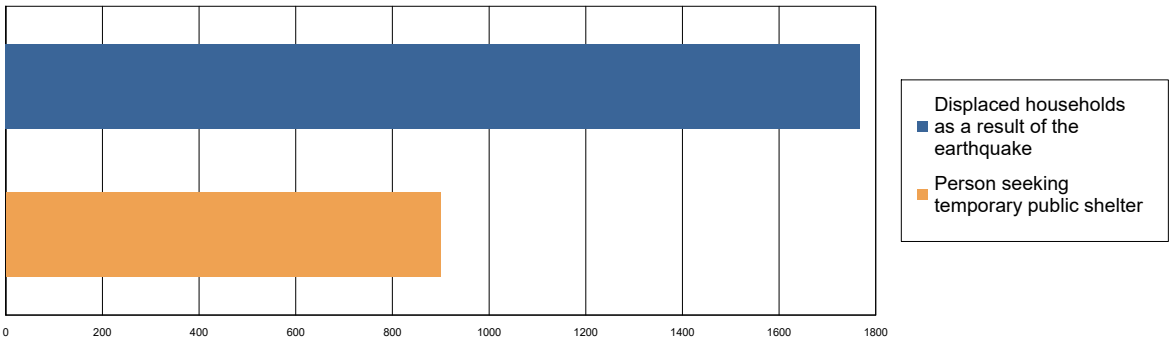
Brick/ Wood	Reinforced Concrete/Steel	Total Debris	Truck Load
0.13	0.19	0.33	13,120 (@25 tons/truck)

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 1,767 households to be displaced due to the earthquake. Of these, 899 people (out of a total population of 10,646) will seek temporary shelter in public shelters.

Displaced Households/ Persons Seeking Short Term Public Shelter



Displaced households as a result of the earthquake	Persons seeking temporary public shelter
1,767	899

Casualties

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

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

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

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

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	6.64	2.11	0.33	0.66
	Commuting	0.03	0.04	0.07	0.01
	Educational	0.00	0.00	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	11.30	3.68	0.60	1.19
	Other-Residential	57.46	18.39	2.92	5.73
	Single Family	303.25	76.41	6.35	11.20
	Total	**379**	**101**	**10**	**19**
2 PM	Commercial	373.47	118.86	18.83	36.85
	Commuting	0.28	0.33	0.62	0.12
	Educational	212.04	69.40	11.61	22.64
	Hotels	0.00	0.00	0.00	0.00
	Industrial	83.92	27.30	4.49	8.75
	Other-Residential	9.47	3.04	0.50	0.93
	Single Family	50.51	12.79	1.24	1.88
	Total	**730**	**232**	**37**	**71**
5 PM	Commercial	279.45	89.02	14.26	27.39
	Commuting	4.91	5.77	10.68	2.02
	Educational	13.80	4.52	0.75	1.47
	Hotels	0.00	0.00	0.00	0.00
	Industrial	52.45	17.06	2.80	5.47
	Other-Residential	22.91	7.35	1.20	2.24
	Single Family	122.34	30.97	3.01	4.56
	Total	**496**	**155**	**33**	**43**

Economic Loss

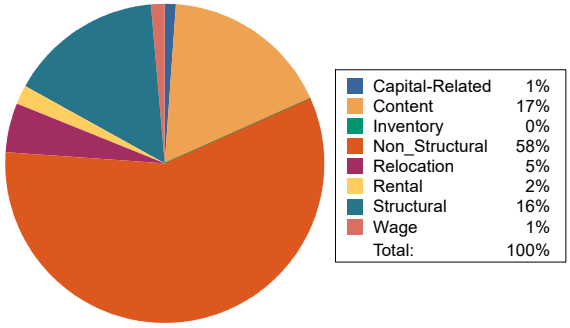
The total economic loss estimated for the earthquake is 2,154.52 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

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

The total building-related losses were 2,130.24 (millions of dollars); 9 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 65 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Earthquake Losses by Loss Type ($ millions)



Earthquake Losses by Occupancy Type ($ millions)

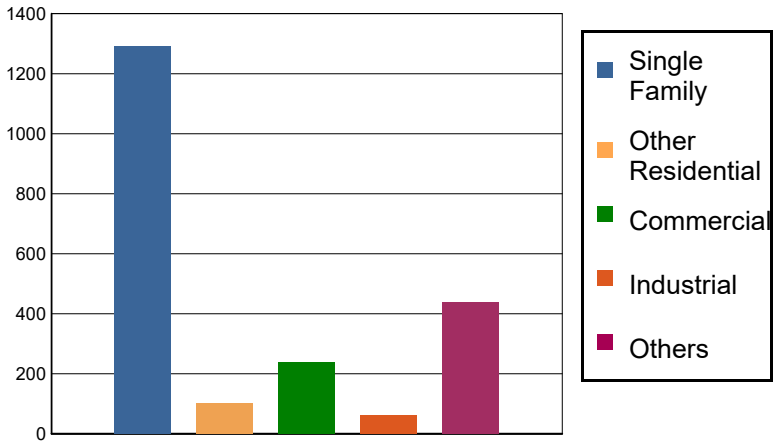


Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	4.1782	17.5135	0.9684	7.0162	29.6763
	Capital-Related	0.0000	1.7696	17.3177	0.5592	2.5902	22.2367
	Rental	20.7914	5.4087	8.1529	0.2110	1.5924	36.1564
	Relocation	68.3579	2.3721	11.3025	1.0166	27.1590	110.2081
	Subtotal	**89.1493**	**13.7286**	**54.2866**	**2.7552**	**38.3578**	**198.2775**
Capital Stock Losses							
	Structural	228.9811	12.1917	26.9320	6.6379	59.4585	334.2012
	Non_Structural	794.3389	61.6134	104.8339	31.6194	235.3183	1,227.7239
	Content	178.4680	13.3258	50.2361	18.4484	105.3875	365.8658
	Inventory	0.0000	0.0000	0.6638	3.3086	0.2028	4.1752
	Subtotal	**1201.7880**	**87.1309**	**182.6658**	**60.0143**	**400.3671**	**1931.9661**
	Total	**1290.94**	**100.86**	**236.95**	**62.77**	**438.72**	**2130.24**

Transportation and Utility Lifeline Losses

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

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

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	343.5654	0.0000	0.00
	Bridges	5.6090	5.3938	96.16
	Tunnels	0.0000	0.0000	0.00
	Subtotal	**349.1744**	**5.3938**	
Railways	Segments	37.4926	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**37.4926**	**0.0000**	
Light Rail	Segments	13.1193	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**13.1193**	**0.0000**	
Bus	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Ferry	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Port	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Airport	Facilities	0.0000	0.0000	0.00
	Runways	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
	Total	**399.79**	**5.39**	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Line	9.5489	11.2748	118.07
	Subtotal	**9.5489**	**11.2748**	
Waste Water	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Line	5.7293	5.6636	98.85
	Subtotal	**5.7293**	**5.6636**	
Natural Gas	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Line	3.8196	1.9403	50.80
	Subtotal	**3.8196**	**1.9403**	
Oil Systems	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Electrical Power	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Communication	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
	Total	**19.10**	**18.88**	

Appendix A: County Listing for the Region

Middlesex,MA

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Massachusetts					
	Middlesex	10,646	1,732	502	2,234
Total Region		**10,646**	**1,732**	**502**	**2,234**

Appendix C

Workshop Materials

TOWN OF GROTON

173 Main Street
Groton, Massachusetts 01450
Tel: (978) 448-1105
Fax: (978) 448-1113
Planning@townofgroton.org

Office of the
PLANNING BOARD

December 20, 2019

Greetings,

The Town of Groton was recently awarded a grant from the Commonwealth's Municipal Vulnerability Preparedness (MVP) Program to identify priority action items that will improve our community's resilience to climate change and to update our hazard mitigation plan.

As a leader in our community, we hope you or a designee can join the Town at an important upcoming invitation-only workshop on January 16, 2020, from 9:00 AM – 5:00 PM. The workshop will take place at The Center (163 West Main Street). The snow date for the event will be January 30th and an email will be sent by 7:00 AM on January 16th if the event will be postponed.

The workshop will follow the Community Resilience Building guidance developed by the Nature Conservancy, which has been successfully used in over 200 communities. The workshop's objectives are to:

- Identify natural hazards that present the greatest threat to the community.
- Evaluate strengths and vulnerabilities of residents, infrastructure, and natural resources.
- Develop and prioritize actions that reduce the impact of hazards and increase resilience.

By participating in this effort, Groton will be designated as an MVP Community and be eligible for future grants that promote resilience. We will also be hosting a listening session open to the public to receive broader input on the planning process (dates to be determined).

Please RSVP for the workshop by January 9th by replying to this email or responding to a forthcoming calendar invitation. We will be serving lunch and refreshments.

Thank you for your consideration and participation!

Sincerely,

Takashi Tada
Land Use Director/Town Planner

Russell Burke, Chair
Groton Planning Board

TOWN OF GROTON

Municipal Vulnerability Preparedness Planning Grant Project

Community Resilience Building Workshop

The Center, 163 West Main Street, Groton, MA
Thursday, January 16, 2020
9:00 am – 5:00 pm

9:00 am – 9:15 am	Registration and Refreshments
9:15 am – 9:30 am	Welcome and Introductions
9:30 am – 9:45 am	MVP Workshop Purpose and Overview • MVP Program Background • Purpose, Desired Outcomes, Objectives, Expectations • Review Agenda • Logistics

9:45 am – 10:30 am	Data Resources and Overview of Science
	• Hazards
	• Existing Climate Change
	• Projected Climate Change
	• Recent Planning Efforts
	• Overview of Data and Maps Used During Workshop
	Risk Matrix
	• Hazards
	• Features
	  • Infrastructure, Societal, Environmental
	  • Vulnerability or Strength
	  • Location
	  • Ownership
	• Actions

10:30 am – 10:45 am	Large Group Exercise #1 • Identify Major Hazards in Community • Prioritize Top Four Hazards
10:45 am – 11:00 am	BREAK
11:00 am – 11:20 am	Small Group Exercise #1 • Infrastructure and Buildings Features: Vulnerability or Strength, Location, Ownership
11:20 am – 11:40 am	Small Group Exercise #2 • Societal Features: Vulnerability or Strength, Location, Ownership
11:40 am – 12:00 pm	Small Group Exercise #3 • Environmental Features: Vulnerability or Strength, Location, Ownership

TOWN OF GROTON

Municipal Vulnerability Preparedness Planning Grant Project

Community Resilience Building Workshop

The Center, 163 West Main Street, Groton, MA
Thursday, January 16, 2020
9:00 am – 5:00 pm

12:00 pm – 1:00 pm	Lunch
1:00 pm – 1:30 pm	MVP Community Actions • Infrastructure • Nature-Based Solutions
1:30 pm – 2:15 pm	Small Group Exercise #4 • Infrastructure and Buildings Features • Define MVP Community Actions
2:15 pm – 3:00 pm	Small Group Exercise #5 • Societal Features • Define MVP Community Actions
3:00 pm – 3:30 pm	Small Group Exercise #6 • Environmental Features • Define MVP Community Actions
3:30 pm – 3:45 pm	BREAK
3:45 pm – 4:45 pm	Large Group Exercise #2 • Identify MVP Priority Actions
4:45 pm – 5:00 pm	Wrap-up and Closing Remarks

Town of Groton
Thursday, January 16, 9:00 am – 5:00 pm
Community Resilience Building Workshop

	Name	Table	Signature
✓	Mark Haddad	3	
✓	Jim Cullen ~~Michael Luth~~	DERBY PD CBS 2	
✓	Michelle Collette	1	
✓	Nikolis Gualco	2	
✓	Russell Burke	1	
✓	Steele McCurdy	3	
✓	Takashi Tada	3	
✓	Tessa David	2	
✓	Thomas Orcutt	3	
	~~Timothy Siok~~	1	
✓	Tom Delaney	1	
✓	Bruce H. Eason	1	
✓	Ari Charles	DEP FIRE. 3	
✓	Hillary King	–	
✓	Tessa David		

Town of Groton
Thursday, January 16, 9:00 am – 5:00 pm
Community Resilience Building Workshop

Name	Table	Signature
Adam Burnett	1	
Alison Dolbear (Peterson)	2	
Alison Manugian	1	
Bob Pine	2	
Eileen McHugh	3	
~~George Barringer~~	2	
George Moore	1	
George Wheatley	3	
John Reilly	2	
Judy Anderson	3	
Kevin Kelly	2	
Lorayne Black	3	
Lynwood "Val" Prest	1	

TOWN OF GROTON

Community Resilience Building Workshop

Thursday January 16, 2020

Weston & Sampson Photo by W&S, 2019 1

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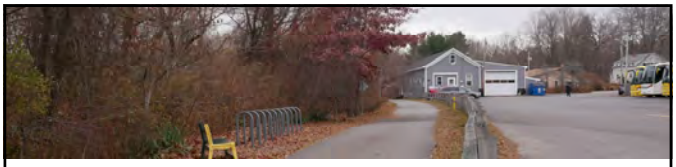

WELCOME PARTICIPANTS

Your name

Organization/Relationship to Groton

Favorite thing about Groton

Weston & Sampson Photo by W&S, 2019 4

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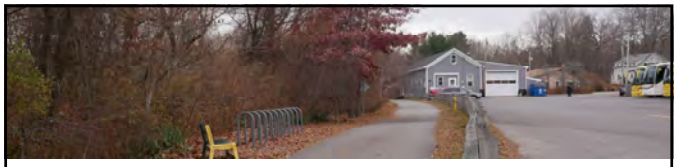

WELCOME CORE TEAM

Takashi Tada	Michelle Collette
Mark Haddad	David Black
Russell Burke	Kevin Kelly
Steele McCurdy	Dan Scheibe
Michael Luth	Nikolis Gualco
Tom Delaney	

Weston & Sampson Photo by W&S, 2019 2

2

WORKSHOP OUTLINE

PRESENTATION:
- Overview of MVP
- Characterization of Hazards

- BREAK -

INDIVIDUAL TABLES:
- Identify Community Features

- LUNCH -

INDIVIDUAL TABLES:
- Identify and Prioritize Actions

- BREAK -

LARGE GROUP DISCUSSION:
- Determine Overall Priority Actions

Photo by W&S, 2019

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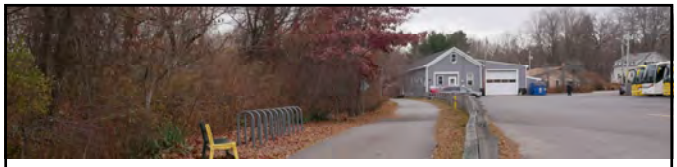

WELCOME W&S

Amanda Kohn

Steve Roy

Adria Boynton

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3

MVP COMPONENTS

PHASE 1 - PLANNING
- Receive Planning Grant
- Prioritize Action Items
- Complete MVP Program
- Submit Final Report for Approval
- Become Certified

PHASE 2 - ACTION
- Select an Action Item from Planning Phase
- Apply for Action Grant Funding
- Implement Action Item

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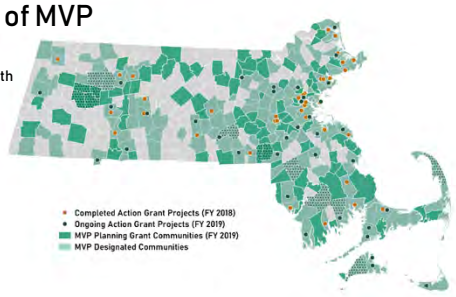
Three Years of MVP

MVP Designations
71% of the Commonwealth
249 communities

Action Grant Projects
FY 18: 37
FY 19: 36

Total Awards
$17M+ in planning and action grants to date



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HAZARD MITIGATION PLAN UPDATE

- Aligns with MVP Process
- Extended hazard profiles and vulnerability assessment
- Update previous mitigation measures table
- Track progress on priority action items

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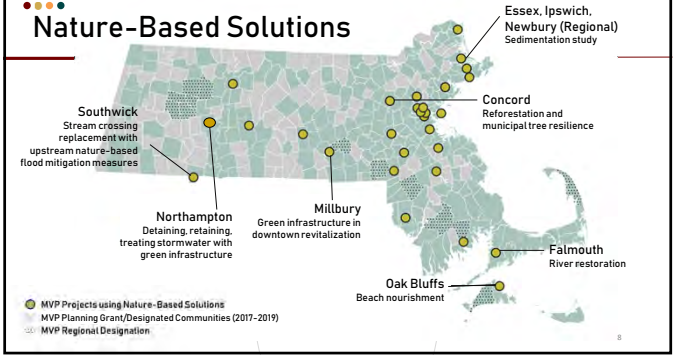
Nature-Based Solutions



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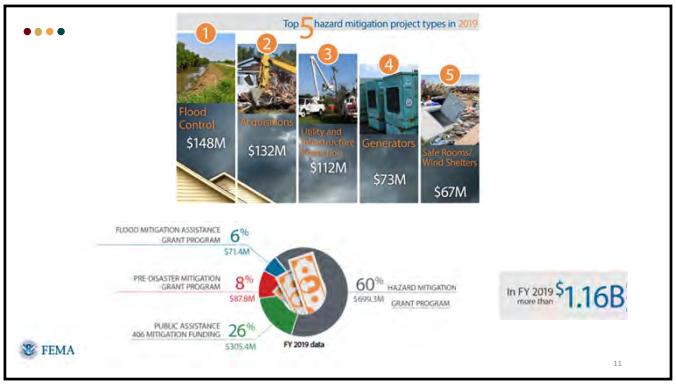

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MVP ACTION GRANT PROJECTS

- Detailed Vulnerability and Risk Assessment
- Public Education and Communication
- Local Bylaws, Ordinances, Plans, and Other Management Measures
- Redesigns and Retrofits
- Energy Resilience Strategies
- Chemical Safety
- Nature-Based Storm-Damage Protection, Drought Prevention, Water Quality, and Water Infiltration Techniques
- Nature-Based, Infrastructure and Technology Solutions to Reduce Vulnerability to Extreme Heat and Poor Air Quality
- Nature-Based Solutions to Reduce Vulnerability to other Climate Change Impacts
- Acquisition of Land to Achieve a Resiliency Objective
- Ecological Restoration and Habitat Management to Increase Resiliency

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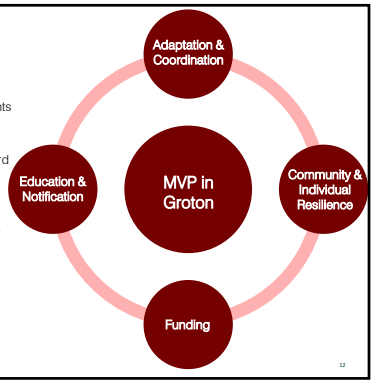
MVP/HMP GOALS IN GROTON

- Provide **shelters and supplies** to displaced residents
- Increase **coordination** between departments, communities, and agencies
- Increase **public education** and awareness of hazard mitigation and climate adaptation
- Provide adequate **notification** to residents in the event of a disaster
- Protect **public infrastructure** and essential services
- Building **community and individual resilience**, including for **vulnerable populations**
- Employ **nature-based solutions**
- Ensure future development **reduces the impact** of future hazards
- Identify potential funding sources for adaptation



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RELEVANT PLANNING DOCUMENTS

In Groton and Massachusetts

- Massachusetts Climate Change Projections (NECSC, 2018)
- Town of Groton 2019-2026 Open Space & Recreation Plan
- Town of Groton 2018 Annual Town Report
- Massachusetts Climate Change Adaptation Report (MA EEA, 2011)
- Montachusett Region Natural Hazard Mitigation Plan 2015 Update
- Nashua, Squannacook, and Nissitissit Rivers Stewardship Plan
- Input from Municipal Officials
- Groton Master Plan, 2011

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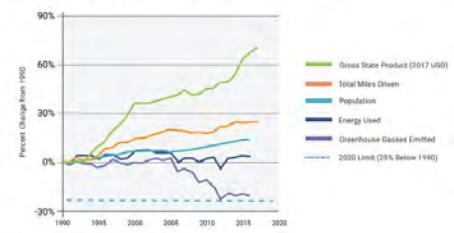
MASSACHUSETTS GHG GOALS

FIGURE 1 | TRENDS OF GROWTH IN GSP, VMT, AND POPULATION WHILE GHG EMISSIONS ARE DECREASING AND ENERGY USE HAS BEEN STABLE



Source: Commonwealth of Massachusetts. 2019. "Global Warming Solutions Act 10-year Progress Report." 10.

