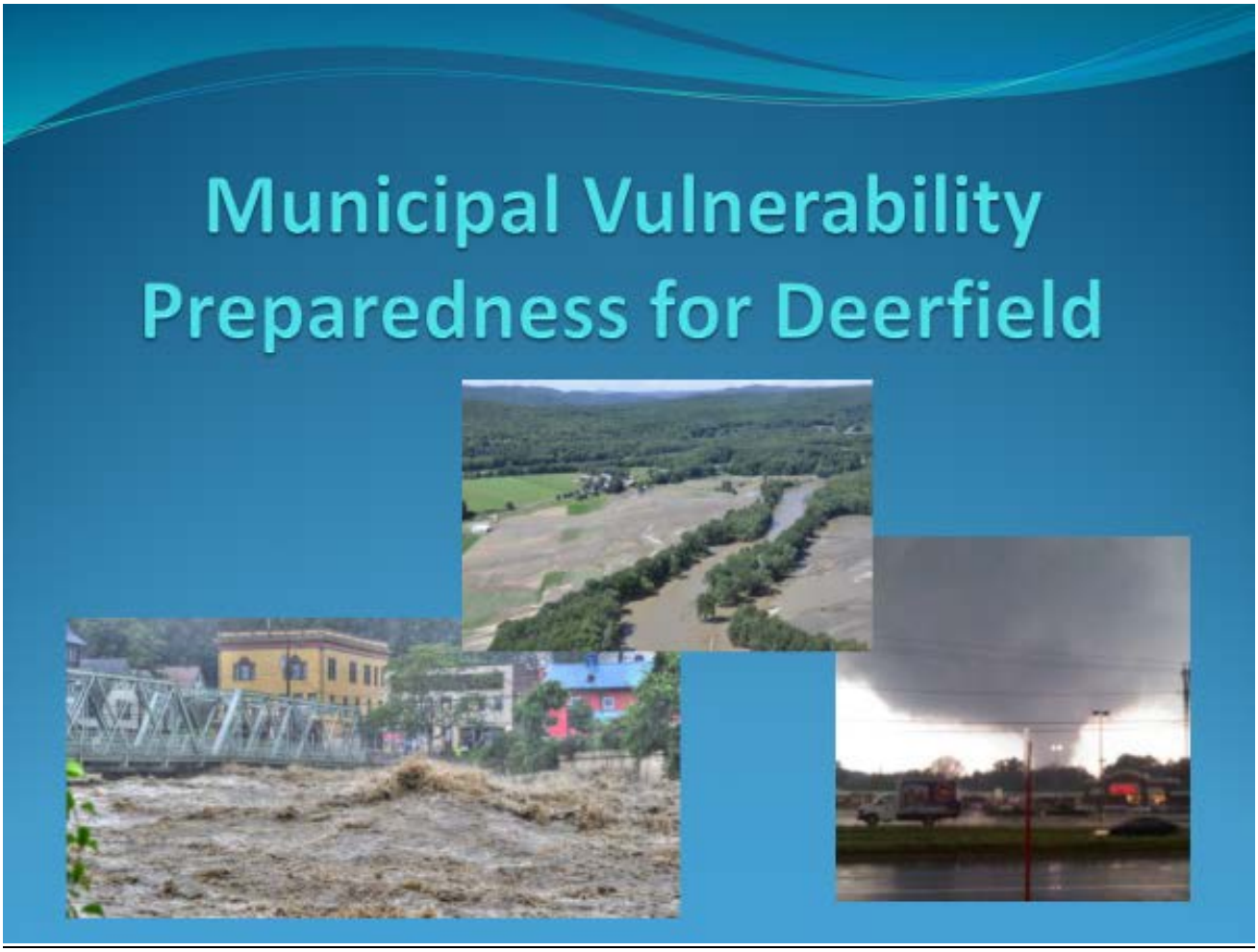


SUMMARY OF FINDINGS FOR THE TOWN OF DEERFIELD MVP PROJECT

Updated December 2018

Town of Deerfield

with Conservation Works, LLC

under a Municipal Vulnerability Preparedness grant from the Massachusetts Executive Office of Energy and Environmental Affairs

SUMMARY OF FINDINGS FOR TOWN OF DEERFIELD – MUNICIPAL VULNERABILITY PREPAREDNESS

Updated December 2018

Acknowledgements

This project was funded under a Municipal Vulnerability Preparedness grant from the Massachusetts Executive Office of Energy and Environmental Affairs.

Thanks to the following town officials for their leadership and guidance on this project:

- Carolyn Shores Ness, Chair, Deerfield Selectboard
- Wendy Foxmyn, Town Administrator

and to the following additional members of the Deerfield MVP Core Team:

- John Paciorek, Deerfield Police Chief
- Bill Swasey, Deerfield Fire Chief
- Kevin Scarborough, Deerfield DPW Superintendent
- Joe Rogers, Franklin Conservation District
- Steve Barrett, Deerfield Conservation Commission
- Kyle Scott, Building Commissioner

Report prepared for the Town of Deerfield by Conservation Works, LLC:

- Christopher Curtis, Project Coordinator
- Pete Westover
- Molly Hale

1) OVERVIEW

1a) Purpose of Grant

The Town of Deerfield applied for and received a Municipal Vulnerability Preparedness (MVP) grant from the Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA) in 2017. The town applied for this grant to better prepare the community for climate change and to reduce vulnerability and increase resilience to climate related events, in particular flooding impacts from the Deerfield River.

The grant provided funding for a Community Resilience Building workshop, which was held on January 24, 2018.

The workshop's central objectives were to:

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

1b) Municipal Vulnerability Preparedness (MVP) Program

The Massachusetts EOEEA established the MVP program to achieve several key goals:

- Increase capacity of municipalities and providers: Over 250 vendors were trained as state service providers;
- Mobilize: local knowledge, climate change data and existing plans to identify vulnerabilities and strengths and prioritize action steps;
- Incentivize: Designated communities will receive advanced standing in EEA grant programs;
- Mainstream: Incorporate climate change into existing municipal planning frameworks;
- National Model: The Nature Conservancy is looking to MVP as a national model and EOEEA is sharing this through the U.S. Climate Alliance.

In September 2016, Governor Charlie Baker signed Executive Order 569, instructing state government to provide assistance to cities and towns to complete climate change vulnerability assessments and resiliency planning.

The Municipal Vulnerability Preparedness grant program provides support for cities and towns in Massachusetts to begin the process of planning for resiliency. The state awards communities with funding to complete vulnerability assessments and develop action-oriented resiliency plans. The program helps communities to:

- Define extreme weather and natural and climate related hazards
- Identify existing and future vulnerabilities and strengths

- Develop and prioritize actions for the community
- Identify opportunities to take action to reduce risk and build resilience

Communities who complete the MVP program become certified as an MVP community and are eligible for follow-up grant funding and other opportunities.

Figure 1. The MVP Process and Executive Order 569

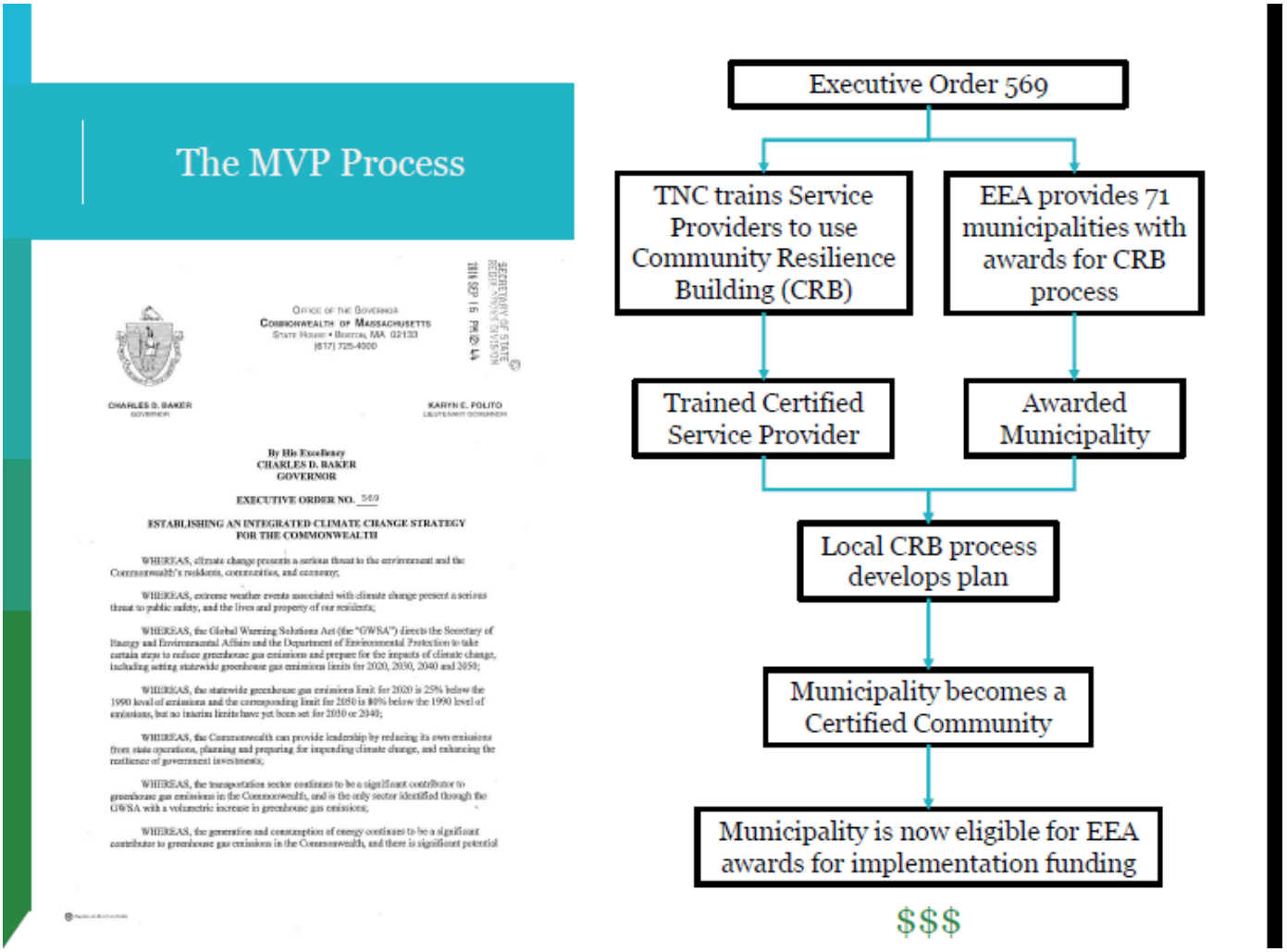
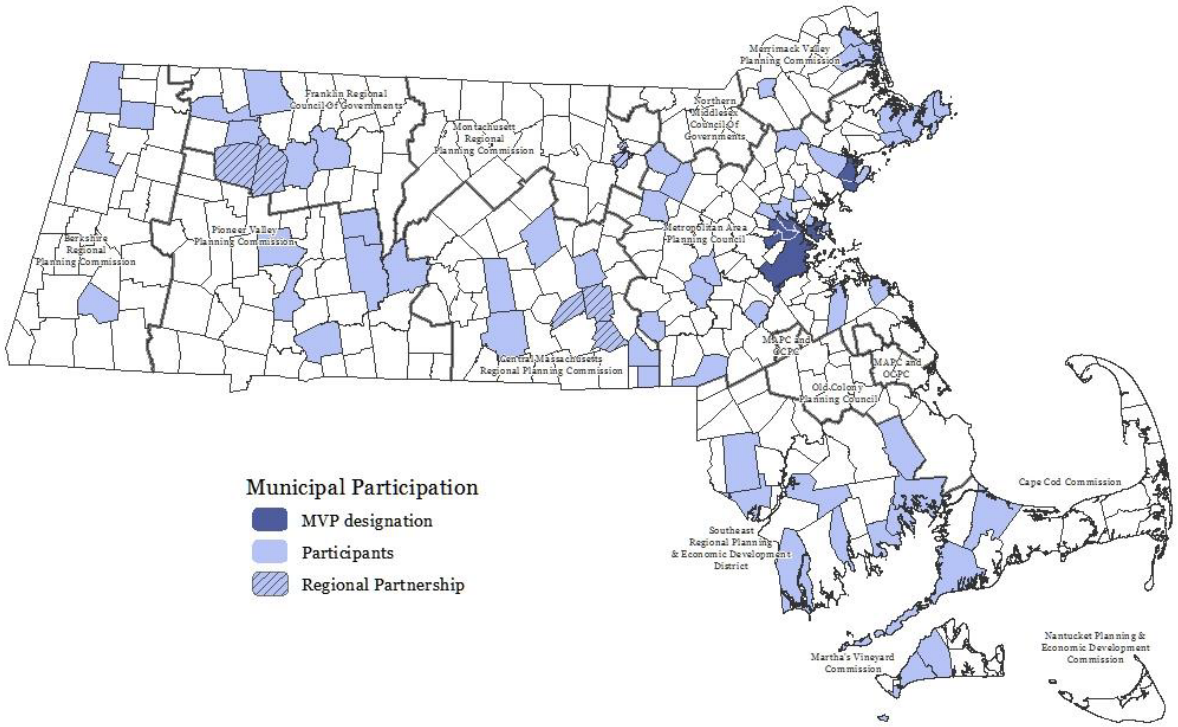


Figure 2. Municipalities Participating in MVP Program



2) COMMUNITY RESILIENCE BUILDING WORKSHOP

The Town of Deerfield held its Community Resilience Building workshop on Wednesday, January 24, 2018 at the Deerfield Town Offices. The workshop was sponsored by the Deerfield Selectboard, and had 53 invitees and a total of 27 participants (see Appendix D for full list).

The workshop was introduced by Carolyn Shores Ness, Chair of the Deerfield Selectboard, and coordinated by the town's MVP consultants, Conservation Works LLC.