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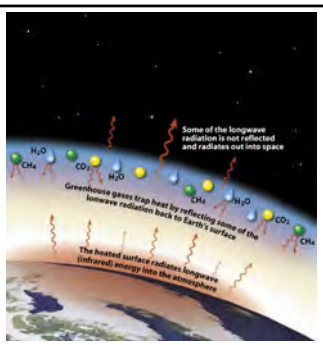
GREENHOUSE GASES (GHG)

- Naturally occurring
- Act as a blanket
- Examples: carbon dioxide and methane

Climate mitigation ensures there is less to adapt to and is a key component of our community's resilience



Smithsonian Environmental Research Center. "Too Much of a Good Thing."
http://bprces.si.edu/atmosphere/02_04_07.html

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HIGH-RISK HAZARDS IN GROTON

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Source: Montachusett Regional Planning Commission (MRPC). 2015. "Montachusett Region Natural Hazard Mitigation Plan 2015 Update." p262.

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MASSACHUSETTS GHG GOALS

Global Warming Solutions Act (GWSA) of 2008

25% reduction in GHG emissions by 2020

80% reduction in GHG emissions by 2050

1990 is the baseline year

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Source: Commonwealth of Massachusetts. 2019. "Global Warming Solutions Act 10-year Progress Report." 10.

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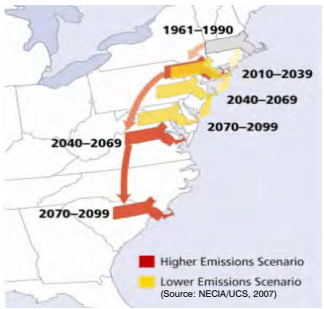

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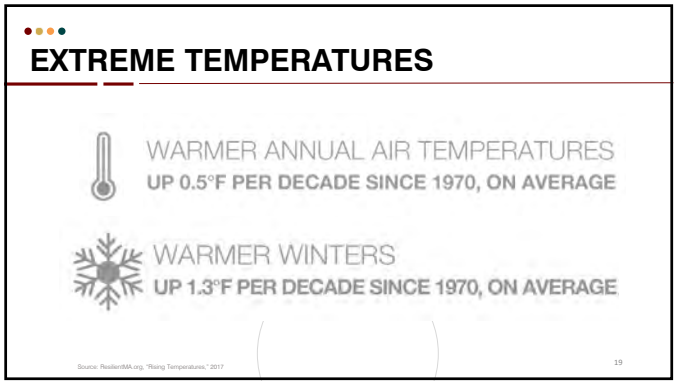

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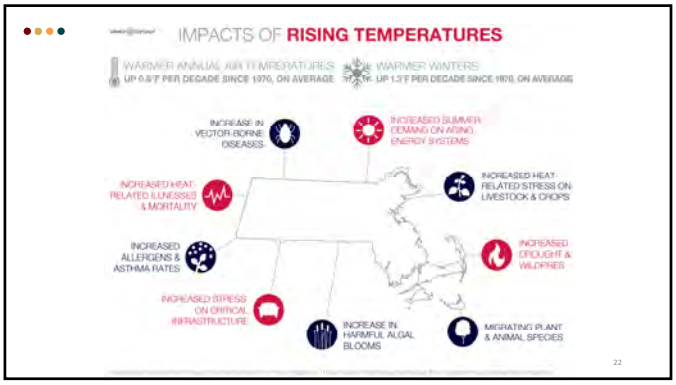

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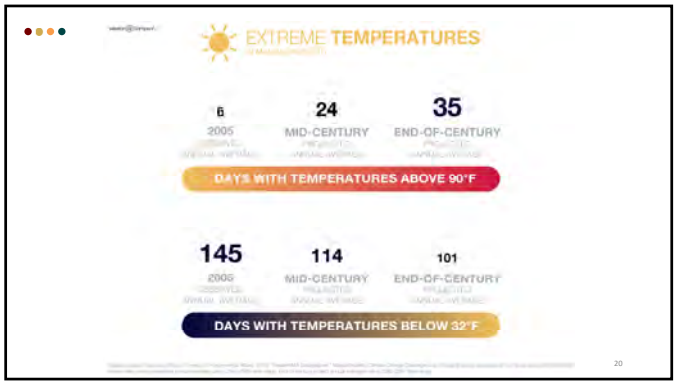

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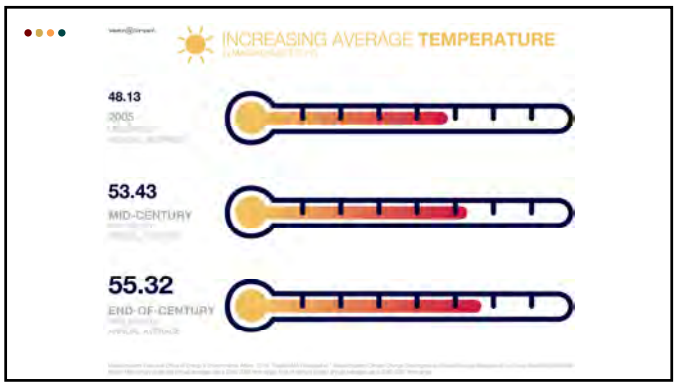

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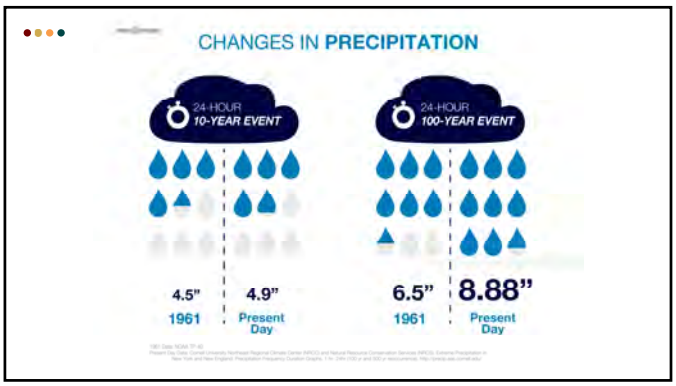

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EXTREME PRECIPITATION

8%

Increase in extreme precipitation events by midcentury

13%

Increase in extreme precipitation events by 2100

Source: Executive Office of Energy and Environmental Affairs, Adaptation Advisory Committee. 2011. "Massachusetts Climate Change Adaptation Report." 19

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FLOODING

ZONE	ANNUAL CHANCE	FLOODPLAIN
A, AE, A1-A30	1% ANNUAL CHANCE	100-YEAR FLOODPLAIN
X	0.2% ANNUAL CHANCE	500-YEAR FLOODPLAIN

"By 2050, Boston could experience the current 100- year riverine flood every two to three years on average"

Source: Executive Office of Energy and Environmental Affairs, Adaptation Advisory Committee. 2011. "Massachusetts Climate Change Adaptation Report." 19.

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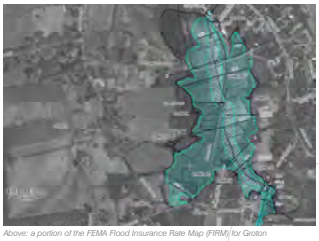
FLOODING



Above: a portion of the FEMA Flood Insurance Rate Map (FIRM) for Groton

NATIONAL FLOOD INSURANCE PROGRAM (NFIP)[1]

Since the initiation of the NFIP, **2** flood insurance claims in the town of Groton have been made, totaling **$12,395.47** in payments

There are **no** repetitive flood loss structures in Groton

1. Montachusett Regional Planning Commission (MRPC). 2015. "Montachusett Region Natural Hazard Mitigation Plan 2015 Update." p258.
Note: Repetitive flood loss structures are defined as an NFIP-insured structure that has had at least 2 paid flood losses of more than $1,000 each in any 10-year period since 1978 (Federal Emergency Management Agency (FEMA). 2019. "Definitions." Accessed August 29, 2019. fema.gov/national-flood-insurance-program/definitions#15)

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FLOODING

LOCALLY IDENTIFIED AREAS OF FLOODING

Local Hazards Map for Groton[1]

- West Main Street and Hill Road (west of the Nashua River)[3]
- Lowell Road and Brook, south of Martins Pond[1]
- Beaver dam northeast of Martins Pond[1]
- West Main Street and Wrangling Brook[1]
- Townsend Road at Park Drive in West Groton[2]
- Area around Baddacook Pond[2]
- Area around Whitney (Cow) Pond[2]
- Area around Lost Lake/Knops Pond[2]
- River Court Housing Complex[3]
- Townsend and Pepperell Streets[3]
- Two bridges on 119[3]
- Nashua River flooding cuts off West Groton[3]

1. Montachusett Regional Planning Commission (MRPC). 2015. "Montachusett Region Natural Hazard Mitigation Plan 2015 Update." p265
2. Town of Groton. 2019. "Town of Groton 2019-2026 Open Space and Recreation Plan." p49
3. Core Team Meeting, December 11, 2019

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FLOODING

RECENT FLOOD EVENTS

Nashua River. Photo by Rich Soar[2]

- The town experienced **25- to 50-year flood events in 1987, 2007 and 2010**[1]
- In 2007, the Nashua and Squannacook Rivers flooded, **causing damage** to Routes 119 and 225 and Broadmeadow Road[1]
- In 2008, the River Court Housing Complex flooded (a 78-unit Assisted Living Center)[3]
- The March 2010 flood event **closed bridges** on Routes 119 and 225, cut off West Groton, and **left several roadways in need of repair**[1,3]
- Hill Road and Broadmeadow have also been closed for flooding[3]
- Flooding at the Groton Inn in 2014 displaced many people[3]

1. Town of Groton. 2019. "Town of Groton 2019-2026 Open Space and Recreation Plan." p67
2. Nashua River Wild and Scenic River Study Committee, Nashua River Watershed Association. 2018. "Nashua, Squannacook, and Nissitissit Rivers Stewardship Plan." px
3. Core Team Meeting, December 11, 2019

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STORMWATER FLOODING

Areas with:

- Poor drainage
- High amounts of impervious surface
- Undersized culverts
  - Route 40 at Cow Pond[1]

Where does stormwater flooding occur in Town?

- Olivia Way (private): the drainage system failed[1]

1. Core Team Meeting, December 11, 2019

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EXTREME STORMS – POWER OUTAGES

Photo by W&S, 2019

- The Town is mainly serviced by its own electric utility[1]
- Only 5% of the Town's power comes from the National Grid[2]
- The utility's tree management efforts help decrease the number of power outages[1]

1. Key Staff Kickoff Meeting, November 18, 2019
2. Core Team Meeting, December 11, 2019

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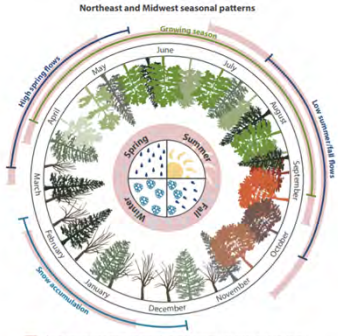

The most notable recent drought event was in **2016**[1]

The occurrence of droughts **lasting 1 to 3 months** could go up by as much as **75% over existing conditions** by the end of the century, under the high emissions scenario[1]

This could impact the groundwater drinking supply and the Fire Department[2]

1. Source: Executive Office of Energy and Environmental Affairs, Adaptation Advisory Committee. 2011. "Massachusetts Climate Change Adaptation Report," 17.
2. Core Team Meeting, December 11, 2019

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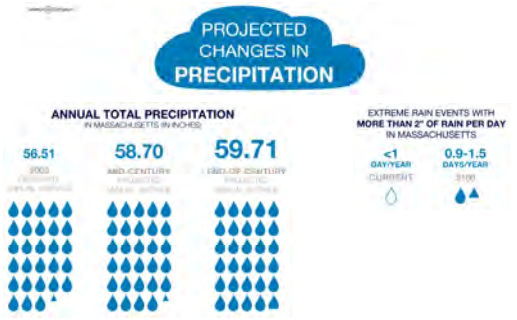

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WINTER STORMS

Nashua River. Photo by Cindy Knox Photography.

- The blizzard of 2013 left nearly **400,000 Massachusetts residents without power**[1]
- "Heavy blizzards are among the **most costly and disruptive** weather events for Massachusetts communities."[1]
- The average annual snowfall for the snowiest city in Eastern Massachusetts is **62.7 inches**[2]
- The Town considers itself to be at **high risk** for Nor'easters and heavy snow, and at **moderate risk** for snow melt, ice jams, ice storms, and blizzards[3]

1. Resilient MA Climate Change Clearinghouse for the Commonwealth. "Extreme Weather," 2017.
2. The snowiest city in Eastern MA is Milton (Commonwealth of Massachusetts. "Massachusetts State Hazard Mitigation and Adaptation Plan," 2018, P4-226).
3. Montachusett Regional Planning Commission (MRPC). 2015. "Montachusett Region Natural Hazard Mitigation Plan 2015 Update." p262
4. Nashua River Wild and Scenic River Study Committee, Nashua River Watershed Association. 2018. "Nashua, Squannacook, and Nissitissit Rivers Stewardship Plan." p1

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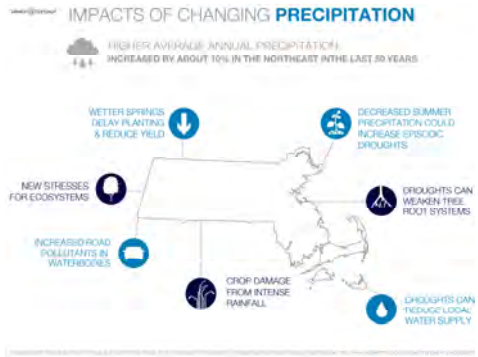

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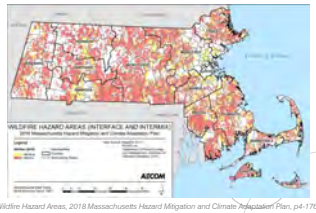
BRUSH FIRE



Wildfire Hazard Areas, 2018 Massachusetts Hazard Mitigation and Climate Adaptation Plan, p4-176

Previous Fires:

- Between 2009-2015, Groton experienced **23 wildland fires** that burned **416 acres**[1]
- 2012 and 2013: **Great Brushfire**
- 2014: **43 fires** during a drought
- After a wildfire at Lost Lake, the Town implemented a **$1.8M mitigation project**[2]

1. Montachusett Regional Planning Commission (MRPC). 2015. "Montachusett Region Natural Hazard Mitigation Plan 2015 Update." p44, 265.
2. Core Team Meeting, December 11, 2019

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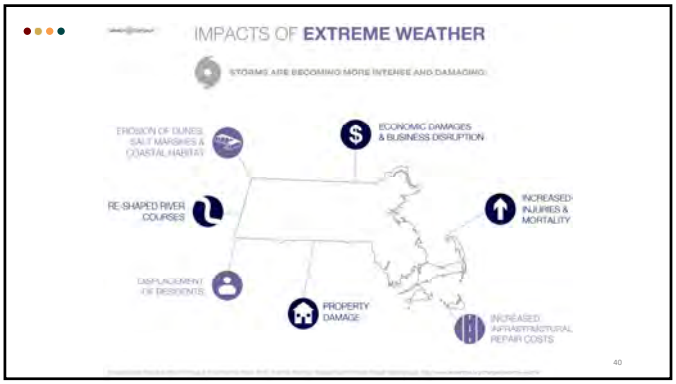

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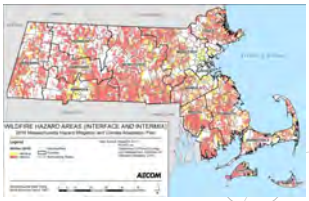
BRUSH FIRE



Wildfire Hazard Areas, 2018 Massachusetts Hazard Mitigation and Climate Adaptation Plan, p4-176

Locally Identified Areas of Fire Risk

- Town Center, around Rt. 119 and Rt. 111[1]
- Lost Lake Drive Neighborhood[1]
- An area without fire hydrants near Island Pond[1]
- Chestnut Hill[2]

Many fires are caused by human error

1. Montachusett Regional Planning Commission (MRPC). 2015. "Montachusett Region Natural Hazard Mitigation Plan 2015 Update." p44, 265.
2. Core Team Meeting, December 11, 2019

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GEOLOGIC HAZARDS

- These hazards include **earthquakes, landslides,** subsidence and unstable soils
- Many structures pre-date the most recent building code, which includes seismic standards
- The Town has a **moderate risk** for earthquakes and landslides[1]
- The Montachusett Region has been affected by **six** relatively small earthquake events between 1978 and 2015. None were in Groton[1]
- Lovers Lane and Meadow Road have experienced construction-related erosion and landslides[2]

1. Montachusett Regional Planning Commission (MRPC). 2015. "Montachusett Region Natural Hazard Mitigation Plan 2015 Update." p47, 262.
2. Core Team Meeting, December 11, 2019

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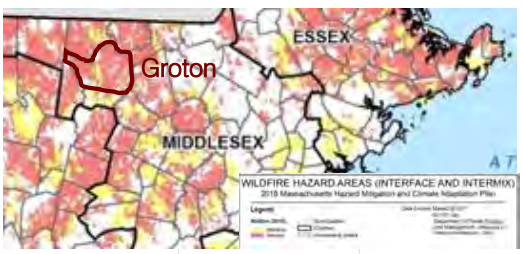
BRUSH FIRE



Wildfire Hazard Areas, 2018 Massachusetts Hazard Mitigation and Climate Adaptation Plan, p4-176

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WIND-RELATED HAZARDS

A downed electric pole. Photo by Groton Electric Light, undated

- These hazards include hurricanes, tornadoes, and high winds during severe storms
- Falling trees and downed power lines causing power outages can be an issue
- The Town considers itself at **high-risk** for high winds, and at **moderate risk** for hurricanes and tornadoes[1]
- The Town experienced microbursts two years ago[2]

1. Montachusett Regional Planning Commission (MRPC). 2015. "Montachusett Region Natural Hazard Mitigation Plan 2015 Update." p262
2. Core Team Meeting, December 11, 2019

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HURRICANES AND EARTHQUAKES

HURRICANE

Sandy
was the most recently identified hurricane according the last HMP

Upward trend in North Atlantic hurricane activity since 1970

Nor'easters along the Atlantic coast are increasing in frequency and intensity

EARTHQUAKE

30-40
Earthquakes occur in New England each year, although most are not felt.

Source: Climate Science Special Report, Fourth National Climate Assessment (NCA4). Volume prepared by the U.S. Global Change Research Program (USGCRP)Northern Middlesex

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As an FYI: Boston Sea Level Rise Projections (ft)

Increased coastal flooding

Permanently inundated low-lying coastal areas

Increased shoreline erosion

Emission Scenario	2030	2050	2070	2100
Intermediate	0.7	1.4	2.3	4.0
Intermediate-High	0.8	1.7	2.9	5.0
High	1.2	2.4	4.2	7.6
Extreme	1.4	3.1	5.4	10.2

(Source: Northeast Climate Adaption Science Center)

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RISK MATRIX

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IDENTIFY HAZARDS

Photo by MAS, 2019

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RISK MATRIX

Photo by MAS, 2019

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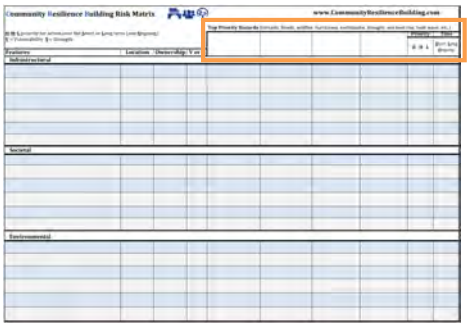
RISK MATRIX: HAZARDS



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HIGH-RISK HAZARDS IN GROTON

CHOOSE 4 FOR THE MVP ACTION PLAN

Flooding

High Winds

Nor'Easters

Severe Thunderstorms

Heavy Snow

Major Urban Fires

Source: Montachusett Regional Planning Commission (MRPC). 2015. "Montachusett Region Natural Hazard Mitigation Plan 2015 Update." p262.