The format of the workshop was as follows:

1) Workshop Group Discussions

Step #1: Identify Past, Current and Future Hazards (Large Group)

- What hazards have impacted your community in the past? Where, how often, and in what ways?
- What hazards are impacting your community currently? Where, how often, and in what ways?
- What effects will these hazards/changes have on your community in the future (5, 10, 25 years)?
- What is exposed to hazards and climate threats within your community?
- What have been the impacts to operations and budgets, planning and mitigation efforts?
- Other concerns or consideration related to impacts?

Step #2: Determine Top-priority Hazards (Small Teams)

- Which 4 hazards pose the greatest threat to the community currently and over the next decade, and against which the community should take action?

Step #3: Identify Infrastructural Vulnerabilities and Strengths (Small teams)

- List all infrastructural features: (housing, commercial buildings, roads, utilities) that could be affected by the top 4 hazards
- Describe locations by participatory mapping
- Identify ownership
- Identify each feature as a vulnerability or strength (or both): V or S

Step #4: Identify Societal Vulnerabilities and Strengths (Small teams)

- List all societal features: (health care services, hospitals, gas stations, supermarkets, shelters, public works centers, fire stations, senior centers or housing, data server facilities, pharmacies, churches, emergency response centers) that could be affected by the top 4 hazards
- Describe locations by participatory mapping
- Identify ownership
- Identify each feature as a vulnerability or strength (or both): V or S

Step #5: Identify Environmental Vulnerabilities and Strengths (Small teams)

- List all environmental features: (wetlands, floodplains, unstable slopes, open space, wildlife habitat areas and corridors) that could be affected by the top 4 hazards
- Describe locations by participatory mapping
- Identify ownership
- Identify each feature as a vulnerability or strength (or both): V or S

Step #6: Identify and Prioritize Community Actions (Small Teams)

- Identify and prioritize infrastructural actions. Examples: Floodproof wastewater plant; upgrade power transformers; adopt more stringent floodplain zoning
- Identify and prioritize societal actions. Examples: Evacuation drills; install signage for evacuation routes; extreme weather communications
- Identify and prioritize environmental actions. Examples: Protect wetlands, floodplains and riparian buffers; open space grants; remove high hazard dams

Step #7: Determine Overall Priority Actions (Large Team)

- Small teams report out on Risk Matrix outcomes (5-7 minutes per team)
- Reach large group agreement on highest priority actions (use small sticky dots for voting – 5 each)
- Further define urgency and timing

Route 2 damages from Tropical Storm Irene

3) CRB PROJECT TEAM AND WORKSHOP PARTICIPANTS

The Community Resilience Building project team for the Town of Deerfield includes the following town officials:

- Carolyn Shores Ness, Chair, Deerfield Selectboard
- Wendy Foxmyn, Deerfield Town Administrator
- John Paciorek, Deerfield Police Chief
- Bill Swasey, South Deerfield Fire District Chief
- Kevin Scarborough, Deerfield DPW Superintendent
- Joe Rogers, Franklin Conservation District
- Steve Barrett, Deerfield Conservation Commission
- Kyle Scott, Deerfield Building Commissioner

This group met prior to the workshop to discuss the town's previous hazard mitigation efforts and future needs, participated in the workshop, and will continue to guide the town's efforts to implement workshop recommendations going forward.

Workshop participants included:

- Carolyn Shores Ness, Chair, Deerfield Selectboard and Board of Health
- John Paciorek, Jr., Deerfield Police Chief
- Bill Swasey, South Deerfield Fire District Chief
- Kevin Scarborough, Deerfield DPW Superintendent
- Joe Rogers, Franklin Conservation District
- Kyle Scott, Building Commissioner
- Paul Chipley, Chipley Gardens

- Laurie McComb, Deerfield Emergency Management Director
- Rich Hubbard, Franklin Land Trust
- Tami Gaylor, Five College Realtors
- Brian Nartowicz, Deerfield Fire Water District, Water Superintendent
- Zachary Smith, Deerfield EMS Director
- Ken Cuddeback, Bement School
- Trevor McDaniel, Deerfield Selectboard/Board of Health
- Erin Rodgers
- Kimberly Noake MacPhee, Franklin Regional Council of Governments
- George Holmes
- Kathie Williams, Richardson's Candy Kitchen
- Milton Chuck Williams, Deerfield Academy
- Laurie Boosahda
- Adam Sokoloski, Deerfield Police Department
- Josh Solomon, The Recorder
- Kip Komosa, Deerfield Selectboard/Board of Health and Planning Board

4) TOP HAZARDS AND VULNERABLE AREAS

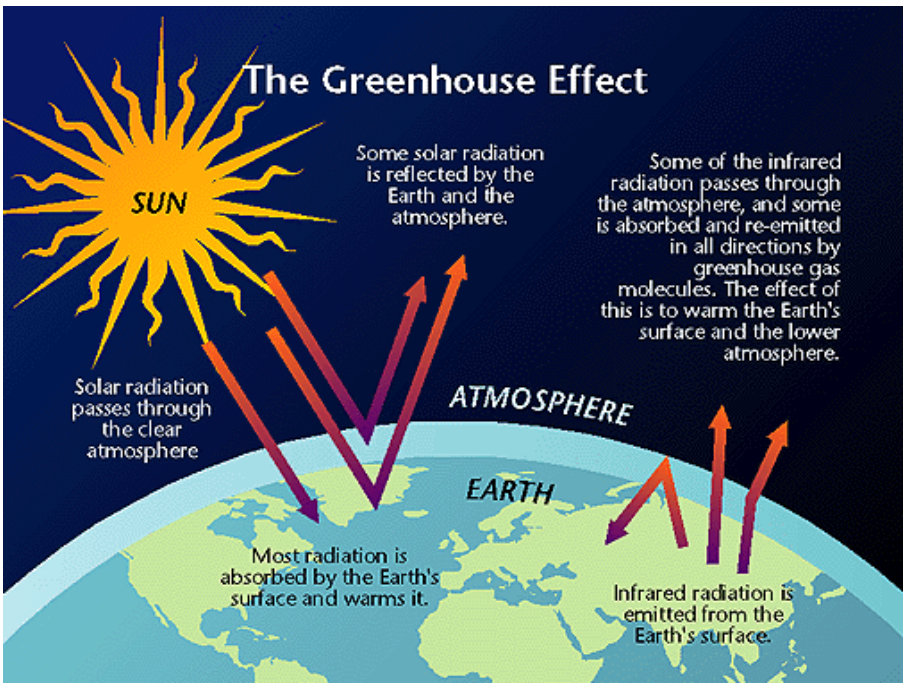
4a) Climate Change is a Reality

In Massachusetts, and in Deerfield, the climate is already changing. Evidence of this change is shown in the following statistics:

- Temperature: has increased 2.9 degrees since 1895

- Growing season: has increased 11 days since 1950
- Sea level rise: 11 inches since 1922
- Strong storms: 55% increase since 1958

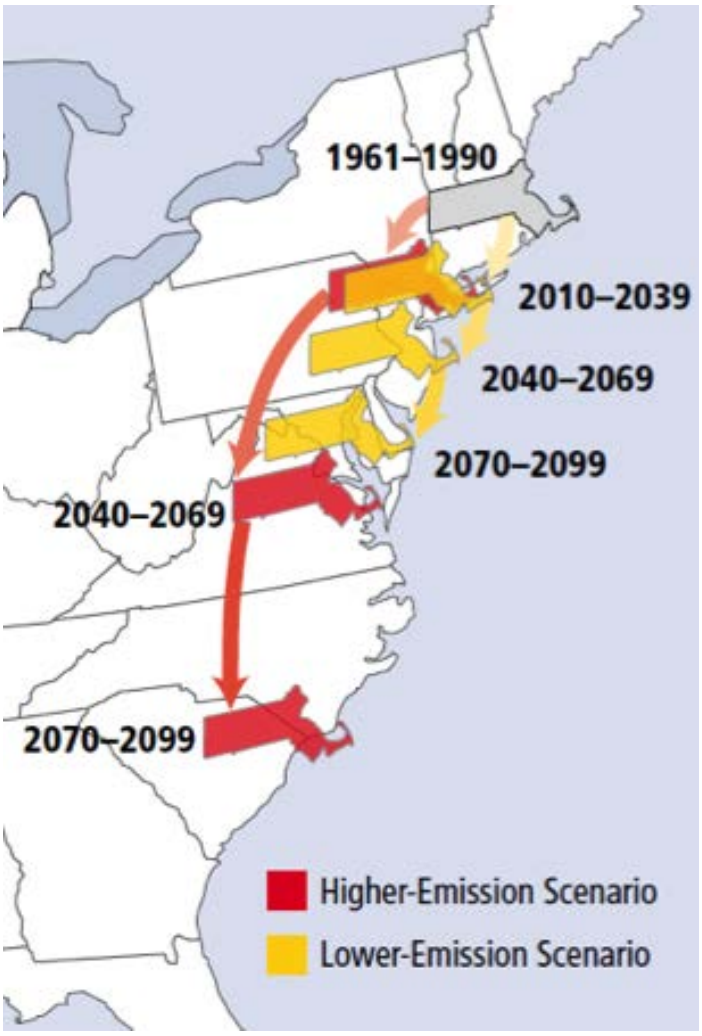
Multiple studies published in peer-reviewed scientific journals show that 97 percent or more of actively publishing climate scientists agree climate-warming trends over the past century are extremely likely due to human activities. This climate warming trend is related to the greenhouse effect, which is illustrated below:



Climate projections for Massachusetts indicate that warming will result in:

- By mid-century Massachusetts climate will be similar to northern Virginia
- By end of century like South Carolina

as illustrated on the map below:



4b) Temperature Changes

Projected temperature changes for Massachusetts indicate the following changes in summer and winter temperatures:

- Summer is expected to see an increase in days over 90 °F. from a baseline of 6 days to 10-35 more days by mid-century, and 15-76 more days by end of the century;
- Winter will have 23-60 fewer days below freezing by the end of the century.

4c) Temperature Change Impacts

The impacts of rising temperatures will include:

- More heat in the summer will put larger cooling demands on aging systems, creating the potential for power outages;
- Urban residents– especially very young, ill, and elderly – will face greater risks of serious heat-related illnesses;
- Rising winter temperatures will have economic impacts on winter recreation industry (e.g. skiing) and will result in increased insect pests.

Tornado damage in Monson, MA

4d) Rainfall Changes and Impacts

Along with rising temperatures, projections indicate major changes in rainfall trends and impacts, including:

- Frequency and severity of high-intensity rainfall events will trend upward
- Days with rainfall over 1" will increase from a baseline of 6 now, by 1-4 days by end of century
- More intense downpours often lead to inland flooding
- Winter precipitation increases, more in form of rain
- Summer precipitation decreases and could combine with higher temperatures to increase the frequency of episodic droughts
- Summer droughts are likely to increase in length from an average of 16 days, by 1-3 days
- Droughts will create challenges for local water supply by reducing surface water storage and the recharge of groundwater supplies

4e) Climate Projections for the Connecticut River Basin in Massachusetts

The Northeast Climate Science Center at UMass has prepared a set of detailed climate change projections, which are specific to each watershed area in Massachusetts. The Town of Deerfield is included within the Connecticut River Basin.

Figure 3. Municipalities Within the Connecticut River Basin

Key overall findings of this work include:

- Annual air temperatures in the Northeast have been warming at an average rate of 0.5°F per decade since 1970.
- Average annual temperatures for the CT River Basin will increase from baseline of 47°F by 3-7° by mid-century and by 4-11° by end of century

Findings specific to the Connecticut River Basin are summarized here:

Figure 4. Projected Temperature Changes in Connecticut River Basin

Connecticut Basin		Observed Baseline 1971-2000 (°F)	Projected Change in 2030s (°F)	Mid-Century Projected Change in 2050s (°F)	Projected Change in 2070s (°F)	End of Century Projected Change in 2090s (°F)
Average Temperature	Annual	46.98	+2.18 to +4.46	+3.00 to +6.43	+3.57 to +9.00	+4.04 to +10.94
	Winter	25.01	+2.36 to +5.37	+3.02 to +7.99	+3.95 to +9.54	+4.18 to +10.83
	Spring	45.35	+1.51 to +3.30	+2.26 to +5.21	+2.76 to +7.23	+3.11 to +8.81
	Summer	67.93	+2.19 to +4.54	+3.05 to +7.24	+3.44 to +10.52	+3.91 to +12.94
	Fall	49.24	+2.27 to +5.23	+3.81 to +6.81	+3.75 to +9.57	+4.21 to +11.69
Maximum Temperature	Annual	58.45	+2.03 to +4.24	+2.65 to +6.56	+3.18 to +9.13	+3.63 to +11.03
	Winter	35.23	+1.96 to +4.66	+2.61 to +7.11	+3.19 to +8.53	+3.43 to +9.63
	Spring	57.16	+1.38 to +3.23	+2.13 to +5.16	+2.66 to +7.53	+3.17 to +8.99
	Summer	80.18	+1.89 to +4.67	+2.75 to +7.45	+3.25 to +10.93	+3.76 to +13.41
	Fall	60.8	+2.47 to +5.04	+3.65 to +7.16	+3.54 to +9.91	+4.21 to +12.20
Minimum Temperature	Annual	35.51	+2.38 to +4.81	+3.35 to +6.64	+3.93 to +8.89	+4.37 to +10.89
	Winter	14.8	+2.63 to +6.03	+3.56 to +8.76	+4.51 to +10.54	+4.94 to +11.83
	Spring	33.53	+1.62 to +3.63	+2.38 to +5.64	+2.96 to +7.07	+3.29 to +8.59
	Summer	55.67	+2.34 to +4.62	+3.21 to +7.33	+3.63 to +10.13	+4.07 to +12.49
	Fall	37.68	+1.97 to +5.33	+3.58 to +6.64	+3.82 to +9.22	+4.21 to +11.37

- The Connecticut River basin is expected to experience increased average temperatures throughout the 21st century. Maximum and minimum temperatures are also expected to increase throughout the end of the century. These increased temperature trends are expected for annual and seasonal projections.
- Seasonally, maximum summer and fall temperatures are expected to see the highest projected increase throughout the 21st century.
    - Summer mid-century increase of 2.8 °F to 7.5 °F (3-9% increase); end of century increase of 3.8 °F to 13.4 °F (5-17% increase).
    - Fall mid-century increase of 3.7°F to 7.2°F (6-12% increase); end of century increase by and 4.2 °F to 12.2 °F (7-20% increase).
- Seasonally, minimum winter and fall temperatures are expected to see increases throughout the 21st century.
    - Winter mid-century increase of 3.6 °F to 8.8 °F (24-59% increase); end of century increase by 4.9 °F to 11.8 °F (33-80% increase).
    - Fall mid-century of 3.6 °F to 6.6 °F (10-18% increase); end of century increase of 4.2°F to 11.4 °F (11-30% increase).

Figure 5. Projected Changes Hot Weather Days in Connecticut River Basin

Connecticut Basin		Observed Baseline 1971-2000 (Days)	Projected Change in 2030s (Days)	Mid-Century Projected Change in 2050s (Days)	Projected Change in 2070s (Days)	End of Century Projected Change in 2090s (Days)
Days with Maximum Temperature Over 90°F	Annual	6.41	+6.36 to +19.72	+9.87 to +35.35	+11.98 to +57.07	+14.50 to +76.01
	Winter	0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00
	Spring	0.39	+0.14 to +0.91	+0.30 to +1.76	+0.37 to +3.31	+0.28 to +5.00
	Summer	5.73	+5.53 to +16.97	+8.31 to +29.50	10.37 to +46.30	+12.47 to +60.30
	Fall	0.29	+0.44 to +2.09	+0.51 to +4.58	+0.61 to +8.80	+1.02 to +11.94
Days with Maximum Temperature Over 95°F	Annual	0.46	+1.74 to +7.34	+2.77 to +16.31	+3.55 to +32.96	+4.56 to +49.67
	Winter	0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00
	Spring	0.00	+0.00 to +0.26	+0.02 to +0.49	+0.04 to +1.03	+0.03 to +1.93
	Summer	0.45	+1.71 to +6.53	+2.54 to +14.84	+3.05 to +28.97	+4.16 to +43.03
	Fall	0.01	+0.06 to +0.63	+0.09 to +1.19	+0.13 to +3.23	+0.20 to +4.87
Days with Maximum Temperature Over 100°F	Annual	0.00	+0.14 to +1.54	+0.22 to +4.35	+0.41 to +11.64	+0.38 to +23.33
	Winter	0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00
	Spring	0.00	+0.00 to +0.03	+0.00 to +0.06	+0.00 to +0.21	+0.00 to +0.45
	Summer	0.00	+0.13 to +1.45	+0.20 to +4.17	+0.36 to +10.72	+0.33 to +21.46
	Fall	0.00	+0.00 to +0.14	+0.00 to +0.37	+0.01 to +0.75	+0.00 to +1.29

- Due to projected increases in average and maximum temperatures throughout the end of the century, the Connecticut River basin is also expected to experience an increase in very hot days.
    - Annually, the Connecticut River basin is expected to see days with daily maximum temperatures over 90 °F increase by 10 to 35 more days by mid-century, and 15 to 76 more days by the end of the century.
    - Seasonally, summer is expected to see an increase of 8 to 30 more days with daily maximums over 90 °F by mid-century.
    - By end of century, the Connecticut basin is expected to have 12 to 60 more days with daily maximums over 90 °F by mid-century.

Figure 6. Projected Changes in Cold Weather Days in Connecticut River Basin

Connecticut Basin		Observed Baseline 1971-2000 (Days)	Projected Change in 2030s (Days)	Mid-Century Projected Change in 2050s (Days)	Projected Change in 2070s (Days)	End of Century Projected Change in 2090s (Days)
Days with Minimum Temperature Below 0°F	Annual	11.33	-4.01 to -7.02	-4.88 to -8.3	-5.42 to -8.76	-5.53 to -9.57
	Winter	11	-3.84 to -6.82	-4.67 to -7.96	-5.11 to -8.52	-5.33 to -9.1
	Spring	0.38	-0.08 to -0.44	-0.12 to -0.44	-0.18 to -0.49	-0.18 to -0.55
	Summer	0.00	-0.00 to -0.00	-0.00 to -0.00	-0.00 to -0.00	-0.00 to -0.00
	Fall	0.01	-0.02 to -0.00	-0.02 to -0.00	-0.02 to -0.00	-0.02 to -0.00
Days with Minimum Temperature Below 32°F	Annual	158.63	-10.58 to -28.13	-18.57 to -37.28	-22.18 to -50.76	-22.88 to -59.79
	Winter	85.33	-1.15 to -5.9	-2.37 to -8.5	-3.50 to -15.82	-4.26 to -19.49
	Spring	41.52	-3.47 to -9.56	-6.03 to -13.97	-6.70 to -17.87	-8.82 to -19.42
	Summer	0.02	-0.01 to -0.17	-0.01 to -0.27	-0.01 to -0.23	-0.01 to -0.26
	Fall	31.7	-4.87 to -12.57	-9.60 to -15.50	-8.89 to -19.96	-9.36 to -22.29

- Due to projected increases in average and minimum temperatures throughout the end of the century, the Connecticut River basin is expected to experience a decrease in days with daily minimum temperatures below 32 °F and 0 °F.
- Seasonally, winter, spring and fall are expected to see the largest decreases in days with daily minimum temperatures below 32 °F.
    - Winter is expected to have 2 to 9 fewer days by mid-century, and 4 to 19 fewer by end of century.
    - Spring is expected to have 6 to 14 fewer days by mid-century, and 9 to 19 fewer by end of century.
    - Fall is expected to have 10 to 16 fewer days by mid-century, and 9 to 22 fewer days by end of century.

Figure 7. Projected Changes in Degree Days in Connecticut River Basin

Connecticut Basin		Observed Baseline 1971-2000 (Degree-Days)	Projected Change in 2030s (Degree-Days)	Mid-Century Projected Change in 2050s (Degree-Days)	Projected Change in 2070s (Degree-Days)	End of Century Projected Change in 2090s (Degree-Days)
Heating Degree-Days (Base 65°F)	Annual	7038.04	-579.08 to -1220.89	-807.65 to -1696.71	-932.31 to -2213.81	-1061.27 to -2563.22
	Winter	3617.34	-196.64 to -492.19	-267.53 to -731.67	-348.79 to -867.16	-385.45 to -997.60
	Spring	1827.32	-122.30 to -279.16	-188.81 to -436.93	-225.95 to -566.74	-272.18 to -666.52
	Summer	127	-45.72 to -80.45	-63.18 to -101.77	-66.76 to -116.60	-72.74 to -119.29
	Fall	1471.22	-176.19 to -404.39	-298.62 to -486.71	-283.22 to -674.74	-306.64 to -768.06
Cooling Degree-Days (Base 65°F)	Annual	459.27	+200.92 to +430.52	+272.64 to +749.47	+326.52 to +1142.40	+379.72 to +1504.58
	Winter	nan	-0.39 to +2.36	+0.05 to +6.58	-0.14 to +3.38	-0.29 to +7.15
	Spring	20.23	+10.02 to +28.89	+17.52 to +55.39	+21.11 to +92.67	+20.81 to +121.55
	Summer	396.24	+162.41 to +335.42	+204.13 to +564.51	+235.28 to +853.52	+270.64 to +1075.43
	Fall	37.72	+25.68 to +84.68	+40.57 to +136.51	+49.64 to +225.83	+63.95 to +304.46
Growing Degree-Days (Base 50°F)	Annual	2348.43	+392.37 to +801.41	+536.06 to +1252.31	+652.08 to +1894.77	+739.11 to +2379.52
	Winter	3.8	-0.26 to +8.95	+0.09 to +9.32	+0.51 to +14.24	+1.70 to +19.27
	Spring	278.98	+59.68 to +130.77	+91.58 to +225.48	+117.65 to +331.37	+117.61 to +434.70
	Summer	1649.87	+201.11 to +416.74	+279.05 to +664.79	+315.32 to +966.48	+358.57 to +1190.01
	Fall	403.13	+105.14 to +284.19	+169.55 to +395.11	+166.52 to +591.21	+211.39 to +734.09

Note: Degree day is a measurement designed to quantify the demand for energy needed to heat or cool a building.

- Due to projected increases in average, maximum, and minimum temperatures throughout the end of the century, the Connecticut basin is expected to experience a decrease in heating degree-days, and increases in both cooling degree-days and growing (agricultural) degree-days.
- Seasonally, winter historically exhibits the highest number of heating degree-days and is expected to see the largest decrease of any season, but spring and fall are also expected to see significant change.
    - The winter season is expected to see a decrease of 7-20% (268-732 degree-days) by mid-century, and a decrease of 11-28% (385-998 degree-days) by the end of century.
    - The spring season is expected to decrease in heating degree-days by 10-24% (189-437 degree-days) by mid-century, and by 15-36% (272-667 degree-days) by the end of century.
    - The fall season is expected to have decreases in heating degree-days by 20-33% (299-487 degree-days) by mid-century, and by and 21-52% (307-768 degree-days) by the end of century.
- Conversely, due to projected increasing temperatures, summer cooling degree-days are expected to increase by 52-142% (204-565 degree-days) by mid-century, and by 68-271% (271-1075 degree-days) by end of century.

- Seasonally, summer historically exhibits the highest number of growing degree-days and is expected to see the largest decrease of any season, but the shoulder seasons of spring and fall are also expected to see an increase in growing degree-days.
    - The summer season is projected to increase by 17-40% (279-665 degree-days) by mid-century, and by 22-72% (359-1190 degree-days) by end of century.
    - Spring is expected to see an increase by 33-81% (92-225 degree-days) by mid-century and 42-156% (118-435 degree-days) by end of century.
    - Fall is expected to see an increase by 42-98% (170-395 degree-days) by mid-century and 52-182% (211-734 degree-days) by end of century.

Figure 8. Projected Change in High Precipitation Days in Connecticut River Basin

Connecticut Basin		Observed Baseline 1971-2000 (Days)	Projected Change in 2030s (Days)	Mid-Century Projected Change in 2050s (Days)	Projected Change in 2070s (Days)	End of Century Projected Change in 2090s (Days)
Days with Precipitation Over 1"	Annual	6.5	+0.05 to +2.22	+0.52 to +3.15	+0.80 to +2.82	+0.67 to +4.35
	Winter	1.04	-0.04 to +0.74	+0.05 to +1.01	+0.06 to +1.30	+0.22 to +1.64
	Spring	1.56	-0.08 to +0.62	+0.08 to +0.81	+0.17 to +1.20	+0.21 to +1.62
	Summer	1.98	-0.37 to +0.57	-0.19 to +0.97	-0.34 to +0.66	-0.38 to +0.74
	Fall	1.89	-0.28 to +0.70	-0.17 to +0.82	-0.27 to +1.00	-0.40 to +1.17
Days with Precipitation Over 2"	Annual	0.55	-0.05 to +0.40	-0.01 to +0.39	+0.00 to +0.45	+0.04 to +0.58
	Winter	0.03	-0.02 to +0.05	-0.02 to +0.07	-0.01 to +0.08	-0.01 to +0.09
	Spring	0.1	-0.03 to +0.10	-0.03 to +0.09	-0.02 to +0.17	+0.00 to +0.25
	Summer	0.26	-0.06 to +0.16	-0.07 to +0.17	-0.06 to +0.17	-0.09 to +0.19
	Fall	0.16	-0.06 to +0.17	-0.06 to +0.16	-0.04 to +0.18	-0.05 to +0.19
Days with Precipitation Over 4"	Annual	0.00	-0.03 to +0.03	-0.02 to +0.03	-0.01 to +0.05	-0.01 to +0.05
	Winter	0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00
	Spring	0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00
	Summer	0.00	-0.02 to +0.02	-0.02 to +0.02	-0.02 to +0.03	-0.02 to +0.03
	Fall	0.00	-0.02 to +0.03	-0.01 to +0.03	-0.01 to +0.04	-0.01 to +0.04

- The projections for expected number of days receiving precipitation over one inch are variable for the Connecticut basin, fluctuating between loss and gain of days.
    - Seasonally, the winter season is generally expected to see the highest projected increase.
    - The winter season is expected to see an increase in days with precipitation over one inch of 0-1 days by mid-century, and of 0-2 days by the end of century.
    - The spring season is expected to see an increase in days with precipitation over one inch of 0-1 days by mid-century, and of 0-2 days by the end of century.

Figure 9. Projected Changes in Total Precipitation in Connecticut River Basin

Connecticut Basin		Observed Baseline 1971-2000 (Inches)	Projected Change in 2030s (Inches)	Mid-Century Projected Change in 2050s (Inches)	Projected Change in 2070s (Inches)	End of Century Projected Change in 2090s (Inches)
Total Precipitation	Annual	46.39	-0.40 to +4.99	+1.25 to +6.22	+1.95 to +7.26	+1.68 to +8.30
	Winter	10.34	-0.39 to +2.08	+0.07 to +2.59	+0.30 to +3.03	+0.73 to +3.87
	Spring	12.12	-0.05 to +2.09	+0.32 to +2.13	+0.57 to +2.80	+0.45 to +2.87
	Summer	11.98	-0.37 to +1.76	-0.17 to +2.13	-0.34 to +1.85	-1.03 to +1.90
	Fall	11.94	-1.20 to +1.48	-1.26 to +1.65	-1.50 to +1.78	-1.73 to +1.49

- Similar to projections for number of days receiving precipitation over a specified threshold, seasonal projections for total precipitation are also variable for the Connecticut River basin.
    - The winter season is expected to experience the greatest change with an increase of 1-25% by mid-century, and of 7-37% by end of century.
    - Projections for the summer and fall seasons are more variable, and could see either a drop or increase in total precipitation throughout the 21st century.
        - The summer season projections for the Connecticut River basin could see a decrease of 0.2 to an increase of 2.1 inches by mid-century (decrease of 1% to increase of 18%), and a decrease of 1.0 to an increase of 1.9 inches by the end of the century (decrease of 9% to increase of 16%).
        - The fall season projections for the Connecticut River basin could see a decrease of 1.3 to an increase of 1.7 inches by mid-century (decrease of 11% to increase of 14% and a decrease of 1.7 to an increase of 1.5 inches by the end of the century (decrease of 14% to increase of 12%).