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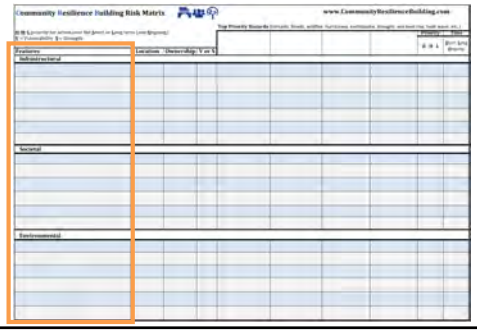
RISK MATRIX: FEATURES



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15 MINUTE BREAK!

Photo by W&S, 2019

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RISK MATRIX: FEATURES

FEATURES	LOCATION	OWNERSHIP	VULNERABILITY OR STRENGTH
Infrastructural	Town wide	State	Vulnerability
Societal	Multi- vs. Single-neighborhood	Town	Strength
Environmental	Specific location	Private	Both
		Shared	

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FEATURES IN GROTON

Photo by W&S, 2019

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INFRASTRUCTURAL FEATURES

Police Department

Photo by the Town of Groton

Fire Department

Photo by the Groton Fire Department

Wastewater Treatment & Collection

Emergency Shelters

Senior Center Rendering from the Groton Center

Roadways

Photo by W&S, 2019

Water Supply

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HAZARD POTENTIAL OF DAMS

Dam Name	River	Owner	Hazard	Date of Last Inspection	Inspection Frequency
Squannacook River Dam	Squannacook River	Town of Groton, Board of Select Board	High	10/17/2017	Every 2 Years
Hollingsworth & Vose Co. Dam	Squannacook River	Hollingsworth & Vose Company (Private Ownership)	Low	11/7/2014	Every 10 Years
Lost Lake Dam	Martin's Pond Brook	Town of Groton, Highway Department	High	4/20/2016	Every 2 Years
Woods Mill Pond Dam	Baddacook Brook	Martina Calnan (Private Ownership)	Low	10/8/2015	Every 10 Years

Source: Army Corps of Engineers. "National Inventory of Dams." 2019

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ENVIRONMENTAL FEATURES

Photo by W&S, 2019

- Groton is a **rural-residential** town[1]
- Groton covers **33.7 square miles** of land and water[1]
- New development **is limited**[2]
  - Residential: average 30 homes constructed per year since 2010
  - Non-residential: Current projects include Indian Hill Music Center, Shirdi Sai Temple, Groton Inn, and Four Corners
- Approximately **42% of the town's total area is protected open space**[3]
- Groton is home to an approximately **130-mile trail system**, the **2nd largest statewide**[4]

1. Town of Groton. "2019-2026 Open Space and Recreation Plan." p9
2. Ibid. p2
3. Core Team Meeting, December 11, 2019
4. Town of Groton. "2019-2026 Open Space and Recreation Plan." p4

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INFRASTRUCTURAL FEATURES

The Groton Police Department. Photo by W&S, 2019

Critical Facilities have the potential to cause serious harm if destroyed or damaged, including:

- **Emergency response facilities**
  - Fire stations
  - Police stations
- **Custodial facilities**
  - Jails
  - Long-term care facilities
  - Hospitals
- **Schools**
- **Emergency shelters**
  - Senior Center
- **Utilities**
  - Water supply
  - Wastewater treatment facilities
- **Communications facilities**

Source: Montachusett Regional Planning Commission (MRPC). 2015. "Montachusett Region Natural Hazard Mitigation Plan 2015 Update." p252.

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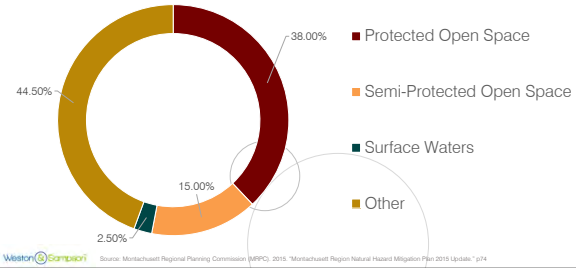
OPEN SPACE



Source: Montachusett Regional Planning Commission (MRPC). 2015. "Montachusett Region Natural Hazard Mitigation Plan 2015 Update." p74

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SOCIETAL FEATURES

Population	Groton	Massachusetts
2010	10,643 residents	6,547,790 residents
2018	11,386 residents	6,902,149 residents
Age		
Under 18 years	24.2%	20%
65+ years	14.7%	17%
Education		
Bachelor's degree or higher	66.2%	42.1%
Additional Information		
Median household income	$123,918	$74,167
Persons in poverty	4.3%	10.5%
With a disability	5.3%	7.9%
Language other than English spoken at home	6.0%	23.1%

Source: American Community Survey. "Quick Facts." U.S. Census Bureau, 2019

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EXISTING HAZARD PROTECTION

Type of Existing Protection	Description	Area Covered	Implementation Resources and Funding	Improvements or Changes Needed
Flood Related Hazards				
Storm water management standards	State Regulation under the Wetlands Protection Act to regulate storm water and other point source discharge Local Stormwater Management bylaw.	Town-Wide	Enforced by the Groton Conservation Commission (Wetlands Protection Act) staffed by the municipal conservation administrator and Groton Planning Board (Subdivision Control Law and site plan review) staffed by the municipal Town Planner.	Storm water management standards remain in place and continue to be enforced. No improvements or changes needed.
Wetlands Protection Act (state)	State law regulating development and activity within wetland buffer zone	100-foot state buffer around wetland area; 200-foot buffer around river front areas.	Enforced by the Groton Conservation Commission staffed by the municipal conservation administrator.	No improvements or changes needed.
Wetlands Protection Bylaw (local)	Local bylaw regulating development and activity within wetland buffer zone	requires a 100-foot buffer to wetlands and a 200-foot buffer to rivers and streams.	Enforced by the Groton Conservation Commission staffed by the municipal conservation administrator.	No improvements or changes needed.

Source: Montachusett Regional Planning Commission (MRPC). 2015. "Montachusett Region Natural Hazard Mitigation Plan 2015 Update." p266-267

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EXISTING HAZARD PROTECTION

Type of Existing Protection	Description	Area Covered	Implementation Resources and Funding	Improvements or Changes Needed
Flood Related Hazards (Continued)				
100 Year Flood Zone	Federal law requiring elevation above 100-year flood level of new and substantially improved residential structures in floodplain	100-year floodplain as shown on Flood Insurance Rate Map dated June 4, 2010.	Enforced by the Building Inspector (municipal staff) and Groton Conservation Commission staffed by the municipal conservation administrator.	No improvements or changes needed.
Town Bylaw Flood Plain Districts	Local bylaw enhancing federal/state laws and regulating any development in the flood plain district	100-year floodplain as shown on Flood Insurance Rate Map dated June 4, 2010.	Enforced by the Building Inspector (municipal staff)	Insurance Flood Rate Maps need to be updated.
Maintenance of municipal storm water drainage system	Regular cleaning of catch basins, storm drains, and culverts	Town-Wide	Undertaken by the Department of Public Works municipal staff.	Maintenance continues but Additional Personnel and Equipment Needed
Maintenance of public water bodies (ponds, streams, brooks, wetlands)	Periodic cleaning of waterways needed, i.e., remove trash, debris	Town-Wide	Undertaken by the Department of Public Works municipal staff with guidance from Conservation Commission staffed by the municipal conservation administrator.	Maintenance continues. No improvements or changes needed.

Source: Montachusett Regional Planning Commission (MRPC). 2015. "Montachusett Region Natural Hazard Mitigation Plan 2015 Update." p266-267.

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ADAPTATION STRATEGIES

Photo by W&S, 2019

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EXISTING HAZARD PROTECTION

Type of Existing Protection	Description	Area Covered	Implementation Resources and Funding	Improvements or Changes Needed
Wind Related Hazards				
State Building Code	State Law related to design loads to include wind effects	Town-Wide	Enforced by Building Department (municipal staff).	Continued enforcement remains in place. No improvements or changes needed.
Tree Maintenance	Regular inspection and tree maintenance to cut branches threatening power lines and overhead utilities	Town-Wide	Groton Electric Light Department municipal staff.	Tree maintenance continues. No improvements or changes needed.

Type of Existing Protection	Description	Area Covered	Implementation Resources and Funding	Improvements or Changes Needed
Winter Storm Related Hazards				
Clearing Snow from Major Arterial Routes	Ensure Access to Emergency Service vehicles.	Town-Wide	Department of Public Works municipal staff.	Snow clearing continues but additional personnel and equipment needed.

Source: Montachusett Regional Planning Commission (MRPC). 2015. "Montachusett Region Natural Hazard Mitigation Plan 2015 Update." p267.

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EXISTING HAZARD PROTECTION

- Massachusetts State Building Code
- Stormwater Management Standards
- Wetlands Protection Bylaw
- 100 Year Flood Zone
- Town Bylaw Flood Plain Districts
- Maintenance of municipal storm water drainage system
- Maintenance of public water bodies
- Tree maintenance
- Snow removal

Source: Montachusett Regional Planning Commission (MRPC). 2015. "Montachusett Region Natural Hazard Mitigation Plan 2015 Update." p266-267.

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LUNCH

Photo by W&S, 2019

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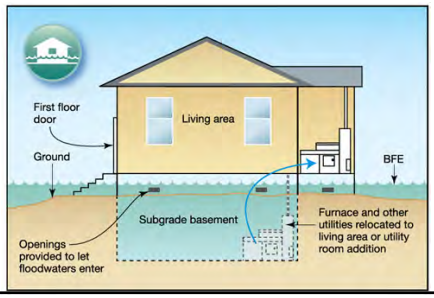
COMMUNITY ACTIONS

66

WET FLOODPROOFING



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PREVENTING SEWER BACKFLOW

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RAISED BUILDINGS

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RETROFITTED FLOODPROOF DOORWAYS

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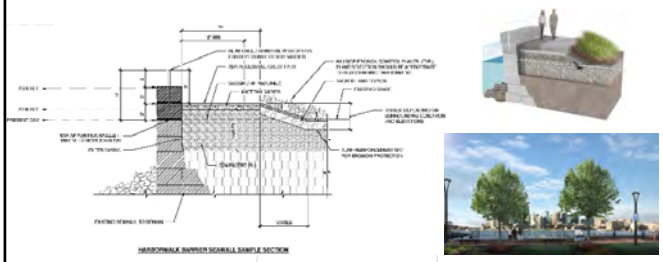
FLOOD WALLS



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DEPLOYABLE FLOOD BARRIER

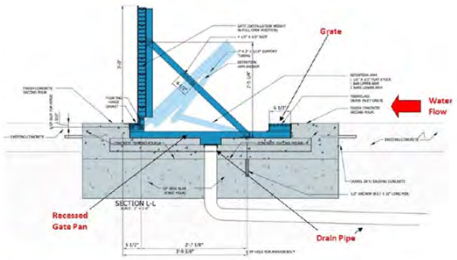

FIGURE 1 | A FloodBreak barrier gate diagram

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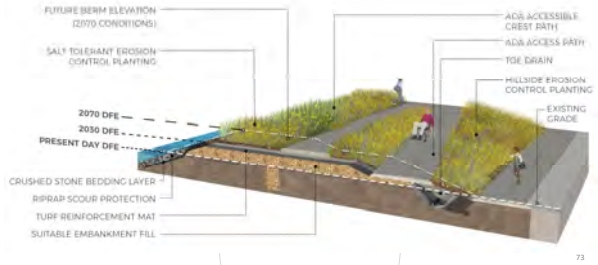
VEGETATED BERM



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LANDSCAPE DESIGN TO ACCOMMODATE WATER

76

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MULTI-PURPOSE FLOOD STORAGE

74

74

CULVERT WIDENING TO IMPROVE HABITAT & FLOW

77

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LANDSCAPE DESIGN TO ACCOMMODATE WATER

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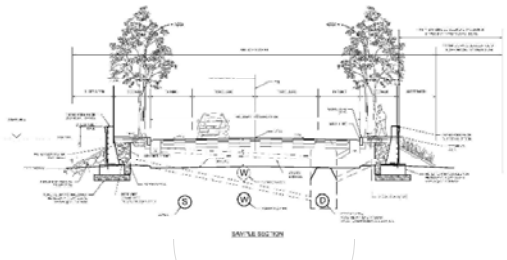
RAISED ROADWAYS



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LOW IMPACT DEVELOPMENT (LID)

Stormwater infiltration / rain gardens

Porous asphalt & permeable pavers

Street trees & tree box filters

79

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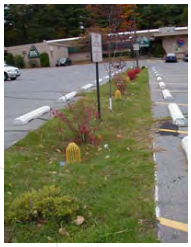
CLOUDBURST STREETS

82

82

STORMWATER DETENTION & RETENTION



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GREEN ROOFS

83

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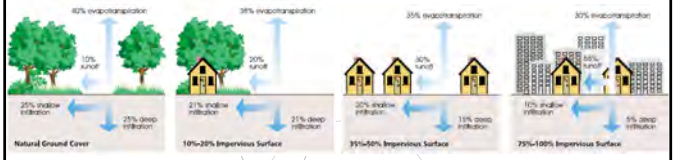
REDUCE IMPERVIOUS AREAS



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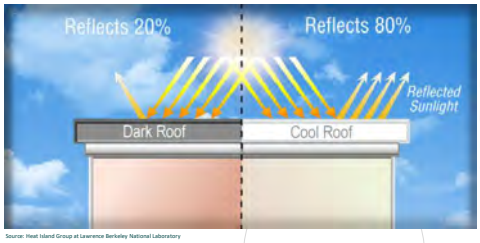
COOL ROOFS



Source: Heat Island Group at Lawrence Berkeley National Laboratory

Source: U.S. Department of Energy Guidelines for Selecting Cool Roofs

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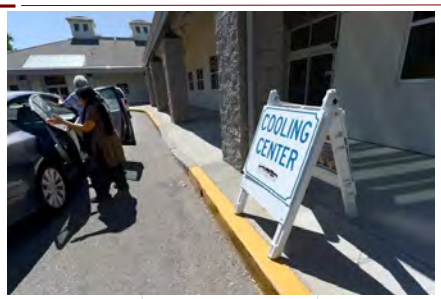
COOLING CENTERS



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RENEWABLE MICRO-GRIDS

86

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RE-EVALUATE LOCAL REGULATIONS & POLICIES

87

87

Example MVP Action Grant Projects

Nature-Based Flood Protection, Drought Prevention, Water Quality, and Water Infiltration Techniques

Millbury

Utilizing green infrastructure like stormwater planters, bioretention bump outs, rain gardens, and other measures like porous pavers and pervious pavement to reduce heat island effects and stormwater runoff into the Blackstone River.

Nature-based solutions

88

88

Example MVP Action Grant Projects

Local Bylaws, Ordinances, Plans, and Other Management Measures
Redesigns and Retrofits

Boston

Developing its first ever resilient building code so that development in the future floodplain is prepared for at least three feet of sea level rise, the likely scenario by late century.

Proactive
Pilot potential

Retrofitting a major waterfront park into a legacy park that uses nature-based solutions to address climate vulnerabilities while providing important access to recreation for residents.

Nature-based solutions
Community co-benefits

89

89

Example MVP Action Grant Projects

Redesigns and Retrofits

Salisbury

Increasing the resilience of the neighborhood of Ring's Island by raising its access/egress roads and by improving tidal flushing through culvert replacements

Vulnerable communities

90

90

Example MVP Action Grant Projects

Nature-Based Flood Protection, Drought Mitigation, Water Quality, and Water Infiltration Techniques

Belchertown

Designing and permitting for a replacement water storage tank that would increase storage capacity and resiliency to drought, and completing a feasibility/ concept design of a rainwater harvesting system at Belchertown High School to irrigate the athletic fields.

Nature-based solutions

Pilot potential

91

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DEFINE COMMUNITY ACTIONS

Photo by W&S, 2019

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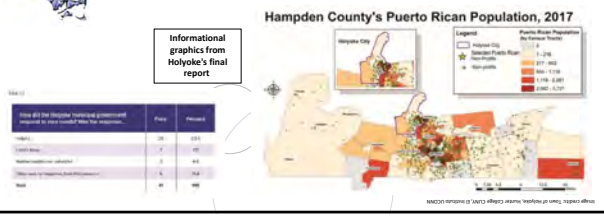
Example MVP Action Grant Projects

Detailed Vulnerability and Risk Assessment, Further Planning

Holyoke

Conducted a detailed demographic analysis of individuals who arrived in Holyoke from Puerto Rico as a result of Hurricane Maria and develop recommendations for planning for future climate change migrants in Holyoke

Informational graphics from Holyoke's final report



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IDENTIFY PRIORITY ACTIONS

Photo by W&S, 2019

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15 MINUTE BREAK!

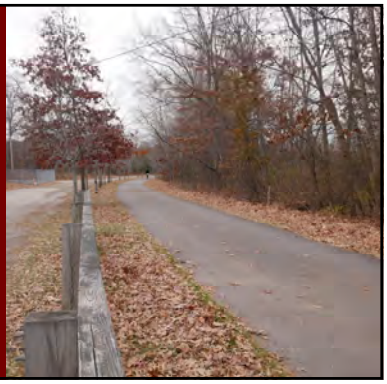

Photo by W&S, 2019

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WRAP-UP & CLOSING REMARKS

Photo by W&S, 2019

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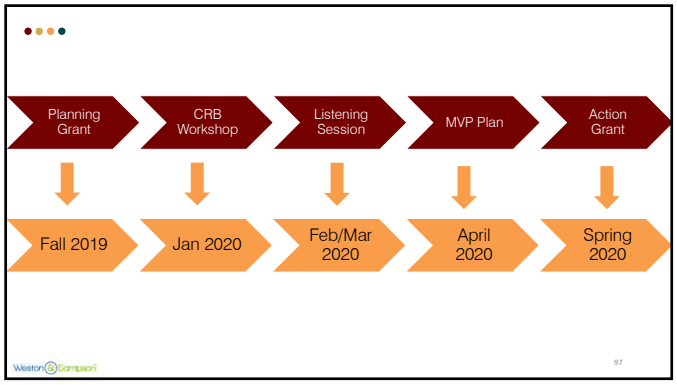
Planning Grant
CRB Workshop
Listening Session
MVP Plan
Action Grant
Fall 2019
Jan 2020
Feb/Mar 2020
April 2020
Spring 2020
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THANK YOU

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Town of Groton
Community Resilience Building Workshop
January 16, 2020
Workshop Notes

Attendees' favorite things about Groton:

- Sense of community
- Great place to live, raise a family, retire
- Critical mass of people that care about open space and the natural environment
- Involvement of people - everyone cares and has an opinion
- Environment and landscape
- Green space and conversation land, small-town environment
- Passion of the residents
- Open space
- Open space and people – warm, welcoming, caring
- Driving into Town and seeing beautiful Groton
- Sense of community and place, the new senior center, Gibbet Hill and farm, projects that are an expression of the community and its dedication
- Conservation ethic, open space, agriculture, people
- Sense of community, large open space and public space
- Open spaces, wildlife habitat, rare species, people and their passion

Summary of attendees' favorite things:

- Community helps build strength
- Open space: how do we use open space as a resilient asset, while also protecting it?