Figure 10. Projected Changes in Dry Days in Connecticut River Basin

Connecticut Basin		Observed Baseline 1971-2000 (Days)	Projected Change in 2030s (Days)	Mid-Century Projected Change in 2050s (Days)	Projected Change in 2070s (Days)	End of Century Projected Change in 2090s (Days)
Consecutive Dry Days	Annual	16.41	-0.18 to +1.34	-0.42 to +1.75	-0.73 to +2.26	-0.35 to +2.44
	Winter	11.4	-0.77 to +1.14	-0.57 to +1.30	-0.80 to +1.18	-1.21 to +1.47
	Spring	11.95	-1.05 to +0.50	-0.91 to +1.05	-1.24 to +1.13	-1.24 to +0.76
	Summer	11.57	-0.70 to +1.46	-0.61 to +1.07	-0.91 to +1.61	-1.37 to +1.87
	Fall	12.03	-0.12 to +1.72	-0.21 to +2.35	-0.61 to +2.61	-0.13 to +2.78

- Annual and seasonal projections for consecutive dry days, or for a given period, the largest number of consecutive days with precipitation less than 1 mm (~0.04 inches), are variable throughout the 21st century.
    - Seasonally, the fall and summer seasons are expected to continue to experience the highest number of consecutive dry days.

- The fall season is expected to experience an increase of 0-3 days in consecutive dry days by the end of the century.

5) SUMMARY OF PREVIOUS DEERFIELD HAZARD MITIGATION WORK

The Town of Deerfield has completed several previous projects that have helped with preparations for this Municipal Vulnerability Preparedness project. This work is summarized below.

5a) Deerfield Multi-Hazard Mitigation Plan

In 2014, the Town completed a Multi-Hazard Mitigation (MHM) Plan, coordinated by the Deerfield Local Multi-hazard Mitigation Planning Committee.

This MHM Plan identified the key natural hazards which are the most important concerns in Deerfield:

- Floods
- Severe winter storms
- Hurricanes and tropical storms
- Tornados, microbursts, thunderstorms
- Wildfires and brushfires
- Dam failures
- Earthquakes
- Landslides
- Ice jams

5b) Major Flood Years and Disasters in Franklin County

Since 1993, the most significant flood years in Franklin County have included:

- 2011- 8 events - $22.3m in property damages, including Tropical Storm Irene
- 2005 – 5 events - $11.4 m in property damage, including Tropical Storm Tammy
- 1996 – 11 events – $1.8m in damages

Flooding in Deerfield from Tropical Storm Irene

5c) Presidential Disaster Declarations

Between the years 1993 and 2013, there have been twelve Presidential Disaster Declarations in Franklin County, shown below with the amount of federal aid to Franklin County:

- March 1993 – Blizzard, record snowfall - $1.2 million in federal aid
- January 1996 – Blizzard - $16.1 million in federal aid
- March 2001 – Snowstorm - $21 million in federal aid
- February 2003 – Snowstorm - $28 million in federal aid
- December 2003 – Snowstorm - $35.6 million in federal aid
- January 2005 – Snowstorm - $ 49.9 million in federal aid
- December 2008 – Winter storm - $66. million in federal aid
- December 2008 – Severe storm & flood - $ 32 million in federal aid
- January 2011 – Winter storm - $1 million in federal aid
- August 2011 – Tropical Storm Irene - $26.6 million in federal aid
- October 2011 –Severe winter storm - $71.9 million in federal aid
- February 2013 – Winter storm and flood - $16.4 million in federal aid

Winter storm damages

Damages to State Route 2 in Franklin County after Tropical Storm Irene

5d) Impacts from Tropical Storm Irene

On August 28, 2011, Tropical Storm Irene, a weakened hurricane, crossed through New England, dumping 10-15" of rain on southern Vermont and western Massachusetts. In the resulting flooding, the Deerfield River crested at 23.7', the highest recorded flow since 1955. Over 700,000 customers lost power in Massachusetts alone, and there was one flooding fatality on the Deerfield River.

Flooding spread across roads and farms along the Deerfield River and in the Old Deerfield area, impacting many properties, including:

- Deerfield Academy
- Historic Deerfield
- Bement School
- Routes 5/10
- Stillwater Bridge
- I-91 Bridge
- Mill Village Road
- Multiple farms

Overall, there were $23 million in damages in Franklin County alone due to this storm.

Repairing damages from Tropical Storm Irene at Stillwater in Deerfield

Flooding of Deerfield farmland from Tropical Storm Irene

5e) Hurricanes to Make Landfall in New England

Since 1900, there have been eight hurricanes that have made landfall in New England, including hurricanes in the following years:

- 1904
- 1938
- 1954
- 1955
- 1960
- 1976
- 1985: Hurricane Gloria
- 1991: Hurricane Bob - $5.5 m in property & crop damage in Franklin County

Note: This list does not include tropical storms such as Tropical Storm Irene (2011), which also did major damage.

Flooded farmland in 2011's Tropical Storm Irene

5f) Tornados

There have been four recorded tornados in Franklin County in the last 15 years. They include:

- 7-3-97: Heath - $50k in property damages
- 7 -3-97: Charlemont - $50k in property damages
- 7-1-06: Wendell - $250k in property damages
- 2-25-17: Conway – an EF1 tornado severely damaged 12 homes and a church

Tornado damage to Conway church

Microburst on Mount Tom

2011 Tornado in Westfield, Springfield, Monson: $24 m in damages

5g) Other Hazards

The Deerfield Multi-Hazard Plan identified and quantified a series of other natural hazards to the town, including:

Thunderstorm, High Wind or Lightning Events:
- 11 events in or near Deerfield since 1993;
- $50k in damages in 2005 lightning storm.

Wildfires:
- Franklin County is at low risk, except for drought years;
- 26 brushfires in Deerfield from 2004-2010.

Earthquakes:
- Ten earthquakes in Northeast 1924-2007 of magnitude 4.7 or more, but none centered in Massachusetts;
- A fault line runs through Franklin County east of Deerfield.

Landslides:
- The Connecticut River Valley has a moderate landslide incidence rating
- In March, 2011 Greenfield experienced a landslide.
- In November, 2011, Deerfield had a significant landslide in the Wapping Road area, which caused ice jams.

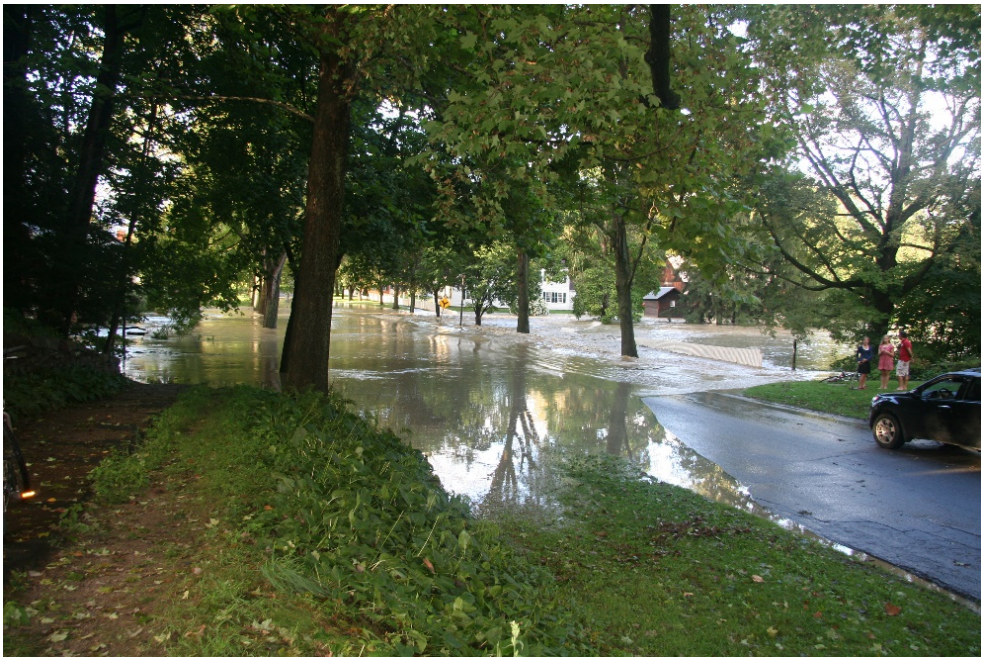
Ice Jams:

- There are documented ice jam occurrences in the Deerfield River: 1947, 1957, 1959.

Dam Failures:

- There are six major dams of concern to Deerfield:
    - Somerset, Harriman, Sherman, Fife Brook and Bear Swamp Dams on the Deerfield River;
    - Moore Dam on the Connecticut River.
- Catastrophic failure of any of these dams would result in cascading dam failures;
- Harriman failure would reach Deerfield in 4 hours;
- Evacuations would be needed at Deerfield Academy and Bement School;
- Roads inundated would include Routes 5/10 and Old Main Street.

Flooding in Shelburne Falls, 2011



Flooding in Old Deerfield, 2011

5h) Vulnerability Assessment

The Deerfield Multi-Hazard Plan assessed the town's vulnerability to natural hazards and had these key findings:

- 24 dwellings are located in Deerfield's flood hazard area
- 1358 elderly and low-income persons are exposed to multi-hazard events
- These significant structures are located in the floodplain: Historic Deerfield, Frontier Regional School, Old Deerfield Wastewater Treatment Plant, Deerfield Academy, Bement School
- Average annual property damages in Franklin County by storm type are:
    - Severe winter storms: $4.1m
    - Hurricanes: $1.3m
    - Tornados: $14k
    - Thunderstorms: $79k
    - Lightning: $34k
    - Floods: data not available

Flooding on Deerfield River in Shelburne Falls, MA, 2011

5g) Recommended Strategies in Deerfield Multi-Hazard Mitigation Plan

The Deerfield MHM Plan recommended a series of mitigation strategies to address the impacts of severe weather and climate change, including:

- Improve Floodplain zoning
- Develop annual program to improve household disaster preparedness
- Update FEMA floodplain maps
- Utility undergrounding program for Routes 5/10
- Stabilize riverbanks
- Remove debris from culverts and drainage structures
- Identify and evaluate beaver dams and risks

6) PREVIOUS WORK: TOWN and REGIONAL CLIMATE AND HAZARD PLANNING

6a) Deerfield Mitigation Work Completed to Date

The Town of Deerfield has completed several recent projects to mitigate the impacts of flooding and severe weather events, including:

- Mill Village Road restoration, 2009-10: total cost of $800,000
- Old Deerfield Wastewater Plant, 2006: total cost of $926,000
- Open bottom culvert, 2011-12: total cost of $120,000

Flood damages at Old Deerfield wastewater treatment plant, 2011

Flooding near Old Deerfield, 2011

6b) River Smart Communities Recommendations

The Town of Deerfield participated in a state grant funded project, titled “River Smart Communities”. The final report for this project included the following recommendations:

- Develop fluvial hazard assessments to map risk of erosion or deposition
- Upgrade vulnerable stream crossings to reduce future damage
- Mitigate flood hazards through planning and land use
- Move threatened buildings and infrastructure
- Restore floodplains and riparian buffers
- Floodplain zoning

Aerial photo of Deerfield River flooding, Deerfield, MA, 2011

6c) Pioneer Valley Climate Action Plan

The Pioneer Valley Planning Commission completed a regional plan, titled the "Pioneer Valley Climate Action Plan" in 2016, which included a number of recommendations that are relevant to the Town of Deerfield.

The PVPC plan recommends Municipal Strategies in three broad categories:

- Mitigation strategies: to reduce greenhouse gas emissions
- Adaptation strategies: to prepare for climate change impacts
- Energy Conservation & Clean Energy strategies: to achieve greater energy efficiency

Municipal Mitigation Strategies - These are recommended municipal strategies to reduce carbon emissions:

- Zoning for compact development, solar access
- Municipal Climate Action policy statements
- Green Communities designation: energy efficiency and development of renewables
- Reduce methane emissions from landfills
- Fuel efficient municipal vehicle fleets
- LED traffic signals and lights

Adaptation Strategies - These are recommended municipal strategies to prepare for climate change impacts:

- Replace under-performing culverts and bridges
- Formalize emergency water supply interconnections
- Prepare water supply system for extreme droughts including repairing leaks and installing water efficient fixtures
- Update FEMA flood maps
- Storm-proof critical infrastructure: energy, electrical, water, wastewater, roads, dams, flood dikes
- Assist populations vulnerable to severe weather events
- Conduct dam inspection, removal and repair
- Move powerlines underground
- Establish extreme weather warning system

Energy and Conservation Strategies - These are recommended municipal strategies to achieve greater energy efficiency:

- Streamline solar and wind zoning
- Participate in Solarize Mass program, reduces solar costs to homeowners
- Conduct energy assessments and upgrade efficiency in municipal buildings
- Assist homeowners in completing Mass Save energy audits and improvements

Solar Array

Flood damages to roads from Tropical Storm Irene

Deerfield River flooding near Shelburne Falls, MA, 2011

7) FLOODING AND PRIORITY CULVERT PROBLEM AREAS

Deerfield has several problem culverts that cause flooding of roads, homes and neighborhoods. These problem culverts are undersized for current flows, or have been damaged or have deteriorated due to age and weather.