Participant input during introductory presentation:

- FEMA maps are conservative and out of date. They don't consider small tributaries where we're seeing more flash floods. We can't rely on these maps.
    - The design of infrastructure and development must consider future flooding
- There was a significant washout due to vandalism. Septic system permits were revoked (related to an elevation rise in a pond). The developer dismantled equipment installed by the Town (beaver deceivers?), the road flooded (sunny day flooding), and the road collapsed. The Town took the developer to court.

Group discussion during the identification of four hazards:

- Drought is a concern because it impacts private wells and the water supply
- The Town has been relying quietly on nuclear power – these are now going offline. We should consider how to become more independent
- Fire risk is a concern
- The hazard most likely to have impacted everyone in the room is flooding. It is also easier to estimate or quantify a financial risk related to flood hazards
- Hazards listed during discussion:

    - Fire
    - Wind
    - Heavy precipitation
    - Flooding
    - Drought
    - High/low or extreme temperatures
    - Population increase
    - Extreme weather (wind, Nor'easters)

Discussion at Table #1:

- Water Supply
    - Whitney downstream of Lost Lake Dam and its reservoir
- 2 bridges over Nashua River
    - Separate Groton and West Groton
    - Routes 119 and 225
- Broadmeadow and Hill Road (Roadways)
    - Station Ave and culverts
- Transmission Lines and Electric Grid
    - Electric Light right on 500-floodplain – solar at landfill
- Dams at River Court highly vulnerable
    - Culverts – Cady Pond Brook on Route 119
- Wastewater goes to Ayer and Pepperell – next to Nashua River
- Rail – commercial on East End
- Emerald Ash Borer – Invasive insect
    - Change in species – stressed natives
- Algal problems – pond near lost lake dam
- Old landfills (not up to compliance) and transfer station (in compliance)
    - Groundwater high in low areas
    - Underground utilities required in new development
- Forested land (fire vulnerability)
- Water supply and contamination
- Agriculture
- Development + Imp.
- Gas line
- Dam → Harvard → Wachusett Reservoir
- Wrangling Brook
- Culvert – Floods and blocks off the center
- High school is shelter sometimes
    - Water – iron from well too high

Discussion at Table #2:

- Broadmeadow road is the litmus test for flooding. It's central and it floods first
- West Groton has few access points

- There are 2 high hazard dams in town – both are Town-owned
    - One is near Senior housing
- Townsend Road into West Groton is not vulnerable to flooding
- The library offers a location for public presentations
- Middle school – warming center
- High school – shelter
- Senior center has a list of vulnerable residents
    - And a list of locals who can help with snow removal (i.e., teenagers)
    - Emergency management checks on the vulnerable residents on the senior center's list
- The Town is compliant with environmental regulations
    - Wetlands bylaw is forward-thinking
    - Earth removal bylaws are up-to-date
- Trails: they had a recent call re: lost hikers
    - Rescue operations – they recently rescued a lost student
    - Signage needed
- 2 Rivers: Nashua (which has invasive chestnut plants) and Squannacook
    - Scenic designations
- Forests and meadows – sequestering carbon
    - Create habitat
    - Create groundwater reservoir to feed rivers and wetlands – counters drought
- 5K square foot milkweed – host plant for monarch butterfly habitat
    - Can plant on private and public land
- Invasive plants – black swallow wort
    - Toxic cousin to Milkweed – kills them
    - Also toxic to goats
- Knotweed, bittersweet
- Invasive species committee in Groton
- Don't want to use chemicals to remove invasive plants
- Grandfathered septic systems in homes
    - Leaching area is near wetlands
    - i.e., Lost Lake
- Assess locations, contractors, outreach/education, identify grant funding to update systems
- Conflict between ticks and mowing laws down to the wetland edge
- Earth removal stormwater committee – green infrastructure strategies
- Prescott – a retired school now rented
    - Needs work
    - Current residents include educational non-profit, small businesses
- Nonprofit neighbors program
- Address overlaps between invasives and endangered species and agricultural land

Discussion at Table #3:

- Participants:
    - Steve Roy

    - Steele
    - Lorraine
    - George Mason
    - Tom O.
    - Judy
    - Eileen
    - Takashi
- Infrastructure
    - Roads and drainage
    - Power grid/communication
    - Water
    - Sewer
- Residential community
    - Restrained in our ability to raise funds
- Lost Lake sewer and water
    - Dense development
    - Services
- Flooding
    - West main street at Nashua River
- Future flood conditions
    - Hydraulic model
- Boarding schools and student populations require emergency services

Group Report-Out of Top Priorities

- Roads and drainage – flooding
    - Broadmeadow, 119, Cady Brook
    - Funded for restoration of streams and drainage
    - Change regulations for new development
        - Stormwater in new development
    - Upgrades
- Wetlands and waterways
    - James Brook
- Development and Land use
- Public Education
    - Vector-borne diseases and implement OSRP
        - Habitat and open space
        - Invasive species management
    - Land use metrics open space and fire vulnerability
- Water supply
- Partnerships with Institutions

Legend
Animal Shelter
Clinic
Communication Facilities
DPW Facility
Early Education Childcare Facilities
Elderly Services
Electric Substations
Emergency Dispensing Sites
Emergency Operations Center
Emergency Shelters
Grocery/Pharmacy/Supply Store
Housing Authority
Other Government Buildings
Water/Wastewater Treatment Plants
Public Health Office
Pumping Stations
Religious Center
Sports and Cultural Areas
Transfer Station
Youth Services
Historic Places
Groton Police Department
Town Hall
Hazardous Material Site
Library
School
Underground Storage Tank
Community Groundwater Source
Non-Community Groundwater Source
Evacuation Routes
Powerline
Railroads
Landfill
Conservation/Protected Land/Open Space
Dams
High Hazard
Significant Hazard
Low Hazard
Vulnerable Populations (Census Blocks)
> 30% of population is < 18 (2010)
> 25% of population is 65+ (2010)
Waterways
Rivers, Streams, and Brooks
Marsh/Bog/Wooded Marsh
Lakes, Ponds, Reservoirs
FEMA National Flood Hazard Layer
1% Annual Chance of Flooding (Zones A, AE, AH, AO)
0.2% Annual Chance of Flooding (Zone X)
N
DUNSTABLE
TYNGSBOROUGH
WESTFORD
PEPPERELL
TOWNSEND
SHIRLEY
LUNENBURG
AYER
LITTLETON
GROTON LANDFILL
Groton Highway Department
Woods Mill Pond Dam
GROTON FIRE DEPARTMENT Station 3 - Lost Lake
Lost Lake Dam
GROTON DUMP
Legion Hall
Water Tank
Groton Dunstable Regional School District Office
Groton Country Club
Lawrence Academy
Groton Electric Light
GROTON POLICE PUBLIC SAFETY BUILDING
GROTON FIRE DEPARTMENT Station 1 - Center Station
Country Day Of Holy Union
Boston Road
Broad Meadow Road
Water Tank (West Groton)
HOLLINGSWORTH & VOSE
Hollingsworth & Vose Co. Dam
Squannacook River Dam
GROTON FIRE DEPARTMENT Station 2 - West Groton
Groton School
Knops Pond/Lost Lake
Forge Pond
Nashua River
0
0.5
1
Miles
FIGURE 1
TOWN OF GROTON, MASSACHUSETTS
MUNICIPAL VULNERABILITY PREPARDNESS HAZARD AND FEATURE MAP
DECEMBER 2019
SCALE: NOTED
Weston & Sampson

TABLE #2

West Groton Power lines should be added (small, older)

FIGURE 1

TOWN OF GROTON, MASSACHUSETTS

MUNICIPAL VULNERABILITY PREPARDNESS
HAZARD AND FEATURE MAP

DECEMBER 2019 SCALE: NOTED

Weston & Sampson

#2

Legend

- Animal Shelter
- Clinic
- Communication Facilities
- DPW Facility
- Early Education Childcare Facilities
- Elderly Services
- Electric Substations
- Emergency Dispensing Sites
- Emergency Operations Center
- Emergency Shelters
- Grocery/Pharmacy/Supply Store
- Housing Authority
- Other Government Buildings
- Water/Wastewateer Treatment Plants
- Public Health Office
- Pumping Stations
- Religious Center
- Sports and Cultural Areas
- Transfer Station
- Youth Services
- Historic Places
- Groton Police Department
- Town Hall
- Hazardous Material Site
- Library
- School
- Underground Storage Tank
- Community Groundwater Source
- Non-Community Groundwater Source
- Evacuation Routes
- Powerline
- Railroads
- Landfill
- Conservation/Protected Land/Open Space

Dams

- High Hazard
- Significant Hazard
- Low Hazard

Vulnerable Populations (Census Blocks)

- > 30% of population is < 18 (2010)
- > 25% of population is 65+ (2010)

Waterways

- Rivers, Streams, and Brooks
- Marsh/Bog/Wooded Marsh
- Lakes, Ponds, Reservoirs

FEMA National Flood Hazard Layer

- 1% Annual Chance of Flooding (Zones A, AE, AH, AO)
- 0.2% Annual Chance of Flooding (Zone X)

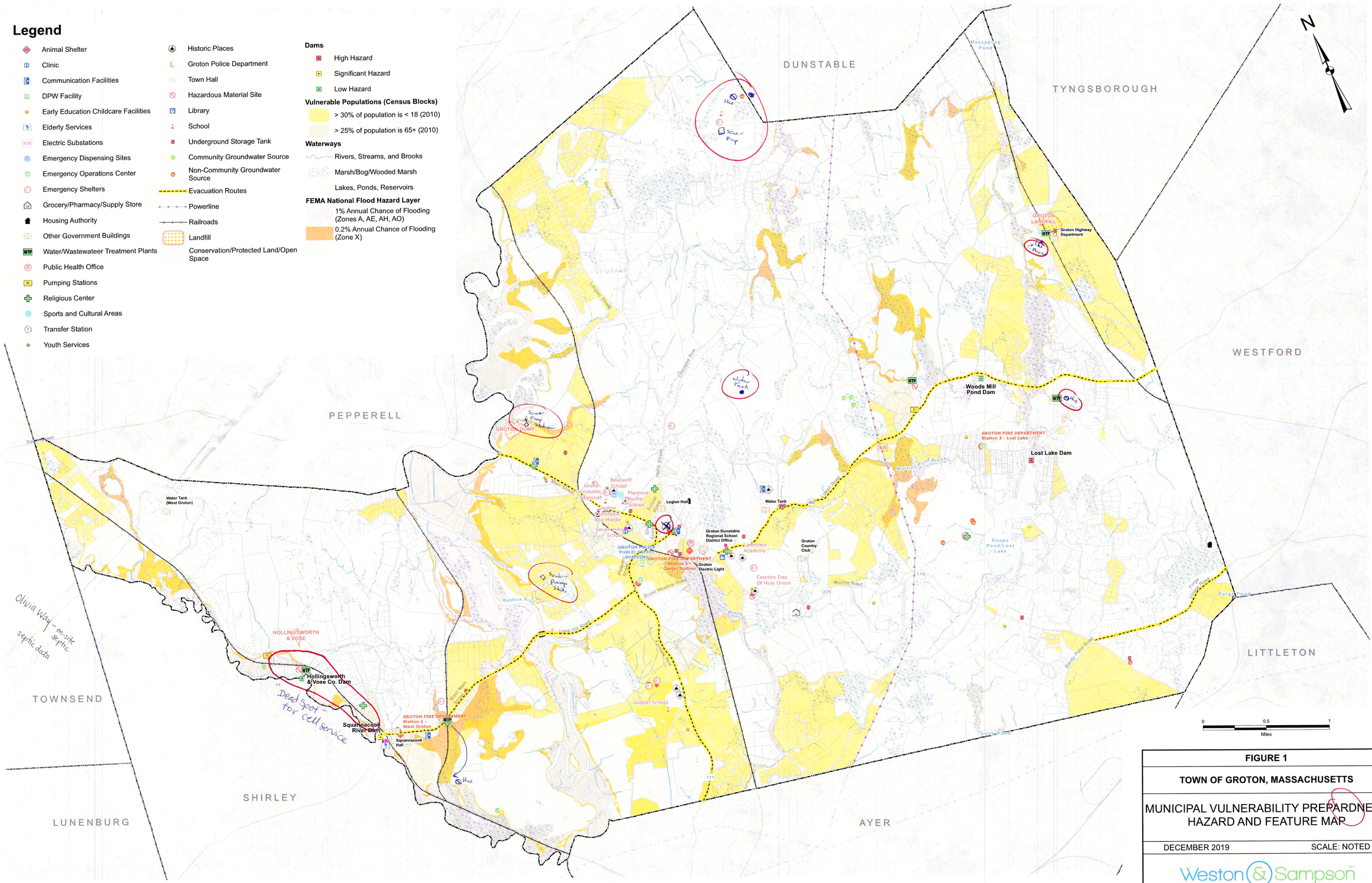

FIGURE 1

TOWN OF GROTON, MASSACHUSETTS

MUNICIPAL VULNERABILITY PREPARDNESS HAZARD AND FEATURE MAP

DECEMBER 2019 SCALE: NOTED

Weston & Sampson

Community Resilience Building Risk Matrix

www.CommunityResilienceBuilding.org

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

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

Features	Location	Ownership	V or S	Fire/Drought	Extreme Weather (Nor'easters, wind, snow)	Flooding	Extreme Temps	Priority H - M - L	Time Short Long Ongoing
Infrastructural									
Water Supply	Townsend Rd. Dam-Whitney Pond, gravel aquifer, Baddacook Pond,	Town/West Groton Supply District	B	FIRE/DROUGHT: Increase storage/cisterns in places; Increase access to water in places without hydrants; Ban/Regulate irrigation systems; improve conservation rate system; Address magnese issue- build a water treatment facility MULTIPLE: Build a resilient water treatment facility (out of floodplain and with GI stormwater controls)				H	O
Bridges	119 and 225- separates Groton and W. Groton	State	B			FLOOD: Develop new regulations for bridge design that reduce storm debris collection; Elevate bridges to reduce flooding; create alternative plans for evaucation routes if flooded		M	L
Roadways and Culverts	Broadmeadow, Hill Rd., Station Ave, culvert on Cady Pond Brook and Wrangling Brook	Town/State	B			FLOODING: Develop mew regulations to ensure roadways and culvert design takes into account climate change; upgrade existing culverts and roadways were necessary	EXTREME TEMPS: Stay on top of emerging pavement technology to reduce buckling and pot holes (L)	H	O
Electric Grid/Energy	Electric Light in 500-floodplain; lines throughout town	Public/Private	B		EXTREME WEATHER: Identify priority candidates (critical facilities and town property/buildings) for solar and batteries to improve resilience; increase education about the option of putting powerlines underground on new construction- possibly put in regulations to underground utilities; when new roadways or other infrastructure goes in use it as an opportunity to underground the lines.		EXTREME TEMPS: Incentives for energy reduction; explore peak demand pricing for everyone (right now its voluntary); increase options for GELD to buy energy from solar during peak.	M	O
Dams	4--rivercourt a priroity; several upstream in othe communities (Harvard and Wachusett Reservior)	Public/Private	V				Remove Rivercourt Dam on (S.River)	L	L
Wastewater	Town Center WW goes to Pepperel; 4 Corners goes to Ayer,; rest is on septic	Intermunicipal	B	DROUGHT: Assess interbasin transfers and how that impacts the groundwater		FLOODING (EXTREME RAINFALL): Education on sewer BMPs and not to flush things that can be disposed at the transfer station (ie. Pharmaceuticals); Sewer W. Groton		M	O
Societal									
Migration/Climate Refugees	n/a	n/a	B	Scale emergency services as population increases; use Smart Growth policies and infill to provide affordable housing and multiple types of housing				L	L
Public Health (concerns and resources)	n/a	Health Board/Water and Sewer Department	B	ALL: increase shelther space (possibly in conjunction with a new elementary school); Rebrand/improve info on when and who should go to a shelter; Increase mosquito and tick control of habitat and increase education				M	S
Public Transit (COA has a van, school buses, Ayer has communter rail)	n/a	Town/MBTA/Private	EXISTING S, NEED-V	All: Create a carpooling system/platform; more sidewalks, plow rail trail; install electric charging stations and prepare regulations for EV; increase parking at the Ayer commuter rail/increase access to commuter rail				M	O
Emergency Response Plan (Evacuation plan, communications, accessibility to resources/shelters)	Townwide	Town	V	Education on the need to sign up for Reverse 911 with cell; increase awareness of need to sign up for database of vulnerable populations; continued emergency response planning, practice, and maintenance				H	O
Seven Hills	2 locations, a hospital and a group home	Private	B	Ensure open communication ad coordination with town				L	S
Schools (drinking water at high school is too high in iron, drinkable now, but not for women who are pregnant. High school is used as a shelter sometimes. New elementary school is a plan)	Multiple locations	Public/Private	B	Improve cell service (no service at high school); improve shelter in place resources; air condition portions of the schools like the gyms				H	S/O
Environmental									
Invasive Species (Emerald Ash Boarer, stressed natives)	Townwide	n/a	V	Management program; design standards that are wildlife friendly/protect at risk species (native and endangered) Education on emerging threats Seed stock for plants				L	S/O
Algal Blooms	Lakes and Ponds; especially Lost Lake	Public/Private	V	Treat stormwater onsite and upstream				L	L
Forested Land	Townwide	Public/Private	B	FIRE: preventative and management plan; clean up debris/create a wood bank with recently downed trees				M	L/O
Contaminated Sites (Nod Landfill was not properly capped and Conductor Lab with ongoing remediation)	Marked on map	Town-Nod/Private Conductor Lab	V	Cut trees growing on site at Nod Landfill; cap landfill (in floodplain); continued outreach on disposal of items at transfer station				L	L
Agriculture	Townwide	Public/Private	B	Reduce pesticide/herbicide/insectiside use, especially on farms near River, long-term planning and diversification, best management practices				M	L
Development and Stormwater (both regulations and infrastructure)	Townwide	Public/Private	B	River stormwater management regulations and update with climate data; LID in development, reduce 2-acre zoning; update FEMA flood maps				H	S

Community Resilience Building Risk Matrix

www.CommunityResilienceBuilding.org

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

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

Features	Location	Ownership	V or S	Fire/Drought	Extreme Weather (Nor'easters, wind, snow)	Flooding	Extreme Temps	Priority H - M - L	Time Short Long Ongoing
Infrastructural									
Roads (Route 225, Pepperell Road in Groton, Shirley Street in Pepperell, Broad Meadow Road)	Townwide	Town	V	Maintenance, staff, time, equipment (chippers, bucket trucks)	Tree maintenance, maintain current plows	Elevate Broadmeadow Road, dredging channels, elevate Route 225	Update O&M plans with climate change considerations	M	O
Dams (Lost Lake Dam, Squannacook River Dam - remove)	Townwide	Town + Private	V		Apply for grants for dam removal. Coordinate with Shirley or provide info/resources	Remove dam. Reduce level to 5 feet. Public outreach and education. Plan for removal		H	S
Municipal Buildings and Shelters	Townwide	Town	S	Prescott sprinkler system. Increase volunteers for fire department.	Emergency management center. Portable generators. Signboards/smart signs for public information. More staff for shelters (recruit/train volunteers)		Review shelters for needed updates (a charging station?)	H	S
Water supply and private wells	Townwide - 2 districts	Quasi public	S/V	Treatment for PFAS and Manganese. Infiltration and open space. Public education about health risks.			Public education about sprinklers. Water restrictions.	H	S
Groton Electric	Townwide	GELD	S		Storage batteries for power (8 Megawatts)		Seamless switch for generators (peak hours) - energy saving, reduce	L	L
Culverts	Townwide	Town + State (~6)	V		Drainage ditch cleaning	Maintenance, updize where needed. Assess where culverts should be upsized. Use future precipitation data		M	O/S
Societal									
Elderly Residents + Assisted Living	Rivercourt (West Groton)	Private	V		Volunteer outreach. Snow removal for seniors.		Assisted living should have A/C. Assess cooling equipment needs. Coordinate with partners - mutual aid agreement	H	O
Schools (Private (boarding schools) and public)	Lawrence Academy, Groton School, High School, Middle, Elementary	Private + public	V/S	Emergency Action Plan Climate change curriculum. Educational programs for water conservation, etc.	Private schools: increased coordination with emergency management		High school (shelter) assess equipment needs, cots. Install A/C for older schools	M	O
Indian Hill Music Center (still under construction, non-profit, source for local jobs, potential for public education, may increase traffic)	See annotated map	Private	V/S		Possible resource for storage (it's a large facility). Climate education - concerts to raise money and awareness	Bus service connection to help reduce traffic. Groton transportation hub (create a link from Lowell)		L	L
Lost Lake Residents (high density, fire risk, all on private wells)	Lost Lake neighborhoods	Private	V	Extend water line. Increase cisterns. Education on open burning regulations. Program to bring debris to a location to create wildlife habitat. Education on alternatives to burning and acceptable materials to burn.			See "Roads" category. Create a "Rent a Goat" program to remove invasives	M	O
Historic Identify (Farms, "Right to Farm" Community)	East Groton or Central	Private	V	Town water for irrigation	Emergency Action Plan for livestock for the last Cattle Farm	Address contaminants that could be spread by floods. Education. Fertilizer	Education related to invasives. Site-specific management plan	L	L
Pets	Town wide	/	V	Equipment, including cages in pet-friendly shelters and carriers. Space to store and shelter pets				L	S
Environmental									
Habitat (endangered species, pollinator habitat)	Townwide	Mixed	V/S	Milkweed planting for pollinator habitat. More volunteers and plant materials. Converting lawns to meadows, increased stormwater infiltration			Address invasive species (mechanical removal strategies, volunteers, assessment of needs and best practices. Lexington is a model). Outreach, education to private landowners	M	O
Wetlands	Townwide	Mixed	S/V	Increase groundwater infiltration near wetlands. "Slow the flow" in streams	Add climate change considerations to bylaw and regulations. Map the future floodplain	Land acquisition. Buy tributaries as well. Continue protect wetlands. Assess grandfathered septic systems.		M	O
Open Space (Recreation areas)	Townwide	Mixed	S/V	Management plan Agreement with fire department. Identify areas that should be allowed to burn.	Volunteers to maintain and improve open space and trails	Increase infiltration. Partner with schools and universities	Identify critical land around reserves and buy land or get an easement	M	O
Vector-borne diseases (ticks)	Townwide	/	V	Publicize list of locations that sell DEET and Permethrin. Addinformation to agendas at already-scheduled meetings. Present at schools, senior center. Learn to live with ticks. Signage on trails. Public education - fact sheets, social media posts.				H	O
Trails (2nd largest trail network in MA)	Townwide	Mixed	S/V	Outreach to dog owners regarding waste products left on trails.	Mark trails to facilitate rescue. Detailed trail signage. Public education about staying safe on trails		Signage about ticks. Guided annual tour walk. Presentation on how to pack for a trail hike	H	O
Clean Water Legacy / Rivers	Nashua + Squannacook Rivers, Lost Lake, Ponds	Mixed	S/V			Plan for flooding and erosion. Increase infiltration. "Slow the flow"	Funding water water chestnut removal. Recruit volunteers and schedule removal days. Find incentives (i.e. the Senior work pgoram). Work with Pepperell	M	O

Community Resilience Building Risk Matrix

www.CommunityResilienceBuilding.org

H-**M**-**L** priority for action over the **S**hort or **L**ong term (and **O**ngoing)
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Infrastructural									
Roads/Drainage	Townwide	Town/State	V		Drainage evaluation	Broad Meadow Road Improvements/Operations. Route 119 - Cady Brook	Pavement types - research	H	O
Power/Communications	Townwide	Town/Private	V/S	Maintain indepdendent electric utility. Backup energy sources. Alternative local power sources.		EV charging stations - reg update. Improve cell coverage.		H	O
Water Supply (3 wells private)	Townwide	Town	V/S	Evaluate additional storage. Emergency water.	Power backup. Future supply planning.	Evaluate W. Groton well field. Educate private well users.	Drought susc.	H	O
Sewer - Wastewater	Town (20%) / Regional	Town/Private	V	Explore onsite wastewater management system/program	Power backup	Assess groundwater levels	Lost Lake assessment. SS regulation review.	H	O
Town Buildings (Police, Fire, DPW, Groton Center)	Site specific	Town/Regional	V/**S**	Have backup. Evaluate additional shelter.		Explore stormwater retrofits/education.		M	O
Dams	Site specific	Town/Private	V/S		Explore dam removal - Squannacook			H	O
Societal									
Health Care (7 Mills, Rivercourt)	Site specific	Private	V/S		Develop emergency Action Plans / Integration with Town			M	O
Private Schools (2 (LA and GS), Boarding)	Sites	Private	V/S		Coordinate on projects - Teaming/Support			M	
Commercial/Industrial (W. Groton, Town Center, 4 Corners)	Specific	Private	V/S			Flooding at H&V - chemicals		L	
(Needs) Housing	Site specific	Public/Private	V/S	Evacuation/Communications. Plans - update/create				H	
Public Schools (Regional)	Site specific	Regional	V/S		Improve cell communications. Evaluate backup power/shelter		Tree plantings. Green infrastructure demo	H	
Mobility (Commuters, walkable/bike)	Roads	Public/Private	V/S		Implement complete streets priorities	Improve road drainage - Boston Road		H	
Environmental									
Agriculture	Townwide	Private/Public	V/S	Support AG preservation Committee / Protection / Partnerships				H	
Wetlands/Waterways (Unique)	Townwide	Private/State	V/S		Nashua River Corridor	James Brook Restoration	Clearing debris / Maintain drainage	H	
Open Space	Townwide	Public/Private	V/S	Educate -> Vector-borne diseases. Implement OSRP				H	
Recreation (Trails, beach fields)	Townwide	Public/Private	V/S	Update Town Fields -->	Bank Restoration. Develop more links.	River access. Hazel Grove Improvements		H	
Land use (encroachment, development)	Townwide	Public/Private	V/S	Educate homeowners on fire safety				H	O
Rare Species	Townwide	Public/Private	V/S	Continue to enforce regulations				H	

Groton Municipal Vulnerability Preparedness Plan Workshop Invitees

Core Team

Invitee	Title	Organization
Nikolis Gualco	Conservation Administrator	Conservation
Steele McCurdy	Fire Chief	Fire Department
Michael Luth	Chief of Police	Police Department
Tom Delaney	DPW Director	Department of Public Works
Michelle Collette	Stormwater Inspector & ADA Coordinator	Earth Removal Stormwater Advisory Committee
David Black	Teaching Chair	Groton School
Dan Scheibe	Head of School	Lawrence Academy
Russell Burke	Chair	Planning Board
Kevin Kelly	Manager	Groton Electric Light
Takashi Tada	Planning Director	Planning Department
Mark Haddad	Town Manager	Town Manager

Advisory Committee

Invitee	Title	Organization
Lisa Larrabee		Housing Authority
Alison Dolbear	Member	Sustainability Commission
John Smigelski	Chair	Conservation Commission
Eileen McHugh	Member	Conservation Commission & Earth Removal Stormv
Jeff Gordon	President	Groton Business Association
Al Futterman	Land Programs and Outreach Director	Nashua River Watershed Association (NRWA)
Thomas Orcutt	Water Superintendent	Groton Water Department
Greg R. Fishbone	Member	Groton Water Commission
Jason Weber	Member	Board of Health
Kathy Shelp	Member	Council on Aging
Lynwood "Val" Prest	Member	Recycling Committee
Tessa David	Member	Recycling Committee

Local (Town Staff)

Invitee	Title	Organization
Edward Cataldo	Building Commissioner/Zoning Enforcement Offic	Building Department
Tom Orcutt	Water Superintendent	Groton Water Department
Dr. Laura Chesson	Superintendent	Groton-Dunstable Regional School District
Mark Haddad	Town Manager	Town Manager
Michael Chiasson	IT Director	Information Technology Department
Vanessa Abraham	Director	Groton Public Library
Jeffrey Pike	Technology Services Librarian	Groton Public Library
Kathy Shelp	COA Director	Senior Center
Robert Johnson	N/A	Veterans Services

Local (Elected and Appointed Boards & Committees)

Invitee	Title	Organization
Sheila Julien	Chair	Affordable Housing Trust
George Moore	Member	Agricultural Commission
Evan Owen	Member	Board of Survey
Bob Fleischer	Member	Commission on Accessibility & Board of Health
Anna Eliot	Member	Community Preservation Committee
George Barringer	Member	Complete Streets Committee
Mark S. Deuger	Member	Conductorlab Oversight Committee
Benjamin Podsiadlo	Member	Emergency Management Agency
Alexander Woodle	Member	Great Pond Advisory Committee
Jim Luening	Chair	Great Pond Advisory Committee
Adam Burnett	Member	Greenway Committee
David Pitkin	Member	Greenway Committee

Kevin J. Lindemer	Member	Groton Electric Light Commission
Brian C. LeBlanc	Member	Groton-Dunstable Regional School Committee
Marilyn Dabritz	Chair	Library Trustees
Christine Brooks	Member	Local Cultural Council
Bud R. Robertson	Chair	Finance Committee
Allen B. King	Member	Historical Commission
George Wheatley	Member	Historical Commission & HDC
Elaine Chamberlain	Member	Historic Districts Commission (HDC)
Brian Bettencourt	Chair	Invasive Species Committee
Adam Burnett	Member	Invasive Species Committee
George Moore	Member	Local Emergency Planning Committee
Anna Eliot	Member	Master Plan Implementation Committee
Judy Anderson	Member	Master Plan Implementation Committee
David Manugian	Member	Major Initiative Planning Committee
John Reilly	Member	Select Board & MBTA Advisory Board
Russell Burke	Member	Montachusett Joint Transportation Committee
Robert Flynn	Member	Nashoba Valley Technical High School Committee
Timothy Siok	Chair	Park Commission
Anna Eliot	Member	Park Commission
Don Black	Member	Park Commission
George Barringer	Member	Planning Board
Lorayne Black	Member	Planning Board
William F. Shute	Member	Regional Emergency Planning Committee
Cheney Harper	Member	Sargisson Beach Committee
Alison Manugian	Chair	Select Board
Annika Nilsson Ripps	Member	Senior Center Building Committee
Stephen Babin	Chair	Town Forest Committee
Paul Funch	Chair	Trails Committee
Olin Lathrop	Member	Trails Committee
Cynthia Maxwell	Chair	Zoning Board of Appeals

Local (Non-profits, community organizations/centers/place of worship)

Invitee	Title	Organization
Ted Lapres	President	Groton Conservation Trust
Laurie Smigelski	President	Hazel Grove Agricultural Association
Marion Stoddart	Founding Director Emeritus	Nashua River Watershed Association (NRWA)
There are no staff members listed online		New England Shirdi Sai Temple
Rev. Mary Day Miller	Executive Minister	The ABC of Massachusetts
Rev. Elea Kemler	Minister	First Parish Church of Groton
Reverend Gail Miller	Pastor	Union Congressional Church
Nena Radtke	Pastor	West Groton Christian Union Church
Tom A. Faulk	Pastor	First Baptist Church of Groton
Linda Kosinski	Director	Groton Community School
Shawn Campbell	General Manager	Groton Country Club
Margaret Ann Matthews	Founder, President, and Chief Executive Officer	Veterans Advocacy Services
There are no staff members listed online		RiverCourt Residences
Mary Jennings	Chair	Prescott School Community Center
Temba Maqubela	Headmaster	Groton School

State and Regional

Invitee	Title	Organization
Elizabeth Warren	Federal Senator	US Senate
Edward J. Markey	Federal Senator	US Senate
Edward Kennedy	State Senator, First Middlesex District	Massachusetts Senate
Lori Trahan	Congresswoman, 3rd Congressional District of MA	US House of Representatives
Sheila Harrington	State Representative, 1st Middlesex District	Massachusetts House of Representatives
Martin Pillsbury	Environmental Planning Director	MAPC
Melissa Fetterhoff	President & CEO	Nashoba Valley Chamber of Commerce
TBD	Central Regional Office Representative (Worceste	Massachusetts Department of Environmental Prote
TBD	Representative from the New England District (Co	Army Corps of Engineers
Matt Amadon	District Supervisor	MA Department of Conservation and Recreation (D
Chris Pryor	Director of Forest Stewardship	New England Forestry Foundation (NEFF)
Stephen Hutchinson	Regional Director, Central and Western Region	Mass Audubon
Sarah White	Hazard Mitigation Unit Supervisor	MA Emergency Management Agency (MEMA)
TBD	Regional Representative (Eastern MA)	Eversource Energy - Gas

Adjacent towns: Dunstable, Tyngsborough, Westford, Littleton, Ayer, Shirley, Townsend, Pepperell

Invitee	Title	Organization
Brian M. Palaia	Town Administrator	Town of Dunstable
Jake Zwicker	Town Engineer	Town of Tyngsborough
Paul Starrat	Town Engineer	Town of Westford
Chris Stoddard	Director of Public Works	Town of Littleton
Mark Wetzel	DPW Superintendent	Town of Ayer
Brandon Kelly	DPW Director	Town of Shirley
James Smith	Superintendent of Highway Department	Town of Townsend
Kenneth Kalinowski	DPW Director & Town Engineer	Town of Pepperell

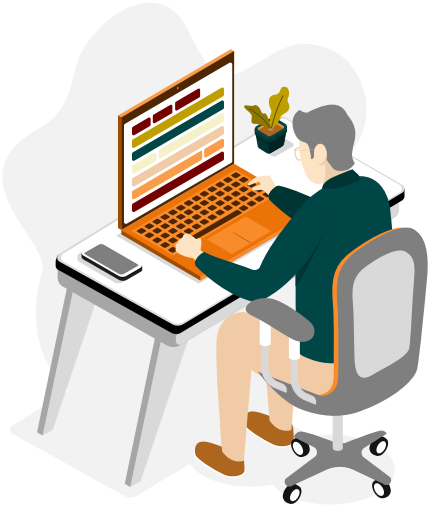
Appendix D

Listening Session

HAZARD MITIGATION & CLIMATE ADAPTATION

ONLINE WEBINAR & SURVEY

AVAILABLE APRIL 9TH – APRIL 23RD



The Town of Groton is seeking community input as a part of their hazard mitigation and climate adaptation planning process.

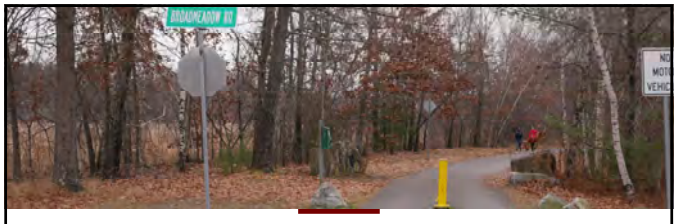
This online engagement format includes a webinar followed by a survey to record comments and feedback.

Watch the webinar at:
tinyurl.com/GrotonMVPWebinar

Take the survey at:
tinyurl.com/GrotonMVPSurvey

Please reach out if you have questions or barriers to participating

Takashi Tada | Land Use Director/Town Planner
(978) 448-1105 | ttada@townofgroton.org



TOWN OF GROTON

April 2020

Photo by W&S, 2019

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OUTLINE

- Overview of MVP and HMP
- Overview of Climate Change
- Strengths and Vulnerabilities
- Priority Action Items
- Next Steps
  - Tell us about your climate adaptation priorities by taking our **online survey!**

Photo by W&S, 2019

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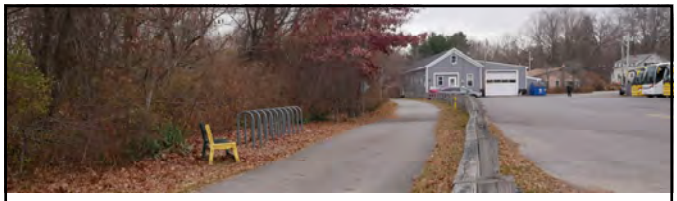

WELCOME PARTICIPANTS

Adria Boynton
Resiliency Specialist, Weston & Sampson
Certified MVP Provider

Photo by W&S, 2019

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MVP & HMP OVERVIEW

Photo by W&S, 2019

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WEBINAR LOGISTICS

- The **webinar** was pre-recorded and presents information and findings related to Groton's MVP-HMP project
- The webinar is paired with an **online survey**
  - Available from **April 9-April 23, 2020**
  - Opportunity for public comments and feedback
  - A link is included at the end of the presentation

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MVP Principles

A community-led, accessible process that

- Employs local knowledge and buy-in
- Utilizes partnerships and leverages existing efforts
- Is based in best available climate projections and data
- Incorporates principles of nature-based solutions
- Demonstrates pilot potential and is proactive
- Reaches and responds to risks faced by EJ communities and vulnerable populations

Why nature-based?
Where appropriate, nature-based solutions can be more cost-effective, protect water quality and quantity, sustain lands that provide food and recreation opportunities, reduce erosion, and minimize temperature increases associated with developed areas and climate change.

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MVP GRANT TYPES

COMMUNITY RESILIENCE BUILDING WORKSHOP(S)

- Define and characterize hazards using latest science and data
- Identify existing and future community vulnerabilities and strengths
- Develop and prioritize community adaption actions
- Determine overall priority actions
- Receive MVP designation

MVP Planning Grant ✓

MVP Action Grant

Implemented priority adaptation actions identified through planning process

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PROJECT TIMELINE

Planning Grant	CRB Workshop	Virtual Listening Session	MVP-HMP Plan	MVP Action Grant Application
Fall 2019	Jan 2020	April 2020	Spring 2020	Spring 2020

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MVP Action Grants: Project Types

- Vulnerability and Risk Assessment
- Community Outreach and Education
- Local Bylaws, Ordinances, Plans, and Other Management Measures
- Redesigns and Retrofits
- Nature-Based Flood Protection, Drought Mitigation, Water Quality, and Water Infiltration Techniques
- Nature-Based, Infrastructure and Technology Solutions to Reduce Vulnerability to Extreme Heat and Poor Air Quality
- Nature-Based Solutions to Reduce Vulnerability to other Climate Change Impacts
- Ecological Restoration and Habitat Management to Increase Resiliency
- Energy Resilience
- Chemical Safety
- Land Acquisition for Resilience
- Subsidized Low-Income Housing Resilience Strategies
- Mosquito Control Districts

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COMMUNITY RESILIENCE BUILDING WORKSHOP

Focused on Four Hazards

Identified:
- Vulnerabilities
- Strengths
- Priority Action Items

Across Three Categories:
- Infrastructure
- Societal
- Environmental

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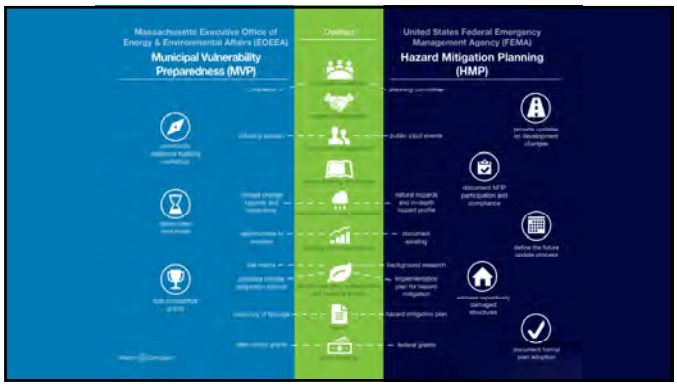

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CLIMATE HAZARDS

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TOP HAZARDS IN GROTON

Extreme Temperatures

Extreme weather (Nor'easters, wind, and snow)

Fires and Drought

Flooding

13

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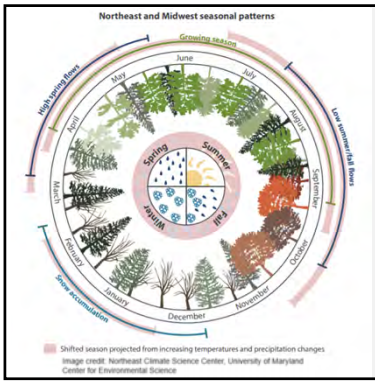

The most notable recent drought event was in **2016**[1].