The town has prioritized culvert replacement or drainage projects at these locations:

1) Mill Village Road (south of intersection with Log Plain Road);
2) Kelleher Drive (at North Main Street intersection);
3) Route 5 (near Richardson's Candy Kitchen);
4) Wapping Road (north of Greenough Crossing Road);
5) Broughams Pond Road (west of intersection with Old Ferry Road);
6) Captain Lathrop Drive;
7) Private culverts along North Main Street and Bloody Brook;
8) Town-wide drainage ditch maintenance.

Mill Village Road Culvert

The Mill Village Road culvert on an unnamed tributary stream to the Deerfield River has been Deerfield's top priority for replacement. This culvert's headwall has partially collapsed, and town has responded by putting in a temporary relief culvert and closing down one lane of Mill Village Road. This culvert is 15' in diameter and 22' long. In heavy rains, this culvert backs up and floods not only Mill Village Road, but also state Route 5.

In May, 2018, Deerfield applied for an EOEEA Municipal Vulnerability Preparedness grant to fund the engineering design for a replacement culvert. The project will improve community resilience in several ways. The proposed culvert replacement project will alleviate flooding at the project site on Mill Village Road, but will also alleviate flooding upstream at a key stream crossing site on Routes 5/10, which is a vital state transportation and evacuation route. The proposed Mill Village Road culvert replacement with an open bottom culvert will promote fish and wildlife passage, accommodate increased flows with climate change and reduce flooding on key roadways.

The town was successful in receiving the MVP grant and is currently working with the engineering firm of Tighe and Bond to complete engineering plans, with anticipated construction in the coming year.

Mill Village Road culvert

Flooding and lane closure at Mill Village Road culvert

Mill Village Road culvert, with flooding

Mill Village Road relief culvert

Kelleher Drive Culvert

The Kelleher Drive culvert on Bloody Brook was originally installed when a developer built this subdivision road in the 1960's, and the work was poorly done. This culvert is constructed from galvanized steel and is 6' in diameter and 30' long.

In 2012, the town hired the engineering firm of Weston and Sampson to prepare an assessment of this culvert. The report noted the pipe was deteriorating on the bottom due to rust, and would not last much longer. The culvert backs up flow whenever there is heavy rain, resulting in flooding on Bloody Brook, including flooded basements and garages, mold and mildew damage to homes.

The town would like to replace the Kelleher Drive culvert with an open box culvert, sized to accommodate larger storms.

Kelleher Drive Culvert

Kelleher Drive Culvert

Flooding at Kelleher Drive and North Main Street intersection

Flooding at Kelleher Drive and North Main Street intersection

Flooding at Kelleher Drive and North Main Street intersection

North Main Street and Bloody Brook Culverts and Related Flooding

Bloody Brook flows through the center of South Deerfield along North Main Street and flows through numerous undersized culverts along its length, including Kelleher Drive. Flooding is a frequent problem after storm events in many homes along North Main Street.

There are a series of under-sized private driveway culverts along North Main Street that create flooding for the homes in this area, notably the culverts at 124 and 130 North Main Street. It will be important to replace these culverts with larger culverts to alleviate this flooding problem and improve flow in Bloody Brook. However, funding for replacement of culverts on private lands may be difficult to come by.

There is a Bloody Brook culvert at the Amtrak rail line near Conway Street, formerly owned by PanAm and now owned by the Commonwealth of Massachusetts, that is also problematic. In previous years, PanAm raised this culvert about 6", resulting in an increase in the static water level in Bloody Brook.

Bloody Brook has long been used as a neighborhood dumping ground for leaves and other debris. The town would like to undertake a geomorphologic study of the brook, and a more comprehensive, neighborhood-wide clean-out of debris and other materials blocking flow in Bloody Brook. Since much of the brook flows through private property, this clean-up may only be possible through a homeowner collective effort of property owners, or through the adoption of a Mosquito Control District. Residents have also suggested increasing the flood storage capacity of Bloody Brook, through increasing stream meanders, stabilizing banks, reducing silt filling and reducing dumping.

Sandbags and floodwaters on North Main Street

Route 5/ Wapping Road Culverts and Wetland System

The culvert system under Route 5 at the Wapping Road intersection is one of the town's highest priorities to address. There are actually two culverts at this location: one culvert under Route 5, and a second culvert just a few yards upstream which is town-owned.

In the past year, back-ups at these culverts have caused deep flooding on Wapping Road, as shown in the flooded car image below. The two culverts need to be replaced and enlarged to accommodate higher flows.

The Route 5 culvert is state-owned and will need to be replaced by MassDOT. The Town of Deerfield has made a request to the Governor's office to initiate a replacement process for this culvert, and state officials have visited the site.

Just downstream of the two culverts is a wetland system that contributes to back-ups of flow through the culverts. This wetland has filled in substantially, likely due to a landslide that occurred upstream in the watershed. The town would like to undertake a comprehensive study of this wetland system to determine if it can be cleaned out to improve water flow and reduce flooding. This could potentially be done as part of the work of a new Mosquito Control District.

Twice a year, the town must clean mud out of these culverts, as they fill with silt. This again is likely due to a landslide that occurred in the watershed.

Submerged car, closed road and deep floodwaters on Wapping Road near

Richardson's Candy Kitchen.

Route 5 culvert flooded

Flooding and wetland west of Route 5 culvert

Broughams Pond Road Culvert

The Broughams Pond Road culvert is located between two ponds in Old Deerfield. The culvert is undersized and after major storms, floods a home and swimming pool. The Bement School has expressed concerns about the condition of this culvert and resulting flood impacts to property they own and a residence at 3 Old Ferry Road.

The town needs an engineered solution at this location, because there is a concrete-encase power line to the wastewater treatment plant located beneath the existing culvert. As a result, an open bottom culvert is not an option here. There have been problems in getting DEP approval for this culvert replacement, due to the ponds adjacent to the culvert.

Broughams Pond Road culvert

Captain Lathrop Drive Culvert

This culvert experiences flooding problems during severe storms due to under-sizing. Residents have noted it is close to becoming a sinkhole. It floods a neighborhood area and farm along this road. It is one of the culverts prioritized by the town for replacement.

Townwide Ditch Clean-out

Deerfield has a large network of drainage ditches, which are very important to good drainage of many areas of town and flood control, since most of Deerfield is low-lying land in and around floodplains of the town's two major rivers, the Deerfield River and the Connecticut River. Many of these ditches are located on private farmland.

Deerfield's DPW is working with the Conservation Commission and Massachusetts Department of Environmental Protection to secure a townwide annual permit to clean out ditches.

Other Priority Floodproofing and Flood Evacuation Planning Needs

Deerfield Wastewater Treatment Plant

The Deerfield Wastewater Treatment Plant is located on the Connecticut River at Route 116, and is vulnerable to flooding during major storm events such as hurricanes. While this treatment plant did not flood during Hurricane Irene, the Greenfield WWTP upstream did flood, and the Deerfield WWTP remains vulnerable due to its proximity to the river.

The town has hired a consultant to undertake an assessment of the wastewater collection and distribution system. This study will recommend upgrades to increase the resiliency of the plant.

Stillwater Road Water Supply Wells and Pumphouse

The town wells and pumphouse on Stillwater Road are located only a few feet from the Deerfield River and are highly vulnerable to flooding. This area was inundated during the Hurricane Irene flooding, when the Deerfield Rive rose 27-30 feet. As a result, the Water Department had to replace a generator and buy flood insurance.

These wells are the main source of water supply for Old Deerfield. There is a need for an engineering study at the pumphouse to look at options like floodproofing or elevating the generator, as well as adding riprap to project the pumphouse from scouring

There is also a Water Department storage garage across the street from the pumphouse that is subject to flooding and needs anchoring to make it more resilient to floods.

Flood Inundation Maps and Emergency Action Plans

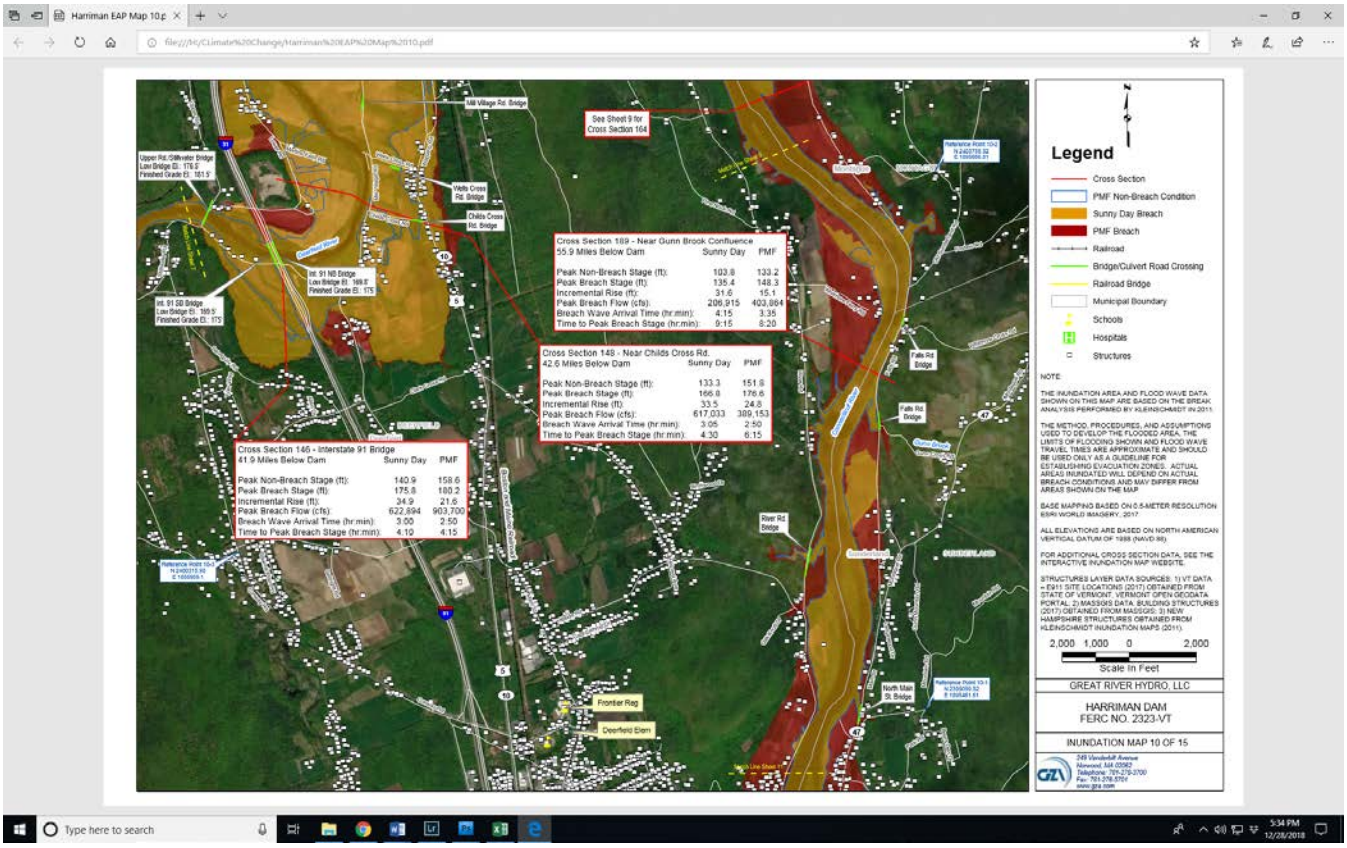
Deerfield is within several flood inundation zones for several dams on the Deerfield River and Connecticut River owned by Great River Hydro LLC. In the event of a breach or collapse of one of these dams, large portions of the town could be inundated with floodwaters.

In November, 2018, Great River Hydro prepared and release for public review, Emergency Action Plans (EAPs) and flood inundation maps. The EAP for the Harriman Reservoir Dam is particularly relevant to Deerfield. The inundation maps show that, in the event of a dam failure or catastrophic release, the Deerfield River would flood most lands between I-91 over to and including State Route 5 in the northern half of Deerfield, and including all of the village of Old

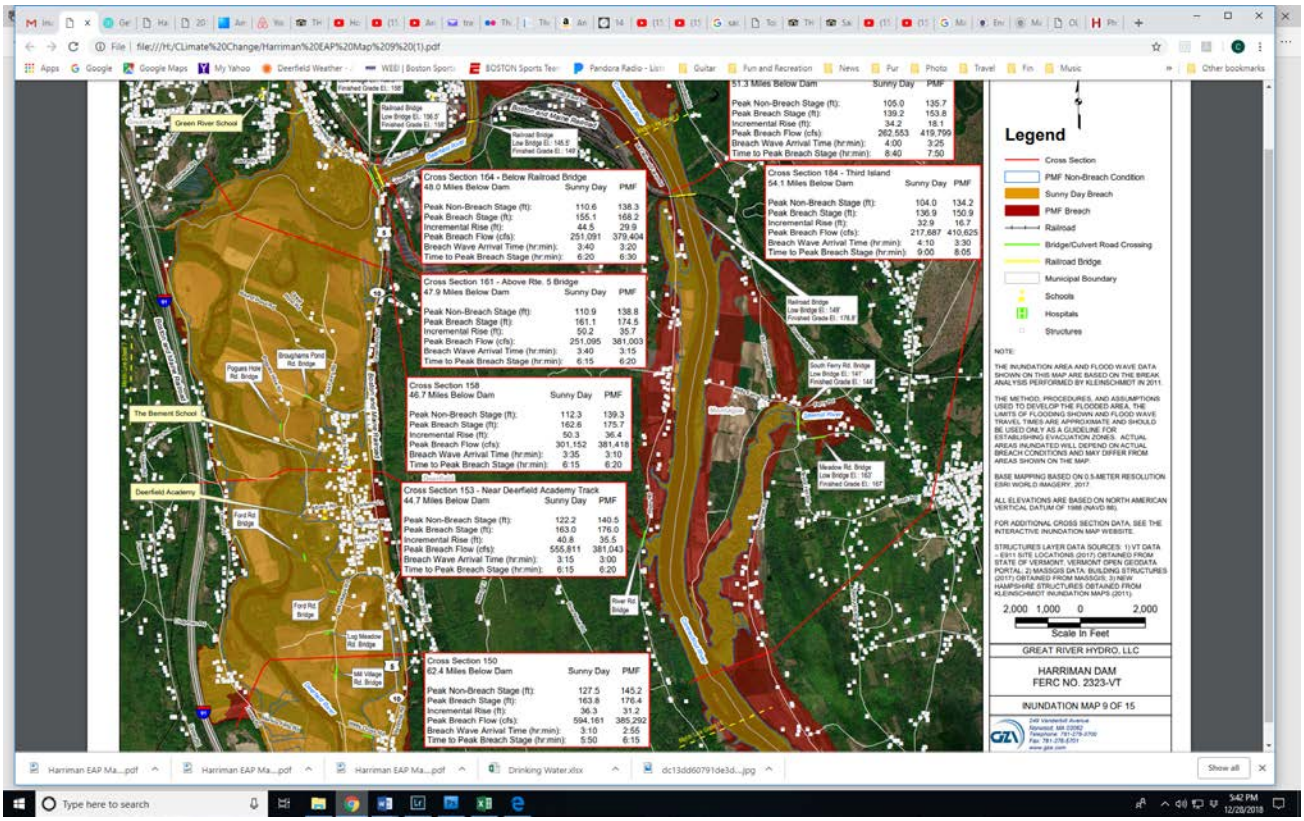
Deerfield, Deerfield Academy and Bement School. A failure at this dam would also result in flooding on the Connecticut River in Deerfield, along the river's floodplain area, including many homes and the town's wastewater treatment plant.