The occurrence of droughts **lasting 1 to 3 months** could go up by as much as **75% over existing conditions** by the end of the century, under the high emissions scenario[1].

This could impact **drinking supply and the Fire Department**[2].

1. Source: Executive Office of Energy and Environmental Affairs, Adaptation Advisory Committee. 2011. "Massachusetts Climate Change Adaptation Report," 17.
2. Core Team Meeting, December 11, 2019

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EXTREME TEMPERATURES

WARMER ANNUAL AIR TEMPERATURES
UP 0.5°F PER DECADE SINCE 1970, ON AVERAGE

WARMER WINTERS
UP 1.3°F PER DECADE SINCE 1970, ON AVERAGE

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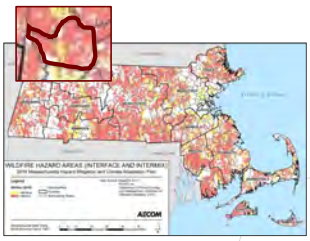
BRUSH FIRE



Wildfire Hazard Areas, 2018 Massachusetts Hazard Mitigation and Climate Adaptation Plan, p4-176

Brush Fires in Groton

- Between 2009-2015, Groton experienced **23 wildland fires** that burned **416 acres**[1].
- 2012 and 2013: **Great Brushfire**
- After a wildfire at Lost Lake, the Town implemented a **$1.8M mitigation project**[2].

Locally Identified Areas of Fire Risk

- Town Center, around Rt. 119 and Rt. 111[1]
- Lost Lake Drive Neighborhood[1]
- An area without fire hydrants near Island Pond[1]
- Chestnut Hill[2]

1. Montachusett Regional Planning Commission (MRPC). 2015. "Montachusett Region Natural Hazard Mitigation Plan 2015 Update," p44, 265.
2. Core Team Meeting, December 11, 2019

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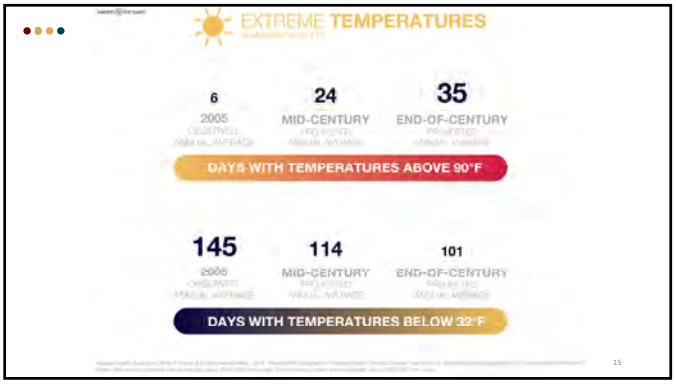

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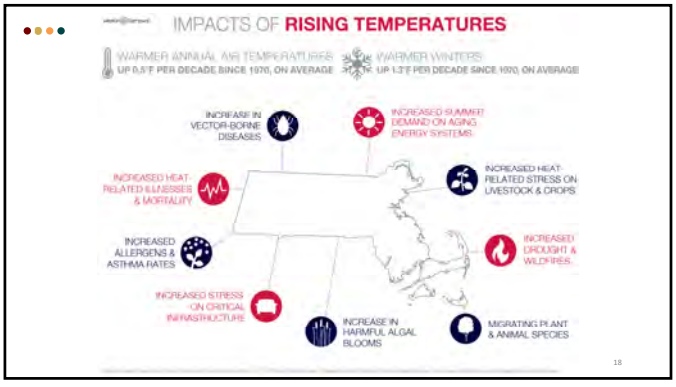

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CHANGES IN PRECIPITATION

MORE **INTENSE & FREQUENT** EXTREME RAIN EVENTS

PRECIPITATION DURING **HEAVY EVENTS** IN THE NORTHEAST **INCREASED BY MORE THAN 70%** BETWEEN 1958-2010

19

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IMPACTS OF CHANGING **PRECIPITATION**

HIGHER AVERAGE ANNUAL PRECIPITATION
INCREASED BY ABOUT 10% IN THE NORTHEAST IN THE LAST 50 YEARS

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EXTREME PRECIPITATION

8%

Increase in extreme precipitation events by midcentury

13%

Increase in extreme precipitation events by 2100

20

20

EXTREME WINTER WEATHER

The blizzard of 2013 left nearly **400,000 Massachusetts residents without power**

Heavy blizzards are among the **most costly and disruptive** weather events for Massachusetts communities

Nor'easters along the Atlantic coast are increasing in frequency and intensity

Jan 3-4, 2018: Winter Storm Grayson
March 2, 2018: Winter Storm Riley
March 8, 2018: Winter Storm Quinn
March 13, 2018: Winter Storm Skylar

Sources: ResilientMA, Climate Science Special Report, Fourth National Climate Assessment (NCA4), Volume prepared by the U.S. Global Change Research Program (USGCRP)/Northern Middlesex

23

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FLOODING

A flooded road in Groton. Photo by the Town of Groton

1. Montachusett Regional Planning Commission (MRPC). 2015. "Montachusett Region Natural Hazard Mitigation Plan 2015 Update." p265
2. Town of Groton. 2019. "Town of Groton 2019-2028 Open Space and Recreation Plan." p49
3. Core Team Meeting, December 11, 2019
4. CRB Workshop, January 2020

LOCALLY IDENTIFIED AREAS OF FLOODING

- Broadmeadow Road[4]
- West Main Street near the Nashua River[4]
- Route 119 near Cady Pond[4]
- Lowell Road and Brook, south of Martins Pond[1]
- Beaver dam northeast of Martins Pond[1]
- Townsend Road at Park Drive in West Groton[2]
- Area around Baddacook Pond[2]
- Area around Whitney (Cow) Pond[2]
- Area around Lost Lake/Knops Pond[2]
- River Court Housing Complex[3]
- Pepperell Streets[3]

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IMPACTS OF **EXTREME WEATHER**

STORMS ARE BECOMING MORE INTENSE AND DAMAGING:

24

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Take the online survey to tell us **what hazard most concerns you**

25

25

ENVIRONMENTAL

Strengths	Both Strength and Vulnerability	Vulnerabilities
• **Wetlands** provide habitat and water storage, and the Town's wetlands bylaw is forward thinking.	• **Forested land** is a fire risk, but forests also sequester carbon and create habitat. • **Agriculture** is part of the Town's historic heritage but faces financial and environmental challenges. • **Stormwater regulations** could be improved. • **Town land** provides habitat, but some species are rare and endangered. • **Open space** offers recreation but also requires protection from hazards. • Groton has the second largest **trail network** in Massachusetts. Recent rescue operations have highlighted the need for improved signage and education, particularly related to poor weather events. • The **Nashua and Squannacook Rivers** are scenic destinations. The Nashua River has invasive Water Chestnut plants. • Increased **development** can provide needed housing but also encroach on natural resources.	• **Invasive species**, including the Emerald Ash Boarer and Black Swallow Wort. • **Algal blooms**, including near the Lost Lake Dam. • **Vector-born diseases** • **Contaminated sites**

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STRENGTHS & VULNERABILITIES

Photo by MAS, 2019

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SOCIETY

Strengths	Both Strength and Vulnerability	Vulnerabilities
• **Public transit**, including the Council on Aging van, and commuter rail connection in Ayer.	• **Health Care facilities**, including Seven Hills Pediatric Center. • **Assisted living facilities** • **Private Boarding Schools** • **Commercial and industrial centers**, including West Groton, Town Center, and Four Corners Village. • **Housing**, although additional housing units are needed. • **Public Schools:** the High School is a shelter and the Middle School is a warming center. • **Mobility**: commuting, walking paths, and cycling options. • **Indian Hill Music Center**, a nonprofit that will provide local jobs and public education opportunities. • **Climate migration** would increase demand on local services but also provide new residents and volunteers in a town that values its sense of community.	• **Elderly residents** • **Lost Lake neighborhood** • Groton is a **"Right to Farm"** community • Residents may not use a shelter if they cannot bring their **pets** • **Emergency Response Plan**

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INFRASTRUCTURE

Strengths	Both Strength and Vulnerability	Vulnerabilities
• **Municipal buildings**, Police, Fire, DPW, and Groton Center. • **Shelters** include the Center and local schools.	• Groton has a strong **water supply** but there is concern about future contamination. • Some residents rely on **private wells**, which could be impacted by drought. • **Bridges**, including two over the Nashua River. • Undersized **culverts**, including culverts at Cady Pond Brook and Route 119. • **Groton Electric Light Department** could improve resilience through underground power lines and the use of batteries and solar power. • **Wastewater,** which goes to Ayer and Pepperell. • **Communication** systems in the event of an emergency could improve. • There are two high-hazard, Town-owned **dams** in Groton (Squannacook River Dam, and the Lost Lake Dam).	• **Roads** that flood.

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Take the online survey to tell us **more about Groton's vulnerabilities and strengths**

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EXISTING HAZARD PROTECTION

- Stormwater management bylaw
- Wetlands protection bylaw
- FEMA FIRM maps updated in 2010
- Town bylaw floodplain districts
- Catch basin cleaning
- Street sweeping
- Public information sessions on stormwater and related topics
- Snow plowing and removal
- Expansion of the sewer system to Four Corners
- Tree maintenance
- Enforce State Building Code
- CodeRED
- Increasing resilience of the communication system
- Open burning permits
- Student Awareness of Fire Education (SAFE) Program
- Cots for shelters
- Backup generators in municipal buildings and the Center
- Memoranda of Understanding letters
- MA WARN Network
- Stormwater management in environmental science curriculum
- Student clubs and initiatives

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HIGHEST HIGH PRIORITIES

- **Roads:** address flooding and improve drainage on Broadmeadow Road and Route 119.
- **Culverts:** new designs should consider climate change. Upsize existing culverts where necessary. Increase maintenance and drainage ditch cleaning.
- **Water supply:** increase storage, access to water in places without hydrants. Regulate irrigation systems and improve conservation.
- **Development and stormwater:** update stormwater management regulations with climate data. Increase low impact development. Update FEMA FIRMs.
- **Habitat:** increase habitat for endangered species and pollinators. Address invasive species. Leverage volunteers and conduct public education and outreach.

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HIGH PRIORITIES: INFRASTRUCTURE

- **Bridges:** develop bridge design to reduce flooding and storm debris collection, identify alternative evacuation routes.
- **Electric utilities:** identify priority facilities for solar power and batteries to improve resilience. Explore backup energy sources and alternative local power sources. Increase EV charging stations. Consider underground utilities. Provide incentives for energy reduction during peak demand.
- **Dams:** pursue funding for dam removal and increase public outreach and education.
- **Wastewater:** assess impact of inter-basin transfers on groundwater. Increase education on sewer BMPs and what not to flush. Review regulations.
- **Communications:** improve cell coverage.

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HIGH PRIORITIES: SOCIETY & ENVIRONMENT

- **Mobility:** implement complete streets priorities.
- **Open space:** work with the Fire Department to identify areas that should be allowed to burn. Educate residents on vector-borne diseases.
- **Wetlands:** pursue land acquisition. Continue to protect and restore wetlands. Increase groundwater infiltration near wetlands and "slow the flow" in streams.
- **Forested land:** develop a fire prevention and management plan. Clean up debris. Create a wood bank with recently downed trees.
- **Algal blooms:** treat stormwater onsite and upstream.
- **Land use and development:** educate homeowners on fire safety.

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Take the **online survey** to tell us more about hazards and preparedness in Groton

- Comment on the webinar, and help us understand your priorities by taking our survey!

  tinyurl.com/GrotonMVPSurvey

- The survey will be available online until **April 23RD**

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Groton Planning Board Meeting
April 9, 2020

9 Panelists:
Bob Colman
Lorayne Black
David Bonnett
Takashi Tada
Russ Burke
George Barringer
Adria Boynton
Tim Svarczkopf
Annika Nilsson Ripps

4 Attendees
Beth Faxon
Judy Anderson
Nii Quao
Mike C.

Notes:
- Introduction from Russ Burke
- Watching the MVP Listening Session webinar
- Survey and webinar link will be posted on the town's website
- Do we have an assessment of the two dams, and is anyone doing maintenance for them?
    - Maintenance falls onto DPW
    - Rivercourt dam has part of its structure in Shirley
    - Lost Lake Dam is Town-owned
        - Who controls the culverts
- Lost Lake Fire protection project 3-4 years ago
    - Fire protection effort, not wetlands mitigation
    - There is a dry hydrant that was installed in either Lost Lake or on the other side of Island Road
    - A hydrant that goes into one of the ponds, that the Fire Department can draw water from
    - They went online with actual water district water
    - There were cisterns installed
    - They put in hydrants connected to Town Water
    - And they put in a dry hydrant connected to Lost Lake
- Wetland restoration in Groton
    - Were either done as required by private projects
    - Groton conservation trust has done some restoration related to controlling invasive species on properties owned by the trust
- Any rain gardens that have been successfully installed

    - Repaving of court street, they put the sidewalks using permeable pavement and there were rain gardens established there
    - Behind the parking lot at Town hall – pervious asphalt parking lot and there's a rain garden
    - Shaw's intersection where four Corners, where Dunkin Donuts? That was bioretention. Not rain gardens. Bioretention.
    - There are lots of small water quality construction projects. Mr. Mike's – project across the street, the old Kilbridge's place – Boynton Medows? Interior of the culdesac is one?
- How is pandemic included in the planning process?
    - Not under the planning boards purvuiew
    - Preparedness comes into play
    - Public education and outreach – what are the strategies? Zoom, social media, flyer sent home, Town website. That came up during the CRB Workshop and is relevant now.
    - Spanish flu – it originated in Kansas. The Army Corps was burning piles of manure and the fumes created a disease, which infected military people going onto a transport ship going to the war in Europe. The concentration of people on the ship led to the outbreak. First outbreak of Spanish flu in the US was at Fort Devons, from returning veterans of the war.
    - Communication systems could improve during an emergency
        - Are there pockets of town that don't have good internet coverage?
        - Charter (now called Spectrum) and Verizon, looking at the future of wireless 5G. If this current situation is a litmus test, we're doing ok.
        - Most people had never heard of Zoom before this. This is one tool out of many that we'll add to our toolbox for future events, and there are other things we're learning during this time
- Stormwater model – do we have one for Groton? How do you size a culvert if you knew it was flooding?
    - You design for a 100-year storm but your storm pipes are all designed for 10-year events, which causes a disconnect or a surcharging of those systems.
    - Assessment of existing culverts or stormwater model for future climate conditions
    - Impact on wildlife – their ability to get from one side of the bank to another
    - There are stream crossing standards under MassDEP – not sure when they take effect
        - Rare species habitat mapped by the state
        - DER grant will help fund studies of replacement culverts
        - 119 across from the medical building – public works has to remove debris from beavers who keep trying to block it and flood
        - We're seeing failures, and those should be high priority on the list. Areas where we have excessive maintenance
        - Broadmeadow Road – Russ took a photo last Saturday just beyond the library. There was a run of the mill storm last Friday and Saturday morning there was still water across the road after a minor storm
            - Been on their radar for Town meetings, appropriated funds
- The planning board website will have a link so you can view the webinar in its entirety, and a link to the survey where you can respond to questions

TOWN OF GROTON PLANNING BOARD

Thursday, April 9, 2020
Meeting Minutes

A virtual meeting of the Planning Board was held on Thursday, April 9, 2020, at 7:00 p.m.

The meeting was broadcasted via Zoom and was available to view on the Groton Channel pursuant to the Governor's Executive Order Concerning the Open Meeting Law.

Members Present:

Mr. Russell Burke, Chair
Ms. Annika Nilsson Ripps, Clerk
Mr. George Barringer, Board Member
Mr. Timothy M. Svarczkopf, Board Member
Mr. David Bonnett, Board Member
Ms. Lorayne Black, Board Member

Members not Present:

Mr. Scott Wilson, Vice Chair

Also Present:

Mr. Takashi Tada, Land Use Director/Town Planner

Webinar Presentation and Discussion
Municipal Vulnerability Preparedness (MVP) Grant Program
Hazard Mitigation and Climate Change Adaptation

NOTE: Webinar & Survey are available on the Town of Groton Planning Board's Website

Mr. Burke stated they would play a recorded webinar prepared by Weston & Sampson, the Town's consultants regarding the Municipal Vulnerability Preparedness (MVP) Grant Program. The recording will be followed by a discussion regarding the information shared.

Ms. Adria Boynton, Resiliency Specialist, Weston & Sampson, narrated the pre-recorded webinar.

Ms. Boynton encouraged people to take an online survey that was available until April 23rd by going to the Planning Board's web page and then double click on the hyperlink entitled **tinyurl.com/GrotonMVPSurvey**. She noted the public's comments would be included in the final deliverable document.

Mr. Bonnett asked if there was an assessment of the two dams and if anyone was doing maintenance on them. He also asked about wetlands restoration and replacing undersized culverts. Mr. Tada replied the maintenance of the dams was within the purview of the Department of Public Works. Mr. Svarczkopf mentioned there were a number of small-scale rain gardens and bioretention areas installed for various project around town.

Ms. Boynton stated the MVP (Municipal Vulnerability Preparedness) Program's Action Grants could be used to fund studies and assessments of dams, culverts, and other infrastructure, and the MA Executive Office of Environmental Affairs (EEA) had been hosting webinars over the last week because they were anticipating the Request for Responses (RFR) for the next round of Action Grants to be released at the end of the month and one of the regional coordinators for the MVP Program stressed that they were very supportive of applications for infrastructure assessments.

Mr. Svarczkopf read a question submitted by Ms. Beth Faxon, via the Zoom chat function. Ms. Faxon asked if infectious diseases such as the current coronavirus pandemic had been factored in. Vector-borne diseases were considered, but the MVP community resilience building workshop was held in mid-January, before the pandemic became a major issue.

Ms. Black observed that access to the Internet is important now, more than ever.

Mr. Burke thanked Ms. Boynton for providing the webinar. Ms. Boynton replied all public feedback would be important in finalizing the report and she was looking forward to seeing what the public had to share.

Discussion – Update on Spring Town Meeting Warrant and Schedule

Mr. Burke said the Town Manager sent out a memo to all boards and departments stating they would like to keep the number of people participating in the Spring Town Meeting to a minimum and asked if there were any Articles being proposed that were essential and if there were others that could be deferred until the Fall Town Meeting. He said he and Mr. Tada responded that they would like to see the recodification of the zoning moved forward but felt the other Articles could be postponed: the clean-up of the site plan review, and the two accessory dwelling unit (attached and detached) amendments.

Committee Updates

- Community Preservation Committee

Mr. Svarczkopf stated he had not been able to attend many meetings as of late due to his travel schedule which obviously had changed about three weeks prior. He said there would

be an online meeting that he would be able to participate in coming up soon but there were some emails that suggested an alternate or another person should be appointed to the committee. He added Monday nights would continue to be a problem for him to attend the meetings in person, however, if the meetings continued to be online he could definitely attend.

Mr. Burke stated the Planning Board had been advised by Town Counsel that they could not appoint an alternate to the Community Preservation Committee. He suggested Mr. Svarczkopf remain on the committee for time being and it could be addressed at the time the board reorganizes ahead of the next fiscal year.

- Complete Streets Committee

Mr. Barringer commented that the Complete Streets Committee had not met since late January. He said he saw no reason why the Complete Streets Engineering Warrant Article could not wait until the Fall Town Meeting.

General Business

- ZBA Updates

Mr. Tada commented the ZBA met the previous evening but he did not have any updates to give to the Planning Board at the time.

- Approval of Meeting Minutes – March 12, 2020

Mr. Barringer made a motion to accept the minutes from the March 12, 2020, meeting, as presented. Ms. Nilsson Ripps seconded the motion.

A Roll Call vote was taken, which resulted as follows:

Yea:	Mr. Barringer, Ms. Nilsson Ripps, Ms. Black, Mr. Bonnett, Mr. Svarczkopf, and Mr. Burke	6
Nay:		0

VOTE: 6 – 0 – 0
MOTION CARRIED

Other Comments

Mr. Burke stated despite the COVID-19 virus they were still receiving invoices to be paid and as it was logistically impossible for them to get a quorum of the Planning Board to sign the invoices. He further stated the Town Accountant suggested a single member be appointed to sign off on them on behalf on the entire Planning Board. Mr. Barringer volunteered for this task.

Mr. Svarczkopf made a motion to authorize Mr. George Barringer to approve and sign off on all invoices submitted to the Planning Board. Ms. Black seconded the motion.

A Roll Call vote was taken, which resulted as follows:

Yea:	Mr. Svarczkopf, Ms. Black, Mr. Bonnett, Ms. Nilsson Ripps, Mr. Barringer, and Mr. Burke	6
Nay:		0

VOTE: 6 – 0 – 0
MOTION CARRIED

Mr. Tada commented there were three invoices that needed approval and explained them as follows:

- Weston & Sampson ($2,200) - He noted the money would come out of the grant that the Town Groton had already been awarded from the state.
- Groton Herald ($243.00) – Mr. Burke suggested Mr. Tada document the payment as part of their local contribution to the MVP planning process.
- Groton Herald (2 charges @ $475.75 each)

Planning Board Meeting Schedule

- A May date to be determined, possibly May 14.
- May 18, 2020 – Spring Town Meeting

Adjournment

Mr. Svarczkopf made a motion to adjourn. Ms. Nilsson Ripps seconded the motion.

A Roll Call vote was taken, which resulted as follows:

Yea:	Mr. Svarczkopf, Ms. Nilsson Ripps, Mr. Bonnett, Ms. Black, Mr. Barringer, and Mr. Burke	6
Nay:		0

VOTE: 6 – 0 – 0
MOTION CARRIED

The meeting was adjourned at 8:24 p.m.

Respectfully Submitted: Trish Gedziun

Groton MVP Survey

The Town of Groton is seeking community input as a part of their hazard mitigation and climate adaptation planning process. In January, a group of stakeholders met to identify strengths, vulnerabilities, and recommendations for next steps. We are reporting the results of this workshop and seeking public feedback as part of a virtual engagement strategy.

This virtual format includes a pre-recorded webinar (available at tinyurl.com/GrotonMVPWebinar) and this online survey. This survey is intended to collect public feedback and will be available from April 9-April 23, 2020. The feedback from this survey will be captured in the project's final report.

If you have questions or barriers to participating, please contact Takashi Tada (Land Use Director/Town Planner) at ttada@townofgroton.org or (978) 448-1105.

1. What hazard most concerns you?




	Hazard of most concern	Hazard of significant concern	Hazard of some concern	Hazard of least concern
Fire and drought	○	○	○	○
Extreme weather (Nor'easters, wind, and snow)	○	○	○	○
Flooding	○	○	○	○
Extreme temperatures	○	○	○	○

2. What memories of climate hazards do you have? These could include impacts from:
    - The 2007 flooding of the Nashua and Squannacook Rivers, which damaged local roads
    - The March 2010 flood, which closed bridges and cut off West Groton
    - The four Nor'easters in March 2018 (Winter Storms Riley, Quinn, Skylar, and Toby)
    - Winter Storm Grayson in January 2018
    - The 2016 drought



Image credits: Town of Groton and Groton Electric Light Department

Short answer response:

3. What do you consider to be Groton's greatest vulnerabilities?

- [ ] Infrastructure; including roads, bridges, and culverts
- [ ] Utilities; including water, wastewater, and electric
- [ ] The stormwater system, including undersized culverts
- [ ] Invasive species and vector-borne diseases
- [ ] Groton's historic resources, including the Town's "Right to Farm" designation
- [ ] Vulnerable residents, including the elderly and those displaced by climate impacts
- [ ] Public and private schools and their students
- [ ] Other (Please specify)

4. What are Groton's greatest strengths considering climate resilience?



Image credits: Weston & Sampson

- [ ] Municipal buildings, including the Police Department, Fire Department, DPW, and the Groton Center
- [ ] Commercial centers, including West Groton, the Town Center, and Four Corners Village
- [ ] Shelters, including the Groton Center and local schools
- [ ] Health care resources, including Seven Hills Pediatric Center
- [ ] Open space, including forests, trails, and outdoor recreational space
- [ ] Waterbodies, including wetlands and rivers
- [ ] Other (Please specify)

5. What steps have you already taken to prepare for extreme events?

- [ ] I have a kit in case of emergencies (which may include food, water, flashlights, batteries, and other supplies)
- [ ] I receive news, updates, and information about emergency preparedness in Groton
- [ ] I know where the nearest local shelter is
- [ ] I have signed up for the Code RED notification system
- [ ] Other (Please specify)

6. What resources do you need to feel more prepared?

- [ ] More information on areas and infrastructure in town vulnerable to climate impacts
- [ ] More information on evacuation routes and shelters
- [ ] More information on preparing an emergency kit and receiving news updates during an extreme event
- [ ] Other (please specify)

7. How should Groton prioritize its climate adaptation strategies?

- ○ Based on funding
- ○ Time frame
- ○ Asset type (i.e., infrastructure, buildings, or natural systems)

- Impact on public safety
- Other (please specify)

8. Rank the following climate adaptation action items from highest priority to lowest priority.
    - Update regulations related to stormwater management and low impact development
    - Upgrade undersized culverts using climate change projections
    - Increase water storage, address potential contaminants, and increase water conservation
    - Address invasive species through removal and public education
    - Increase and maintain open space and habitat for endangered species
    - Address roads that are vulnerable to flooding, including Broadmeadow Road and Route 119

9. Are there any other comments or questions that you would like to share with the project team?

Short answer response:

10. If you are interested in receiving additional updates related to climate initiatives in Groton, please enter your email below.

Short answer response:

55 Walkers Brook Drive, Suite 100, Reading, MA 01867
Tel: 978.532.1900

Groton MVP Survey

Summary of Survey Results

Introduction

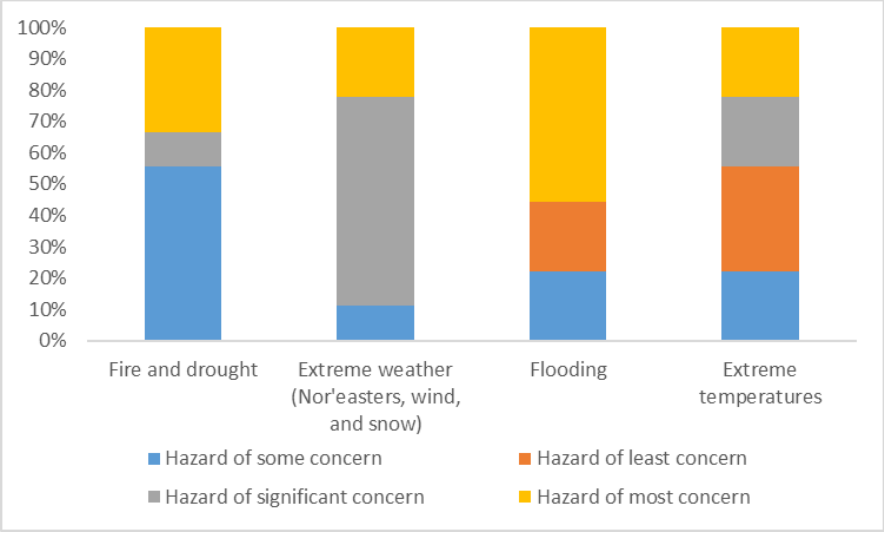
The Town of Groton was awarded a Municipal Vulnerability Preparedness (MVP) Planning Grant to improve the Town's resilience to climate change, and to mitigate natural hazards. The MVP Program aims to provide technical and financial support for cities and towns across the Commonwealth to plan for, and mitigate the impacts from, climate change. As part of the virtual public listening session, the project team shared a survey with the public to collect feedback related to climate hazards, strengths, vulnerabilities, and priority adaptation action items. Key information related to the results of this survey are summarized below:

- The survey was accessible on the Microsoft Forms website from April 7 to April 23, 2020. The survey was extended to April 24th to allow time for additional input.
- A link to the online survey was shared on April 7th, during the Town's Planning Board meeting, which was conducted using the Zoom video conferencing platform. A pre-recorded video was presented during the meeting, which included a link to the online survey. The link was also posted on the Town website and YouTube pages.
- The project team received 9 online responses to the survey.

The following summary provides an overview of the survey responses, along with key findings and recommendations for using this information. A spreadsheet of short-answer responses from survey participants, along with a copy of the original survey, are included as attachments to this document.

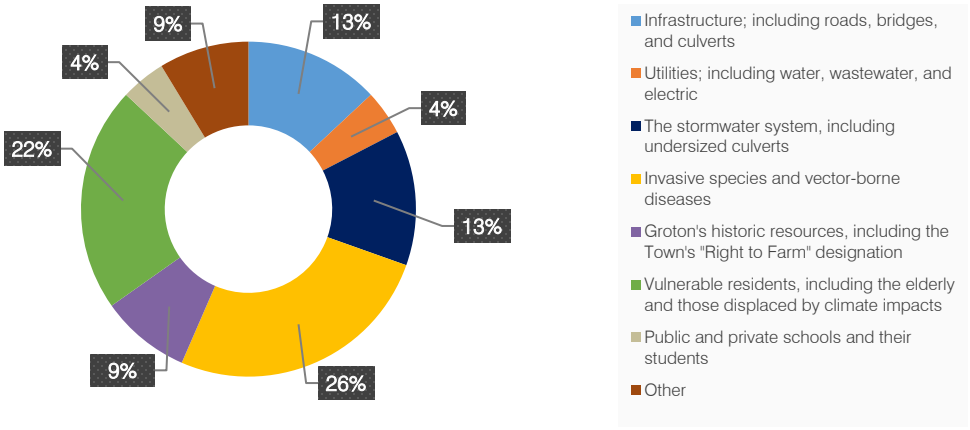
Survey Results

What hazard most concerns you?

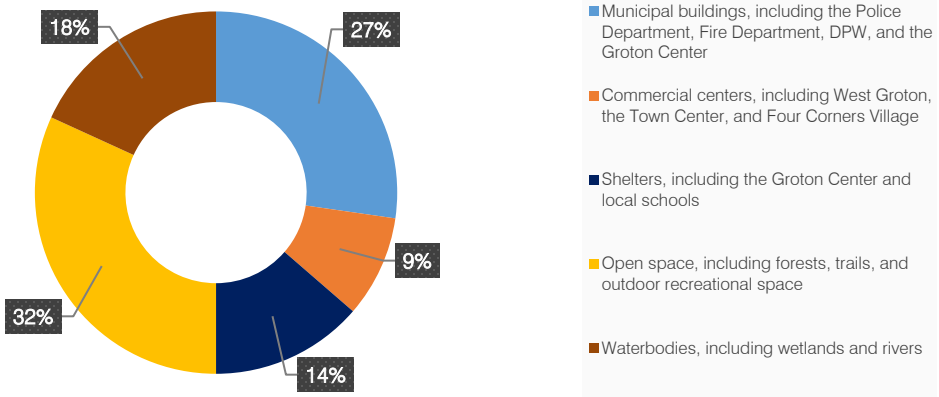


- Survey result suggests that flooding is the hazard of most concern.
- Extreme weather such as Nor'easters, wind, and snow are of significant concern.
- Fire and drought are of some concern among the residents.
- Extreme temperature is of least concern.

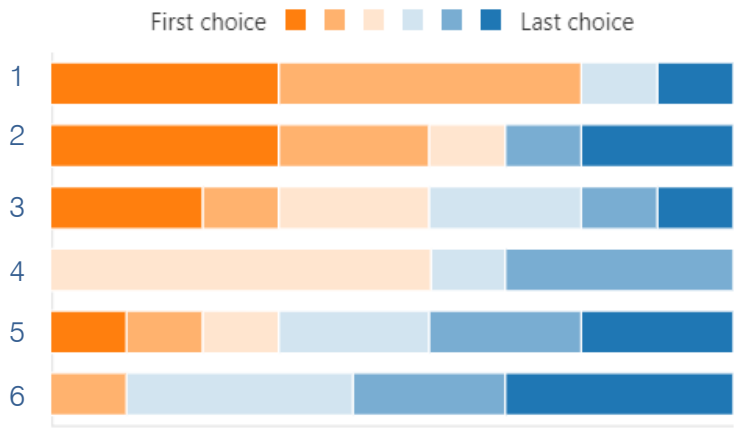
What do you consider to be Groton's greatest vulnerabilities?



What are Groton's greatest strengths considering climate resilience?

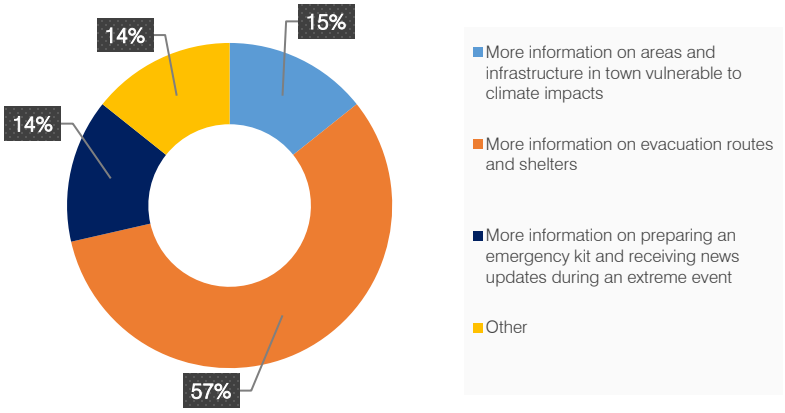


Rank the following climate adaptation action items from highest priority to lowest priority.

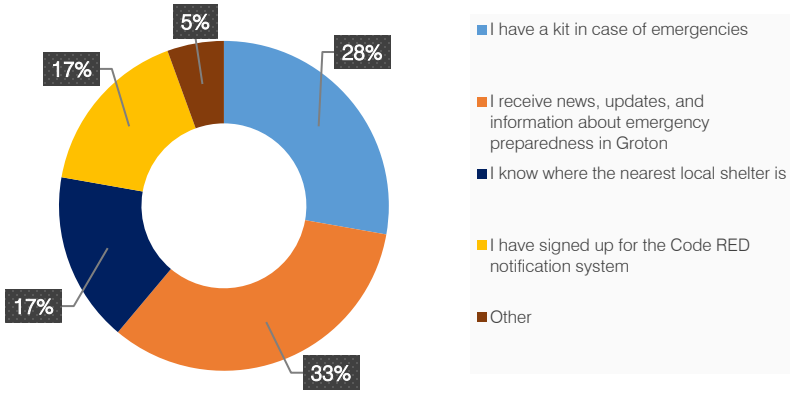


1. Upgrade undersized culverts using climate change projections
2. Address roads that are vulnerable to flooding, including Broadmeadow Road and Route 119
3. Address invasive species through removal and public education
4. Increase water storage, address potential contaminants, and increase water conservation
5. Update regulations related to stormwater management and low impact development
6. Increase and maintain open space and habitat for endangered species

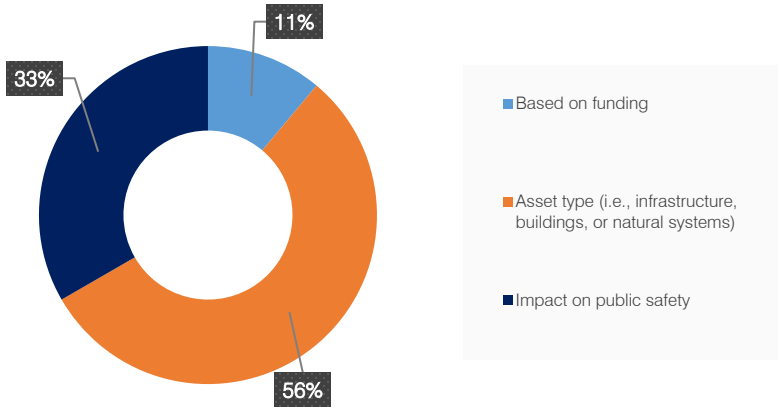
What resources do you need to feel more prepared?



What steps have you already taken to prepare for extreme events?



How should Groton prioritize its climate adaptation strategies?



Summary of short-answer responses:

- The most frequently cited climate hazard that caused significant impacts in the Town is flooding (4 out of 9 responses). Flooding can isolate parts of the Town by shutting down bridges and roads. Fire and drought events were also mentioned by residents. One respondent expressed concern related to potential fire damage due to insufficient clearing of dead woods and fallen leaves. Nor'easters were also mentioned, although one respondent added that Groton Electric is efficient in pruning trees, thus reducing power outages during storm events. This respondent also mentioned that poor water quality should be included in the final report.
- Two residents stated that preparedness, planning, and collaboration with other government bodies are required to successfully combat climate issues. Concerns related to Groton's water quality were mentioned again in the additional comments section.

Key Findings & Next Steps

As the pie charts and bar graphs indicate, flooding is the main concern for Town residents. The survey responses suggest that the Town needs better stormwater management systems. Strategies could include upgrading undersized culverts and improved drainage infrastructure on roads that are

vulnerable to flooding. Although most of the residents receive news, updates, and information during emergencies, more information on evacuation routes and available shelters are desired.

The project team should use this information to:

- Pursue funding to implement climate adaptation strategies related to flooding, including upgrading culverts or addressing vulnerable roads.
- Share more information on evacuation routes and shelters.
- Use the email addresses collected to start a climate resilience listserv. Additionally, the next public meeting should be advertised via email to respondents who shared their contact information.

Attachments

- Attachment A: Short Answer Responses Spreadsheet
- Attachment B: Groton Community Feedback Survey

Appendix E

Plan Adoption

TOWN OF GROTON
173 Main Street
Groton, Massachusetts 01450-1237
Tel: (978) 448-1111
Fax: (978) 448-1115

CERTIFICATE OF ADOPTION
SELECT BOARD

TOWN OF GROTON, MASSACHUSETTS

A RESOLUTION ADOPTING THE
TOWN OF GROTON
2020 HAZARD MITIGATION PLAN - MUNICIPAL VULNERABILITY PREPAREDNESS PLAN

WHEREAS, the Town of Groton established a Committee to prepare the Town of Groton 2020 Hazard Mitigation Plan - Municipal Vulnerability Preparedness Plan; and

WHEREAS, the Town of Groton 2020 Hazard Mitigation Plan - Municipal Vulnerability Preparedness Plan contains several potential future projects to mitigate potential impacts from natural hazards as well as climate change in the Town of Groton, and

WHEREAS, the public provided input through a duly-noticed listening session, recorded video, and online survey advertised by the local Planning Board on April 9, 2020, and

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

NOW, THEREFORE BE IT RESOLVED that the Town of Groton Select Board adopts the Town of Groton 2020 Hazard Mitigation Plan - Municipal Vulnerability Preparedness Plan, in accordance with M.G.L. 40 §4 or the charter and bylaws of the Town of Groton.