It would take about three hours for the flood waters from a Harriman breach to reach Old Deerfield. The plan lays out detailed notification procedures in the event of a breach.

Figure 11. Inundation Maps for Harriman Reservoir Emergency Action Plan



Source: Great River Hydro, Harriman Reservoir Emergency Action Plan



Stillwater Road water supply wells and pumphouse

8) TOP PRIORITY HAZARDS FOR DEERFIELD

The Deerfield Community Resilience Building (CRB) workshop identified four top priority hazards for the town, based on the information presented above, and the input of workshop participants. The top four priority hazards include:

- tornados and windstorms;
- hurricanes and tropical storms;
- floods and dam failures; and,
- severe winter storm and ice storms.

This ranking was based primarily on the frequency, severity, and extent of damage from previous storm or weather events, as described in the preceding sections of this report. Deerfield was heavily impacted by flooding from Tropical Storm Irene in 2011, so this hazard was a particularly important issue for the town.

Tornado in downtown Springfield

8) CURRENT STRENGTHS AND VULNERABILITIES

The Deerfield Community Resilience Building (CRB) workshop identified the town's key strengths, assets and vulnerabilities in relation to top priority hazards. Some features were identified as both strengths and vulnerabilities. Full copies of the CRB Risk Matrix are included in Appendix C. The strengths and vulnerabilities identified are also summarized here.

8a) Strengths/Assets

Key strengths and assets in natural hazard preparedness, hazard impact mitigation, and climate change mitigation were identified by CRB workshop participants in Deerfield, and included:

- Sugarloaf State Park and Connecticut River Greenway State Park - These parks protect Connecticut River floodplain lands and other environmentally sensitive areas.
- Deerfield Water Protection Zoning District - This overlay zone protects land in the reservoir watershed from development.
- Agricultural Preservation Restrictions - APRs are important land protection tools that permanently protect farmland in floodplains from development. This tool needs to be used more expansively, particularly along the Deerfield River in Old Deerfield and West Deerfield;
- Creating Resilient Communities Group - This committee helps to coordinate the efforts of 20 communities along the Deerfield River using a watershed-based approach to protect flood storage areas, particularly along tributaries like the North and South Rivers.
- Solar Arrays - Locally generated solar power mitigates greenhouse gas emissions by providing renewable energy.
- UMass Farm - This farm helps protect the Connecticut River floodplain from development.
- Fuller Swamp - This wetland area serves as an important flood storage area.
- Franklin Medical Center - Located in Greenfield, this medical center should be used to establish a center for special medical needs and could promote better communication between town Fire Departments and emergency medical services.
- Franklin Regional Transit Authority - Also located in Greenfield, this public transit agency is an asset for evacuation.
- Emergency Shelters -Shelter sites are an asset in storm events, and are established at Frontier Regional High School, Deerfield Elementary School and South Deerfield Fire Department.
- Flood Storage Areas - There are substantial natural flood storage areas along the Deerfield River, including farmlands, Deerfield Academy playing fields, and floodplain areas in upstream communities. There is a need for a multi-community effort to protect these areas, through agreements with neighboring communities, and use of tools like APR and NRCS farmer floodplain agreements and payments.
- Joint Pioneer Valley Mosquito Control District - This regional initiative to reduce mosquitoes and habitat can also provide joint benefits of improving flood drainage in swampy areas.
- CodeRED or Reverse 911 - Deerfield has in place a contract with the Emergency Communications Network to deliver Emergency Notification Messages through the CodeRED high-speed notification system, which provides town officials with the ability to quickly deliver messages to targeted areas of town or town wide about emergencies, including weather events. There is a need to expand this system to include more residents and more cell numbers.
- Frontier Community Access Television (Cable TV) - Another asset in delivering messages about weather events.

- Faith Community - Can be a helpful partner in providing shelters or other support in weather disasters.
- Fire, Ambulance, DPW Garage: These can provide emergency shelter and support emergency communications.

8b) Vulnerabilities

Key vulnerabilities in hazard preparedness and impact mitigation that were identified by CRB workshop participants in Deerfield included:

- Deerfield Water and Wastewater Treatment Plants - These plants need bank stabilization and armament, flood proofing of emergency generators and buildings, and installation of emergency generators where they are not installed.
- Great Hydro Dams Upstream on Deerfield River - There is a need for an emergency communications plan to give towns better notification of pre-storm dam releases or dam failures. There should be penalties and liability for failure of Great Hydro to adequately notify towns.
- Culverts - There is a need to replace culverts on Route 5/10, Wapping Road, Mill Village Road North, and Broughams Pond Road with open bottom culverts.
- Vulnerable Neighborhoods - There are several flood prone neighborhoods, including Old Deerfield and the Bloody Brook area, as well as elderly housing that greater need for flood warnings and flood prevention.
- Businesses with Hazardous Chemicals - Businesses such as Pelican Products, Crop Production Services, Trew Stone and Yankee Candle that handle larger quantities of hazardous chemicals should continue pro-active training for disasters.
- Private and Public Schools - The many schools in Deerfield, including private schools like Bement, Eaglebrook and Deerfield Academy, should create contingency and evacuation plans, and should be considered for use as shelters and emergency supplies stock points.
- Gas Stations - There are concerns about release of hazardous chemicals in floods or severe weather.
- Melnik Farm Methane Digester - There are concerns about release of hazardous chemicals in floods or severe weather.
- Municipal Water Supply Wells - The town wells, under districts jurisdiction, are located close to rivers, are vulnerable to flooding, and need emergency generators.
- Stillwater Bridge - This bridge over the Deerfield River is vulnerable to flood damages.
- Old Deerfield village including museums and schools - The village is close to the Deerfield River and experiences periodic flooding when the river overflows.
- Septic Systems in homes near Old Deerfield - Some septic systems near Richardson's Candy Kitchen (Routes 5/10) are impacted by flooding.
- East Deerfield Railyard - Located along the Connecticut River near the mouth of the Deerfield River, this railyard has hazardous materials subject to flooding impacts.
- Buildings Subject to Flooding in Bloody Brook Drainage - This drainage is impacted by chronic flooding of buildings. Better FEMA flood maps are needed to require floodproofing of buildings in construction.

- Evacuation and Emergency Communications Plan - Deerfield needs more robust, up-to-date evacuation plans, and needs a central communication system on road flooding.
- Deerfield and Connecticut Riverbanks, Bloody Brook - The banks of the Deerfield River were reduced in elevation due to Hurricane Irene flooding, and there is a need to reinforce and restore riverbanks and to restrict vehicles from driving to the river and eroding banks.
- Farmland and Farming Practices - Flooding and runoff cause farm pollutants such as fertilizers to be washed into the river. There is a need to promote more no till agriculture to reduce phosphorus and nitrogen pollution.
- Small Dam - There is a small, unnamed privately-owned dam that needs removal in town.
- Power Lines - The town should work with utilities to move power lines underground, starting in priority areas like the Route 5/10 corridor. A tree management plan is needed along powerlines.
- Roads in Floodplain -: There is a need to protect flood prone roadways, including Routes 5/10, Mill Village Road and Stillwater Road, by replacing culverts, raising riverbanks, and raising the level of roadways.
- FEMA Floodplain Maps - The town's federal floodplain maps are badly outdated, and need to be updated using LiDAR technology and climate change data.
- Flood prone Structures - Structures in floodplains that have been subject to repeated flooding need to be relocated.
- Beaver Dams - These need regular monitoring of their condition, to predict possible downstream flooding in case of failure.

8c) Combined Strengths and Vulnerabilities

Some features were identified by CRB workshop participants in Deerfield as both strengths and vulnerabilities, and these included:

- East Deerfield Railyard/ Amtrak Rail Line - There is a danger of chemical explosions at the railyard where hazardous chemicals are stored in a flood zone. The Amtrak line is a potential evacuation route.
- Trees - Trees are an asset in that they reduce greenhouse gases and provide shade, but also can be a hazard in storms. There is a need for a DEP-approved tree stockpile site in town, possibly on private farmland or in the Montague Plains.
- I-91 Bridge, Stillwater Bridge, Routes 5/10 - These are important parts of transportation infrastructure and evacuation routes. But they were severely impacted during Hurricane Irene, and monitoring of flood/tree debris is needed, as well as setting emergency protocols for evacuation route alternatives in case of flooding or damage.
- Private and Public Schools - These include Bement, Eaglebrook, Frontier, Deerfield Academy and Deerfield Elementary. They can provide shelter in emergencies. There is a need for better communications with Great Hydro, notification of dam releases or failures, as well as evacuation planning and drills at schools for dam failures.
- Senior Center and Town Halls - They can provide shelter in emergencies, but are also vulnerable to flooding.

- Floodplain and Riparian Areas - These are vulnerable assets that need protection. There is a need to protect Deerfield River farmland, using NRCS farmer floodplain payments and APR restrictions. There is a need to re-establish pre-Tropical Storm Irene riverbanks and improve floodplain mapping and zoning.

9) TOWNWIDE LISTENING SESSION

9a) Summary of MVP Listening Session

The Deerfield Selectboard held a public listening session at Deerfield Town Hall at 6pm on September 26, 2018 to present the Deerfield MVP Plan to the public and to seek public input and suggestions for additions or improvements to the plan. The agenda for this meeting included:

- Welcome and Introductions
- Summary of Deerfield Municipal Vulnerability Preparedness Planning Process and Recommended Actions
- MVP Implementation Projects
- Question and Answer Period
- Discussion of Additional Needs

This Listening Session was run by the Selectboard, with the participation of Core Group members, and was attended by 24 residents and town officials. A copy of the attendance sheets is included in Appendix F.

The meeting was posted at town hall, on the town website, a media release was sent to all area media outlets, and letters inviting residents to participate were sent out to neighborhoods particularly impacted by flooding.

Speakers described the MVP program, the year-long planning process that led to the adoption of the Deerfield MVP plan, the key findings and recommendations of the MVP plan, and the town's success efforts to secure implementation funding for an MVP Round 2 project. It was also noted that the town was amending and updating the plan to incorporate issues that had come up since the plan was originally adopted.

Residents were asked for their comments on the adopted MVP Plan, on any issues or recommendations that might have been overlooked in the plan, and on any related issues they wished to discuss. Cards were also provided to residents to allow for submission of written comments if desired.

The focus of much of the discussion at the Listening Session was on the many ongoing flooding problems and culvert concerns throughout the town. Comments received from residents included the following:

- The culvert on Captain Lathrop Drive is close to becoming a sinkhole, and a dip in the road has developed. This culvert causes flooding in the neighborhood and a farm.
- Water is being backed up due to clogged private culverts on North Main Street.
- A home at 136 North Main Street floods 6-7 times per year due to Bloody Brook and the private culverts on North Main Street.
- A resident questioned if the town could increase the flood storage of Bloody Brook could be increased by increasing meanders, stabilizing banks, reducing silt filling and stopping dumping.
- There was a discussion about private land issues and who is liable for flooding. It was noted that with the adoption of the Mosquito Control District, it would allow the town to access private land. This District is just starting to form for next spring.
- There is a need for public education to reduce leaves and debris being put into the brook. There was a suggestion for a homeowner collective agreement to dredge the brook. DEP permits would still be needed for this work.
- Drainage ditches are not being maintained in many areas of town, including along Routes 5/10 and Kelleher Drive.
- The DPW Superintendent is working with the Conservation Commission and DEP to seek a town wide permit to clean out ditches.
- It was noted that since at least 1975, floods on North Main Street, Kelleher Drive and Mill Village Road have been annual events.
- There is field silt eroding into a small culvert on Routes 5/10 near the greenhouses.
- There is additional flooding on Graves Street and Mountain Road, along with brook erosion and basement flooding.
- There is basement and garage flooding on North Main Street, which is becoming more frequent.

The following issues were discussed by town officials:

- The Emergency Action Plan developed by Great River Hydro will roll out on October 11. With the rollout, Deerfield will have new impacts because flooding will take in consideration lower riparian buffers and banks.