ADOPTED AND SIGNED December 24, 2020
(Date)

Groton Select Board:

Alison S. Manugian, Chair

Joshua A. Degen, Vice Chair

Rebecca H. Pine, Clerk

John R. Giger, Member

John F. Reilly, Member

Appendix F

FEMA Approval

U.S. Department of Homeland Security
FEMA Region I
99 High Street, Sixth Floor
Boston, MA 02110-2132

FEMA

January 04, 2021

Samantha C. Phillips, Director
Massachusetts Emergency Management Agency
400 Worcester Road
Framingham, Massachusetts 01702-5399

Dear Director Phillips:

The U.S. Department of Homeland Security, Federal Emergency Management Agency (FEMA) Region I Mitigation Division has approved the Town of Groton 2020 Hazard Mitigation Plan - Municipal Vulnerability Preparedness Plan effective **December 30, 2020** through **December 29, 2025** in accordance with the planning requirements of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act), as amended, the National Flood Insurance Act of 1968, as amended, and Title 44 Code of Federal Regulations (CFR) Part 201.

With this plan approval, the jurisdiction is eligible to apply to the Massachusetts Emergency Management Agency for mitigation grants administered by FEMA. Requests for funding will be evaluated according to the eligibility requirements identified for each of these programs. A specific mitigation activity or project identified in this community's plan may not meet the eligibility requirements for FEMA funding; even eligible mitigation activities or projects are not automatically approved.

The plan must be updated and resubmitted to the FEMA Region I Mitigation Division for approval every five years to remain eligible for FEMA mitigation grant funding.

Thank you for your continued commitment and dedication to risk reduction demonstrated by preparing and adopting a strategy for reducing future disaster losses. Should you have any questions, please contact Melissa Surette at (617) 956-7559 or Melissa.Surette@fema.dhs.gov.

Sincerely,

Captain W. Russ Webster, USCG (Ret.), CEM
Regional Administrator
FEMA Region I

WRW:ms

cc: Sarah White, State Hazard Mitigation Officer, MEMA
Jeffrey Zukowski, Hazard Mitigation Planner, MEMA
Beth Dubrawski, Hazard Mitigation Contract Specialist, MEMA

LOCAL MITIGATION PLAN REVIEW TOOL - Final
Town of Groton, MA

The *Local Mitigation Plan Review Tool* demonstrates how the Local Mitigation Plan meets the regulation in 44 CFR §201.6 and offers States and FEMA Mitigation Planners an opportunity to provide feedback to the community.

- The Regulation Checklist provides a summary of FEMA's evaluation of whether the Plan has addressed all requirements.
- The Plan Assessment identifies the plan's strengths as well as documents areas for future improvement.
- The Multi-jurisdiction Summary Sheet is an optional worksheet that can be used to document how each jurisdiction met the requirements of each Element of the Plan (Planning Process; Hazard Identification and Risk Assessment; Mitigation Strategy; Plan Review, Evaluation, and Implementation; and Plan Adoption).

The FEMA Mitigation Planner must reference this *Local Mitigation Plan Review Guide* when completing the *Local Mitigation Plan Review Tool*.

Jurisdiction: Town of Groton	**Title of Plan:** Town of Groton 2020 Hazard Mitigation Plan (HMP) - Municipal Vulnerability Preparedness (MVP) Plan	**Date of Plan:** 2020
Single or Multi-jurisdiction plan? Single jurisdiction	**New Plan or Plan Update?** Update	
Local Point of Contact: Takashi Tada **Title:** Land Use Director/Town Planner **Agency/Address:** Land Use Department 173 Main Street Groton, MA 01450 **Phone Number:** (978) 448-1105 **E-Mail:** ttada@townofgroton.org	**Regional Point of Contact:** N/A **Title:** **Agency/Address:** **Phone Number:** **E-Mail:**	

State Reviewer: Jeffrey Zukowski	**Title:** Hazard Mitigation Planner	**Date:** 10/20/20; 12/30/2020

FEMA Reviewer: Sean Loughlin Brigitte Ndikum-Nyada	**Title:** Community Planner Community Planner	**Date:** 10/21/20 – 11/3/2020 11/3/20 – 11/13/2020; 12/30/20
Date Received in FEMA Region I	10/20/20; 12/30/2020	
Plan Not Approved		
Plan Approvable Pending Adoption	11/13/2020	
Plan Adopted	12/24/2020	
Plan Approved	**12/30/2020**	

SECTION 1:
REGULATION CHECKLIST

INSTRUCTIONS: The Regulation Checklist must be completed by FEMA. The purpose of the Checklist is to identify the location of relevant or applicable content in the Plan by Element/sub-element and to determine if each requirement has been 'Met' or 'Not Met.' The 'Required Revisions' summary at the bottom of each Element must be completed by FEMA to provide a clear explanation of the revisions that are required for plan approval. Required revisions must be explained for each plan sub-element that is 'Not Met.' Sub-elements should be referenced in each summary by using the appropriate numbers (A1, B3, etc.), where applicable. Requirements for each Element and sub-element are described in detail in this *Plan Review Guide* in Section 4, Regulation Checklist.

1. REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	**Location in Plan (section and/or page number)**	**Met**	**Not Met**
ELEMENT A. PLANNING PROCESS			
A1. Does the Plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction? (Requirement §201.6(c)(1))	Executive Summary and Sections 1.3 through 1.5	X	
A2. Does the Plan document an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, agencies that have the authority to regulate development as well as other interests to be involved in the planning process? (Requirement §201.6(b)(2))	Section 1.4.2	X	
A3. Does the Plan document how the public was involved in the planning process during the drafting stage? (Requirement §201.6(b)(1))	Sections 1.4.2; 1.4.3 and 1.5; Appendix C and D	X	
A4. Does the Plan describe the review and incorporation of existing plans, studies, reports, and technical information? (Requirement §201.6(b)(3))	Section 1.4.1	X	
A5. Is there discussion of how the community(ies) will continue public participation in the plan maintenance process? (Requirement §201.6(c)(4)(iii))	Section 8.3.2	X	
A6. Is there a description of the method and schedule for keeping the plan current (monitoring, evaluating and updating the mitigation plan within a 5-year cycle)? (Requirement §201.6(c)(4)(i))	Sections 8.3 and 8.4	X	
ELEMENT A: REQUIRED REVISIONS			
ELEMENT B. HAZARD IDENTIFICATION AND RISK ASSESSMENT			
B1. Does the Plan include a description of the type, location, and extent of all-natural hazards that can affect each jurisdiction(s)? (Requirement §201.6(c)(2)(i))	Ch. 4	X	
B2. Does the Plan include information on previous occurrences of hazard events and on the probability of future hazard events for each jurisdiction? (Requirement §201.6(c)(2)(i))	Ch. 4	X	

1. REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	Location in Plan (section and/or page number)	Met	Not Met
B3. Is there a description of each identified hazard's impact on the community as well as an overall summary of the community's vulnerability for each jurisdiction? (Requirement §201.6(c)(2)(ii))	Ch. 4	X	
B4. Does the Plan address NFIP insured structures within the jurisdiction that have been repetitively damaged by floods? (Requirement §201.6(c)(2)(ii))	Sections 4.2.1 and 5.2	X	
ELEMENT B: REQUIRED REVISIONS			
ELEMENT C. MITIGATION STRATEGY			
C1. Does the plan document each jurisdiction's existing authorities, policies, programs and resources and its ability to expand on and improve these existing policies and programs? (Requirement §201.6(c)(3))	Ch. 5	X	
C2. Does the Plan address each jurisdiction's participation in the NFIP and continued compliance with NFIP requirements, as appropriate? (Requirement §201.6(c)(3)(ii))	Section 5.2	X	
C3. Does the Plan include goals to reduce/avoid long-term vulnerabilities to the identified hazards? (Requirement §201.6(c)(3)(i))	Executive Summary; Ch. 2	X	
C4. Does the Plan identify and analyze a comprehensive range of specific mitigation actions and projects for each jurisdiction being considered to reduce the effects of hazards, with emphasis on new and existing buildings and infrastructure? (Requirement §201.6(c)(3)(ii))	Ch. 7	X	
C5. Does the Plan contain an action plan that describes how the actions identified will be prioritized (including cost benefit review), implemented, and administered by each jurisdiction? (Requirement §201.6(c)(3)(iv)); (Requirement §201.6(c)(3)(iii))	Ch. 7	X	
C6. Does the Plan describe a process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate? (Requirement §201.6(c)(4)(ii))	Section 8.3.3 (pg. 6.1)	X	
ELEMENT C: REQUIRED REVISIONS			
ELEMENT D. PLAN REVIEW, EVALUATION, AND IMPLEMENTATION (applicable to plan updates only)			
D1. Was the plan revised to reflect changes in development? (Requirement §201.6(d)(3))	Section 3.7; Section 4.2.2 (pgs. 4.11-4.13)	X	
D2. Was the plan revised to reflect progress in local mitigation efforts? (Requirement §201.6(d)(3))	Ch. 6	X	
D3. Was the plan revised to reflect changes in priorities? (Requirement §201.6(d)(3))	Table 6.1	X	

1. REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	Location in Plan (section and/or page number)	Met	Not Met
ELEMENT D: REQUIRED REVISIONS			
ELEMENT E. PLAN ADOPTION			
E1. Does the Plan include documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval? (Requirement §201.6(c)(5))	HMP adopted on **12/24/2020.** A signed adoption certificate is on file	X	
E2. For multi-jurisdictional plans, has each jurisdiction requesting approval of the plan documented formal plan adoption? (Requirement §201.6(c)(5))	N/A		
ELEMENT E: REQUIRED REVISIONS			
ELEMENT F. ADDITIONAL STATE REQUIREMENTS (OPTIONAL FOR STATE REVIEWERS ONLY; NOT TO BE COMPLETED BY FEMA)			
F1.			
F2.			
ELEMENT F: REQUIRED REVISIONS			

SECTION 2:
PLAN ASSESSMENT

A. Plan Strengths and Opportunities for Improvement

This section provides a discussion of the strengths of the plan document and identifies areas where these could be improved beyond minimum requirements.

Recommended Corrections:

- P. 1-2: The new BRIC program can be added to the table listing FEMA grants.
- P. 3-6: Section 3.5 states that critical facilities are listed in Appendix C, however, they appear to be in Appendix B.
- P. 4-30: Paragraph one refers to Figure 4-8, which is labeled as Figure 4-9.
- P. 4-35: Paragraph one refers to Figure 4-10 below, however, Table 4-10 comes before.
- See FEMA Plan Guide 2011, page 34 for Plan Adoption requirement. – *"**FEMA:** If all Elements are met except adoption, FEMA determines that the Local Mitigation Plan is **APA.** The FEMA Region sends an APA letter to the State who, in turn, forwards the determination to the local community. The jurisdiction can then proceed with the adoption process, knowing the adopted plan will be approved. When the APA plan is adopted by the jurisdiction, and FEMA has received the documentation of adoption, then it will be formally approved through a signed FEMA approval letter."*

Element A: Planning Process

Strengths:

- The plan replaces the previous Town of Groton Natural Hazard Pre-Disaster Mitigation Plan, which was prepared by the Montachusett Regional Planning Commission (MRPC) in 2015.
- The update of Hazard Mitigation Plan happened concurrently with the MVP Process, integrating these two important initiatives.
- An online Listening Session was held to solicit input from the community due to the outbreak of covid-19. This was an excellent idea to move the plan update process forward.
- The plan does a nice job of referencing the State Hazard Mitigation and Climate Adaptation Plan throughout.
- The plan incorporates the Community Resilience Building (CRB) Guidebook, developed by the Nature Conservancy, as part of the planning process.
- The planning process included schools and utilities, which are excellent community stakeholders to involve in the update process.
- The plan contains a comprehensive list of resources that contributed to the plan's development (p. 1-6). Additionally, these resources were recommended by Core Team members themselves.
- The planning process is well documented and includes a detailed schedule of the events and meetings that contributed to the development of the plan.
- The plan states that a survey will be conducted every two years as part of the plan maintenance process. The Core Team will also meet at least once a year and the adopted plan will be posted on the community's web site.

- The plan contains comprehensive appendices detailing the 2020 update, for future reference.
- In the appendix there are valuable comments from public participation.

Opportunities for Improvement:

- N/A.

Element B: Hazard Identification and Risk Assessment

Strengths:

- The plan incorporates 500-year flood plain data into the flood profile. While not regulatory, the 500-year data is a great planning tool for future development.
- There is a well-grounded rationale for why certain hazards were omitted from the analysis.

Opportunities for Improvement:

- Consider incorporating into the plan dams in upstream areas that may pose a risk to the community, if applicable.

Element C: Mitigation Strategy

Strengths:

- The plan includes a variety of different types of mitigation actions (local plans and regulations, structure and infrastructure projects, natural systems protections, and education and awareness programs, etc.).
- The plan identifies a range of potential funding sources for implementing the mitigation strategy and includes a link to a Community Grant Finder as well, increasing opportunities for success.

Opportunities for Improvement:

- Further develop the analysis of how existing capabilities could be expanded. As part of the analysis, specify what is currently lacking (funding, personnel, equipment, regulations, authority, community consensus, etc.).
- For Element C6.d., further elaborate within future updates any progress made on integrating the mitigation plan, when appropriate, into other planning mechanisms as a demonstration of progress in local mitigation efforts.
- The NFIP continued compliance requirement needs be strengthened in the next update. Include a narrative describing all or some of the actions the Town of Groton has done and continues to do to stay in good standing with the NFIP. Consider participation in the Community Rating System (CRS) as a potential mitigation action as a way to improve current NFIP capabilities. See the new Massachusetts Floodplain management **Model Bylaw** to improve the town's NFIP. https://www.mass.gov/guides/floodplain-management

Element D: Plan Update, Evaluation, and Implementation (*Plan Updates Only*)

Strengths:

- Progress on mitigation actions is clear and comprehensive.
- The plan includes planned and/or potential future development (P. 3-8), as well as developable, vacant land within the 100 & 500-year flood zones (P. 4-13).
- The plan indicates that 172 single family, 24 multi-family and 62,000 s.f. of commercial space have been developed the past decade (p. 3-8); and there have been no recently developed parcels in the 100 or 500-year flood zones (p. 4-12). The plan also notes that the community is considering requiring regulatory controls out to the 500-year floodplain to account for climate change (p. 5-5).

Opportunities for Improvement:

- For future updates of the plan, keep in mind that the development in hazard areas is not limited to the flood hazard. An increase in risk can apply to development within or in proximity to *any* hazard area.

- In the future, please have the plan reviewed by FEMA *prior* to the community adopting the plan. Should there be necessary changes to the plan, this will avoid the need for the community having to adopt it twice.
- For future updates of the plan, a discussion of lessons learned about implementing mitigation actions would further strengthen the plan, as would a short narrative on some "success stories" about their implementation.

B. Resources for Implementing Your Approved Plan

Refer to the Massachusetts Integrated State Hazard Mitigation and Climate Action Plan, Resilient MA Climate Clearinghouse, and State's Climate Action Page to learn about hazards relevant to Massachusetts and the State's efforts and action plan.

Technical Assistance:

FEMA

- FEMA Climate Change: Provides resources that address climate change.
- FEMA Library: FEMA publications can be downloaded from the library website. These resources may be especially useful in public information and outreach programs. Topics include building and construction techniques, NFIP policies, and integrating historic preservation and cultural resource protection with mitigation.
- FEMA RiskMAP: Technical assistance is available through RiskMAP to assist communities in identifying, selecting, and implementing activities to support mitigation planning and risk reduction. Attend RiskMAP discovery meetings that may be scheduled in the state, especially any in neighboring communities with shared watersheds boundaries.

Other Federal

- EPA Resilience and Adaptation in New England (RAINE): A collection of vulnerability, resilience and adaptation reports, plans, and webpages at the state, regional, and community levels. Communities can use the RAINE database to learn from nearby communities about building resiliency and adapting to climate change.
- EPA Soak Up the Rain: Soak Up the Rain is a public outreach campaign focused on stormwater quality and flooding. The website contains helpful resources for public outreach and easy implementation projects for individuals and communities.
- NOAA C-CAP Land Cover Atlas: This interactive mapping tool allows communities to see their land uses, how they have changed over time, and what impact those changes may be having on resilience.
- NOAA Sea Grant: Sea Grant's mission is to provide integrated research, communication, education, extension and legal programs to coastal communities that lead to the responsible use of the nation's ocean, coastal and Great Lakes resources through informed personal, policy and management decisions. Examples of the resources available help communities plan, adapt, and recovery are the Community Resilience Map of Projects and the National Sea Grant Resilience Toolkit
- NOAA Sea Level Rise Viewer and Union for Concerned Scientists Inundation Mapper: These interactive mapping tools help coastal communities understand how their hazard risks may be changing. The "Preparing for Impacts" section of the inundation mapper addresses policy responses to protect communities.
- NOAA U.S. Climate Resilience Toolkit: This resource provides scientific tools, information, and expertise to help manage climate-related risks and improve resilience to extreme events. The "Steps to Resilience" tool may be especially helpful in mitigation planning and implementation.

State

- Massachusetts Emergency Management Agency: The Massachusetts State Hazard Mitigation Officer (SHMO) and State Mitigation Planner(s) can provide guidance regarding grants, technical assistance, available publications, and training opportunities.

- Massachusetts Departments of Conservation and Recreation and Environmental Protection can provide technical assistance and resources to communities seeking to implement their hazard mitigation plans. https://www.mass.gov/guides/floodplain-management
  Massachusetts 2020 Model Floodplain Bylaws. https://msc.fema.gov/portal
- MA Mapping Portal: Interactive mapping tool with downloadable data
- https://www.mass.gov/guides/floodplain-management Massachusetts 2020 Model Floodplain Bylaws. https://msc.fema.gov/portal

Not for Profit

- Kresge Foundation Online Library: Reports and documents on increasing urban resilience, among other topics.
- Naturally Resilient Communities: A collaboration of organizations put together this guide to nature-based solutions and case studies so that communities can learn which nature-based solutions can work for them.
- Rockefeller Foundation Resilient Cities: Helping cities, organizations, and communities better prepare for, respond to, and transform from disruption.

Funding Sources:

- Massachusetts Coastal Resilience Grant Program: Funding for coastal communities to address coastal flooding, erosion, and sea level rise.
- Massachusetts Municipal Vulnerability Preparedness program: Provides support for communities to plan for climate change and resilience and implement priority projects.
- Massachusetts Water Quality Grants: Clean water grants that can be used for river restoration or other kinds of hazard mitigation implementation projects.
- Grants.gov: Lists of grant opportunities from federal agencies (HUD, DOT/FHWA, EPA, etc.) to support rural development, sustainable communities and smart growth, climate change and adaptation, historic preservation, risk analyses, wildfire mitigation, conservation, Federal Highways pilot projects, etc.
- FEMA Hazard Mitigation Assistance (HMA): FEMA's Hazard Mitigation Assistance provides funding for projects under the Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation (PDM), and Flood Mitigation Assistance (FMA). States, federally recognized tribes, local governments, and some not for profit organizations are eligible applicants.
- GrantWatch: The website posts current foundation, local, state, and federal grants on one website, making it easy to consider a variety of sources for grants, guidance, and partnerships. Grants listed include The Partnership for Resilient Communities, the Institute for Sustainable Communities, the Rockefeller Foundation Resilience, The Nature Conservancy, The Kresge Climate-Resilient Initiative, the Threshold Foundation's Thriving Resilient Communities funding, the RAND Corporation, and ICLEI Local Governments for Sustainability.
- USDA Natural Resource Conservation Service (NRCS) and Rural Development Grants: NRCS provides conservation technical assistance, financial assistance, and conservation innovation grants. USDA Rural Development operates over fifty financial assistance programs for a variety of rural applications.