The following issues were noted in written questions and comments received at the Listening Session:

- As the water table rises, are underground storage tanks being monitored?
- Are there banks and slopes that can be re-vegetated to reduce silting?
- Can homeowners on Bloody Brook form a "district" and hire someone to dredge and increase flood storage with grant funding?
- 38 Eastern Avenue has a crumbling drain, that is brick-lined and slowly sinking.

The issues and suggestions raised in the Listening Session are addressed in the revised Deerfield Municipal Vulnerability Preparedness Plan.

10) CURRENT CONCERNS, CHALLENGES AND RECOMMENDATIONS FOR TOP PRIORITY HAZARDS

In preparing the CRB Risk Matrix, workshop participants in Deerfield identified current concerns and challenges presented by top priority hazards. These were then prioritized into a list of the top ten recommendations to improve resilience for the Town of Deerfield.

10a) Top Recommendations to Improve Resilience

The South Deerfield CRB workshop reached a consensus on its top-ranked recommendations to improve resilience, shown below in order of priority:

1) **Replace Vulnerable or Failed Culverts -** The town has prioritized culvert replacement at these locations:

    a. Mill Village Road (south of intersection with Log Plain Road);
    b. Kelleher Drive (at North Main Street intersection);
    c. Route 5 (near Richardson's Candy Kitchen);
    d. Wapping Road (north of Greenough Crossing Road);
    e. Broughams Pond Road (west of intersection with Old Ferry Road);
    f. Captain Lathrop Drive;
    g. Private culverts along North Main Street.

    In designing the replacement culverts, consideration should be given to open bottom culverts to improve flow and fish/wildlife passage, and to ensuring culverts are sized to accommodate increased flows expected with climate change.
2) **Advance and Coordinate Emergency Evacuation Plans, including the Great River Hydro Emergency Action Plan (EAP) –** In April, 2018, Great River Hydro completed an Emergency Action Plan for Harriman Dam, with inundation maps showing impact areas in Deerfield. The EAP identified a notification flow chart and procedures in the event of a dam release or failure. The EAP is needed to address better communications and evacuation planning for potential dam failures or releases from upstream Deerfield River

dams, in cooperation with Great River Hydro. It will help to improve communications between Great River Hydro and towns regarding pre-storm dam releases and impending dam failures. The Town has concerns about Harriman Dam releases, including erosion and riparian buffer damages. Further work is needed in the Town of Deerfield to provide information to affected institutions (particularly Deerfield Academy and Bement School) and other large employers about emergency procedures and to coordinate evacuation drills.

3) **Protect Flood Storage Areas -** Use a watershed approach in working with upstream communities and improving participation in the state's Agricultural Preservation Restriction (APR) program in town. Farmland that is located in Deerfield's 100-year floodplain is likely eligible for funding through the APR Program, provided it is primarily comprised of "prime" and "state important" soils.

The primary land conservation target areas in Deerfield's flood zone where much land conservation work remains to be done are:

- the north and south meadows of Old Deerfield;
- along the Deerfield River in west Deerfield;
- some farmland conservation opportunities also exist in the Bloody Brook watershed.

Deerfield should protect riverfront buffer areas, and ensure flood access to the floodplain, with the goal of decreasing the velocity of floods. A key issue in land conservation in floodplain areas is finding development value that can be purchased. Provided that a landowner can prove appraised value, development rights can be purchased on farm or open space parcels.

The best options for sources of funding are:

- APR Program;
- other state funding sources (e.g. MA Fish and Game) aimed at land conservation for such things as wildlife;
- Community Preservation Act funds, which can also be an effective local match for state grants;
- private fundraising;
- Commonwealth Conservation Land Tax Credit, through which the state will grant a tax credit (not a classic tax credit; in this case the state hands over a check) to a landowner who donates or bargain sales an interest in their land (fee, CR or APR) to a qualified entity (i.e. land trust, town, state) of 50% of the appraised donative value of the interest or $75,000, whichever is less. Such a donation may also qualify a landowner for a federal tax deduction.

These programs need to be promoted in Deerfield, and landowners educated on the benefits.

4) **Establish and Implement a Mosquito Control District -** This regional initiative to reduce mosquitoes and habitat can also provide joint benefits of improving flood drainage in swampy areas, including removal of debris and silt from drainage ditches and facilities in many areas of town.

5) **Improve and Increase Participation in the Reverse 911 Warning System** - Deerfield has in place a contract with the Emergency Communications Network to deliver Emergency Notification Messages through the CodeRED high-speed notification system, which provides town officials with the ability to quickly deliver messages to targeted areas of town or town wide about emergencies, including weather events. There is a need to expand this system to include more residents, businesses and more cell numbers.

6) **Adopt Updated Floodplain Zoning and Other Zoning Improvements** – The town's floodplain bylaw has not been updated since the 1980's. Prepare and adopt improved floodplain zoning regulations to meet federal flood insurance standards and ensure that new development does not increase flood hazards and endanger public health. Develop and adopt new zoning regulations to promote development reduces pollution, impacts to natural features and stormwater runoff.

7) **Carry Out a Utility Undergrounding and Tree Management Program to Bury Power Lines -** Work with Eversource on a phased undergrounding program for electric lines, focusing first on the Route 5 corridor.

8) **Petition FEMA to Update the Town's Floodplain Maps –** FEMA has indicated that Deerfield's floodplain maps will be updated soon. The town should request that FEMA use the latest LiDAR technology and climate data in this map update. This request should be made through Congressional representatives and in concert with other western Massachusetts communities. Updated floodplain maps can also be used to support improved floodplain zoning.

9) **Floodproof the Town's Wastewater and Water Treatment Plants** - Armoring these plants, in particular generators, against flood damages and providing emergency generators if not already in place. Key facilities for floodproofing include the Stillwater Road Water Supply Wells and Pumphouse in Old Deerfield, and the Deerfield Wastewater Treatment Plant on the Connecticut River at Route 116.

10) **Implement No Till Farming** - Throughout town to reduce agricultural non-point pollutant runoff to waterways and reduce climate impacts.

11) **Develop Plans for Green Infrastructure Improvements** – Reduce stormwater pollution from impervious surfaces throughout Deerfield through promoting green infrastructure that infiltrates stormwater runoff on site. Potential demonstration projects could include a rain garden at Frontier Regional High School and tree box filters in the town center. Develop and adopt a town policy to promote green infrastructure improvements as streets and infrastructure are replaced.

12) **Reduce the Town's Carbon Footprint** – Develop strategies to reduce carbon emissions in Deerfield, including plans to improve energy efficiency in town buildings, vehicles and infrastructure, and educational materials for town residents and employers about what they can do to reduce carbon emissions.

10b) Summary of Next Steps for MVP Project

The Town of Deerfield leadership has agreed on the following short-term action steps to move this MVP project into the implementation phase:

1. **Finalize final report and seek formal MVP community designation from EOEEA.** This is the top priority task for remaining funding and includes preparation of a summary of the workshop and its recommended strategies.

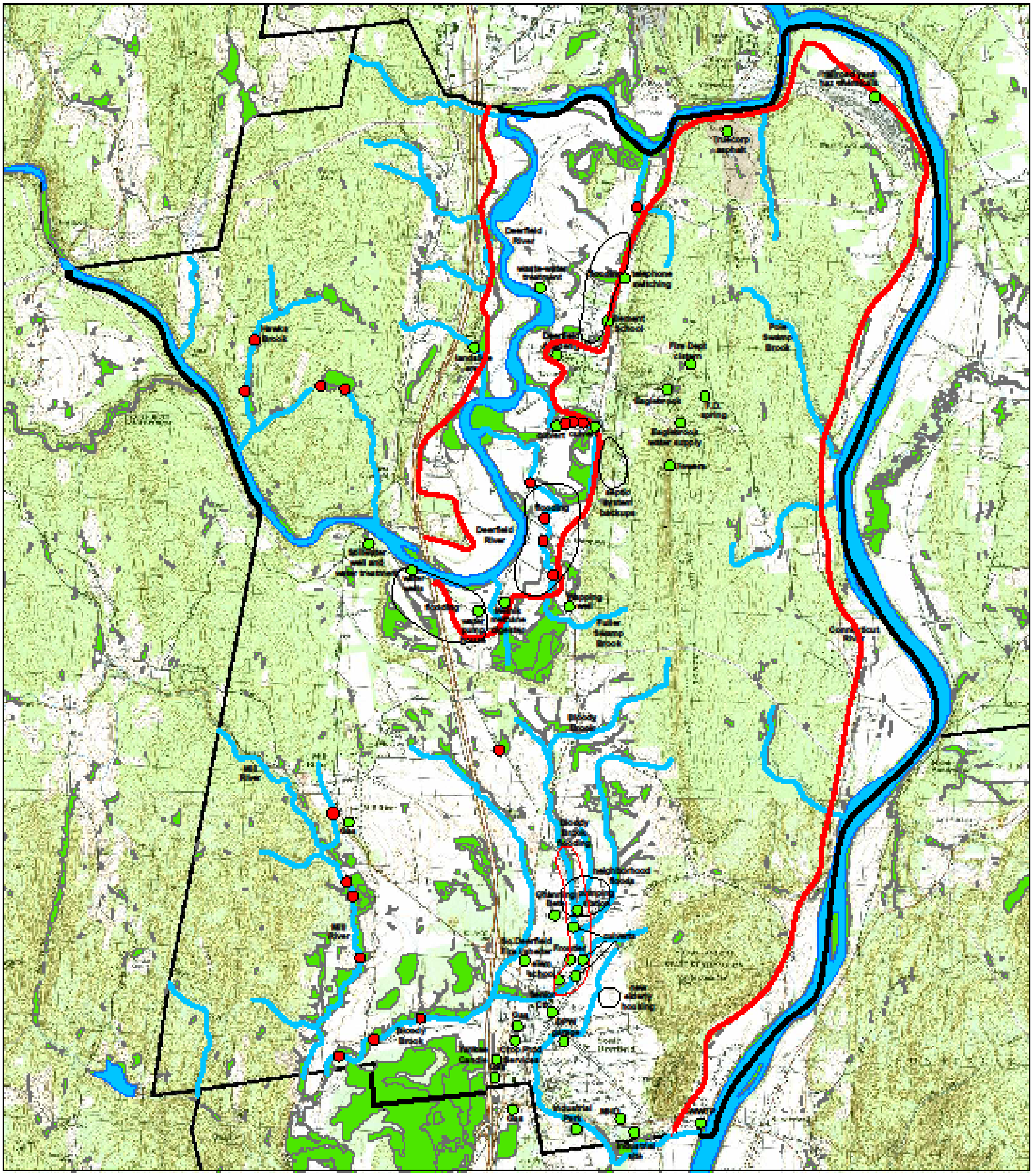
2. **Pursue funding opportunities for culvert replacement.** The best option may be DER's Culvert Replacement Municipal Assistance grant program, launched last year. DER released a Pre-RFR announcement for the FY19 CRMA grant round in February. While Deerfield was not able to apply in FY19, efforts should be made to be ready to submit in FY20

   Other options may include, pending funding availability:
   - MEMA Hazard Mitigation program
   - MEMA Pre-disaster Mitigation grants

3. **Update floodplain zoning.** Several town plans have recommended the adoption of stronger zoning controls to restrict development in the floodplain area. This task will involve drafting of recommended zoning bylaw improvements and, if time permits, working with the Planning Board toward adoption.

4. **Request update of FEMA flood maps for Deerfield.** Seek help from FEMA in using LiDAR technology to update 100-year floodplain maps to reflect more recent storm data and climate change projections. This task will involve working with Congressional representatives to seek funding support, and surrounding communities to collaborate on the request.

APPENDIX A. MAP OF WORKSHOP RESULTS and MAP OF DEERFIELD LAND PROTECTION OPPORTUNITIES



Streams & Rivers

Approximate 100-year FEMA Flood Plain Boundary

Facilities & Vulnerability Points

Beaver dams

DEP Wetlands

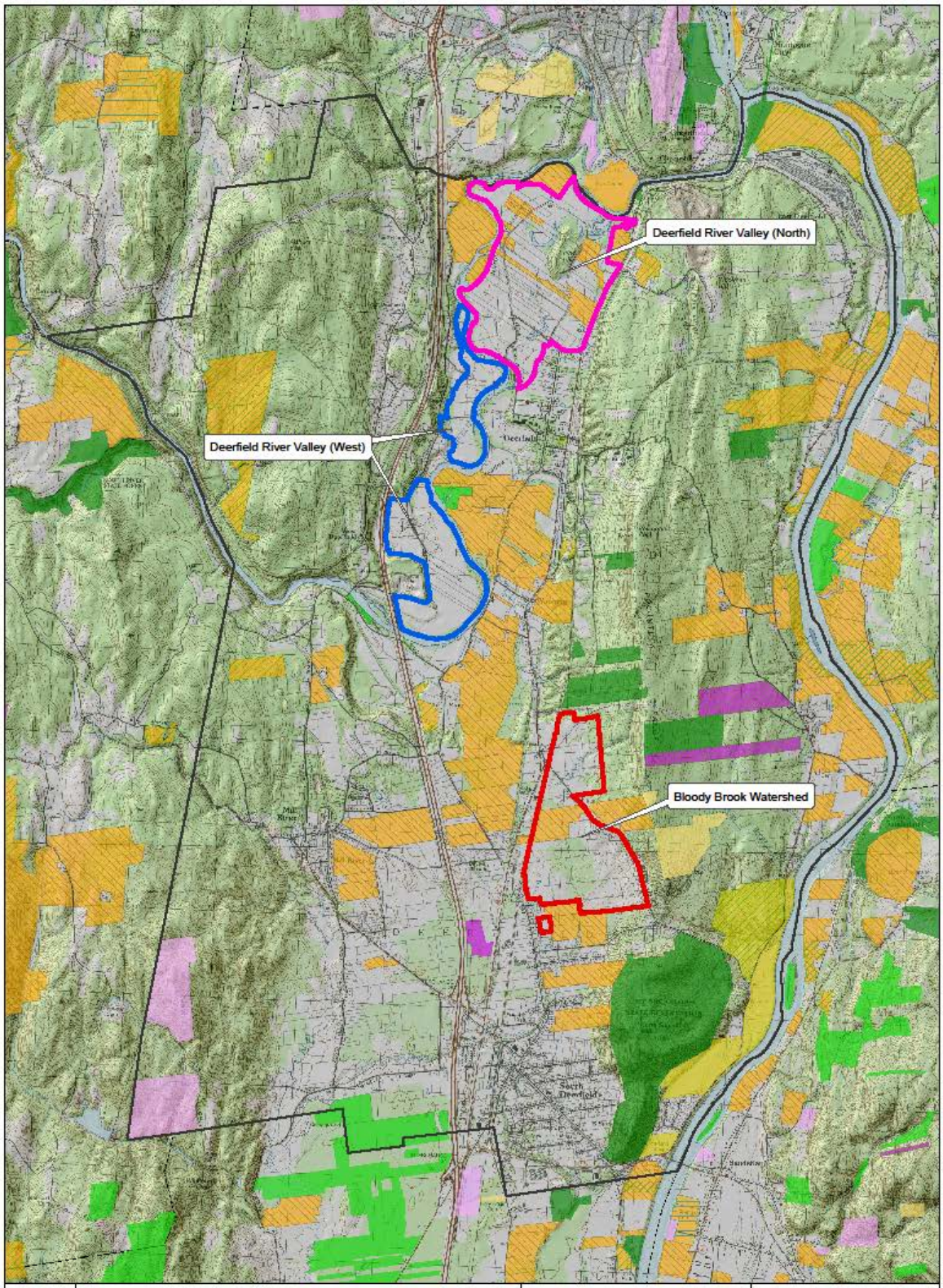
Deerfield Community Resilience/Vulnerability Points

0 1,500 3,000 6,000 9,000 12,000 Feet

Conservation Works - January 2018

N W E S

Ortho Photo from Mass GIS 2014



DEERFIELD LAND PROTECTION & OPPORTUNITIES

0 0.5 1 Miles

True north

03/2018

Ownership Type

- Federal (1 total)
- DCR-State Parks & Recreation (36 total)
- Department of Fish & Game (53 total)
- Commonwealth of Massachusetts (8 total)
- Municipal (30 total)
- Land Trust (5 total)
- Non-Profit (11 total)
- Private (233 total)

Protection Type

- CR (35 total)
- APR (173 total)
- CR/APR Combination (16 total)
- Other Legal Interest (12 total)

FRANKLIN LAND TRUST

Sources:
USGS, MA EOEEA MassGIS
(tax parcels - 2017, open space - 12/2017)
Boundaries approximate.

APPENDIX B. NEWS COVERAGE OF WORKSHOP

Gazette Jan 26, 2018

Deerfield climate change workshop urges need to prepare for disaster

By JOSHUA SOLOMON
For the Gazette

SOUTH DEERFIELD — To stay ahead of severe weather and natural disasters like Hurricane Irene, Deerfield taxpayers need to raise money, town leaders have been told.

Responding to federal policy changes since President Donald Trump took office, Select Board Chairwoman Carolyn Shores Ness said the town needs to actively invest in preparing — as opposed to reacting to — storms and more subtle threats like the advance of insect-borne diseases.

"At the local level, we're really stressed out," with the effects of climate change and how to pay for rising costs, with likely less federal funding in the future, Ness said to a group gathered Wednesday at the

FROM B1

Deerfield Municipal Vulnerability Preparedness Workshop. The meeting was held to increase the chances of getting state money for natural disasters and severe weather. The workshop was run by Ness and representatives from the Massachusetts consulting firm, Conservation Works.

Deerfield residents will likely be asked at this year's annual Town Meeting to approve $25,000 to $50,000 toward repairing and replacing the culverts on Greenfield Road from Richardson's Candy Kitchen to the Deerfield River, an area that was flooded during Irene, Ness said.

The project will cost a total of $1.3 million, Ness estimates, which she hopes can be paid through several sources. She does not expect it to fall solely on residents.

Taxpayers will also be asked to join the Pioneer Valley Mosquito District, she said. Deerfield is spearheading the regional partnership to combat mosquito-borne illnesses as the insects work their way north with climate change.

"We're moving from recovery to preparing," Ness said. "This is what we're trying to do today with these accelerating changes in the climate, which will cost us more in the future; we're doing financial resiliency."

In attendance were many local stakeholders, including members of law enforcement and public works, Select Board members, representatives from the Franklin Land Trust, Historic Deerfield, Deerfield Academy, Bement School and the Franklin Regional Council of Governments.

The group agreed on five priorities for the town, part of the requirements for state funding:

- Upgrading and replacing the culverts from Richardson's Candy Kitchen down to the river.
- Developing an emergency communication plan with the owners of the regional dams on the Deerfield River following a changeover in ownership in recent years.
- Updated floodplain maps portraying conditions post-Hurricane Irene.
- Debris management-approved site in Deerfield.
- Two-part priority in regards to drainage. One aspect supports the Natural Resources Conservation Service's no tilling plan, which helps pay for equipment for farmers to avoid tilling. The other would be joining the Pioneer Valley Mosquito District.

These five priorities will now be a part of Deerfield's application to become one of the first in the state to be approved for "Municipal Vulnerability Preparedness," or MVP, which would qualify the town for state money for projects concerning the environment.

"It's not new information for us as a Select Board. What's really great is it's been educating the community members and it's been crystalizing in our mind what are the top priorities," Ness said.

Receiving state money through this program will be one way Deerfield can circumvent a lack of potential federal funding for natural disasters and weather-related emergencies.

It can also speed up the process of receiving funding in general, since at times towns can see a lag in response.

The process to become a certified "MVP" by the state will be ongoing and Ness said there isn't a timeline at the moment, but she felt confident that the state funding would be there, regardless of what happens on the federal level.

EDITORIAL

Deerfield leaders looking forward and build on past lessons of Irene

When Tropical Storm Irene hovered over western Massachusetts in 2011, the deluge caused the Deerfield River to jump its banks like never before in recent memory, stripping acres of rich topsoil from adjacent farm fields, leaving behind silt and sand. Nearly seven years later, many people, especially those in charge of our federal government, have stuck their heads in the sand, denying the impacts of severe weather that the world's experts say global warming promises to send our way again. Think globally and act locally, we are told, and Deerfield officials should be credited for doing just that.

To stay ahead of severe weather and natural disasters like Hurricane Irene, the Deerfield Selectboard is pushing to spend local tax money on some flooding resiliency measures. Selectboard Chairwoman Carolyn Shores Ness says the town needs to actively invest in preparing for — as opposed to reacting to — storms and more subtle threats like the advance of insect borne diseases that seem headed this way with the subtle rise in global temperatures. "At the local level, we're really stressed out," with the effects of climate change and how to pay for rising costs, with likely less federal funding in the future," Ness told a recent Municipal Vulnerability Preparedness Workshop aimed at getting state money for natural disasters and severe weather.

Deerfield residents will likely be asked at this year's annual town meeting to approve $25,000 to $50,000 toward repairing and replacing culverts on Greenfield Road from Richardson's Candy Kitchen to the Deerfield River, an area that was flooded during Irene. The project will cost a total of $1.3 million, Ness estimates, which she hopes can be paid through several sources. She does not expect it to fall solely on local taxpayers.

Town meeting voters will also be asked to join the Pioneer Valley Mosquito District. Deerfield is spearheading the regional partnership to combat mosquito-borne illnesses as the insects work their way north with climate change.

"We're moving from recovery to preparing," Ness said, arguing such action is practicing "financial resiliency."

The plan also calls for developing an emergency communication plan with the owners of the regional dams on the Deerfield River; updated floodplain maps portraying conditions post-Hurricane Irene.

These priorities will now be a part of Deerfield's application to become one of the first in the state to be approved for "Municipal Vulnerability Preparedness," which would qualify the town for state money for projects concerning the environment.

Receiving state money through this program will be one-way Deerfield can circumvent a lack of potential federal funding for natural disasters and weather-related emergencies.

Shores Ness and her fellow Selectboard members deserve credit for anticipating local impacts of global warning, and deserve taxpayer support at town meeting.

APPENDIX C. INVITEES for MUNICIPAL VULNERABILITY WORKSHOP IN DEERFIELD

NAME	CORE TEAM	AFFILIATION	ADDRESS	EMAIL
Carolyn Shores Ness	X	Deerfield Selectboard		csness@town.deerfield.ma.us
Wendy Foxmyn	X	Deerfield Town Administrator		townadmin@town.deerfield.ma.us
Trevor McDaniel		Deerfield Selectboard		tmcdaniel@town.deerfield.ma.us
Dick Calisewski	X	Deerfield Health Agent		rcalisewski@town.deerfield.ma.us
Chris Curtis				chcurtis89@gmail.com
Pete Westover				westover03@comcast.net
Molly Hale				
Laurie McComb		Deerfield Police/Amherst Fire		ljlankowski@yahoo.com
Rich Hubbard		Franklin Land Trust	679 Mohawk Trail Shelburne, MA	rkhubbard@verizon.net
John Paciorek	X	Deerfield Police Chief		jpaciorek@police.deerfield.ma.us
Bill Swasey	X	Deerfield Fire Chief		wswasey@southdeerfieldfire.org
Keith Milne - No		Deerfield WWTP		kmilne@town.deerfield.ma.us
Kevin Scarborough	X	Deerfield DPW Superintendent		kscarborough@town.deerfield.ma.us
Darius Modestow		Frontier Regional High School	113 North Main Street South Deerfield, MA 01373	Darius.Modestow@frsu38.org
Joe Rogers **Deb Shriver - No**	X	Franklin Conservation District	8 Pocumtuck Drive S Deerfield, MA 01373	geojoerogers@yahoo.com debbieshriver@gmail.com
Katherine Williams		Richardson's Candy Kitchen	500 Greenfield Road P.O. Box 338 Deerfield, MA 01342	rck@richardsonscandy.com
Nancy Sadoski		Old Deerfield Country Store	480 Greenfield Road Deerfield, MA 01342	USPS 1/10/18
Tim Neumann		Pocumtuck Valley Memorial Association	P.O. Box 428 10 Memorial Street Deerfield, MA 01342-0428	pvmaoffice@deerfield.history.museum
M.A. Swedlund - No	X	Franklin County Solid Waste Management District Commission	542 River Road Deerfield, MA 01342	maswedlund@comcast.net

Christopher Wilson, Head of School		Bement School	94 Old Main Street P.O. Box 8 Deerfield, MA 01342	cwilson@bement.org
Keith Finan - No		Deerfield Academy	P.O. Box 87 Deerfield, MA 01342	kfinan@deerfield.edu
Chuck Williams (until 2:30)		Deerfield Academy		cwilliams@deerfield.edu
Rachel Blain (until lunch)		Eaglebrook School	261 Pine Nook Road Deerfield, MA 01342	rblain@eaglebrook.org
Chip Williams		Williams Farm	477B Greenfield Road Deerfield, MA 01342	williamsfarmsugarhouse@gmail.com chipwilliams.farm@gmail.com
Jay Savage		Savage Farm	128 Lower Road Deerfield, MA 01342	Jsavage35@comcast.net info@savagefarms.com
Skip Yazwinski		Yazwinskis' Farm	109 Main Street Deerfield, MA 01342	syazwinski@gmail.com
Peter Melnik		Melnik Farm	188 Mill Village Road Deerfield, MA 01342	melnikfarm@comcast.net
		Dept. of Environmental Conservation, Sugarloaf S.P.	136 Damon Road Northampton, MA 01060	
Kim Snyder		Historic Deerfield	84B Old Main Street Deerfield, MA 01342	ksnyder@historic-deerfield.org
Lynn Rose - No		former Planning Board	3 McClelland Farm Road Deerfield, MA 01342	lynnfaith@comast.net
Zach Smith		South County EMS Director		zsmith@town.deerfield.ma.us
Steve Barrett	X	Deerfield Conservation Commission	124 North Main Street South Deerfield, MA 01373	Barrett127@aol.com
Mark Wightman		developer	7 Oak Knoll Drive South Deerfield, MA 01373	Maw10@comcast.net
Kyle Scott	X	Building Commissioner		kscott@town.deerfield.ma.us
Scott Jackson		UMass	328 Holdsworth Hall, UMass, Amherst, MA 01003	sjackson@umass.edu
Ken Cuddeback		Bement School Business Manager		kcuddeback@bement.org
John Waite		Deerfield Planning Board	15 Keets Road	johnw@fccdc.org

			Deerfield, MA 01342	
Tom Clark		Deerfield Agricultural Commission	312 Upper Road Deerfield, MA 01342	clarkdalefarms@comcast.net
Paul and Stacy **Chipley**		Chipley Gardens	397 Greenfield Road Deerfield, MA 01342	USPS 1/10/18
Jaap Molenaar		Pioneer Gardens		jaap@pioneergardens.com
Daren Melnik		Old Deerfield Fire District		DMelnikTrucking@verizon.net
Laurie Boosahda		Frontier Regional School	193A Main Street South Deerfield, MA 01373	laurieboosahda@hotmail.com
Andy Fisk - No		Connecticut River Conservancy	15 Bank Row Greenfield, MA 01301	Afisk@ctriver.org
Scott Hall		Great Hydro		shall@greatriverhydro.com
Rita Thibodeau		NRCS		Rita.thibodeau@ma.usda.gov
Vince Snyder		NRCS		Vince.snyder@ma.usda.gov
Tami Gaylor		Five College Realtors	11 Jackson Road South Deerfield, MA 01373	USPS 1/10/18
Louis Misiun - No		Deerfield Conservation Commission	49 River Road South Deerfield, MA 01373	USPS 1/10/18
Brian Dejnak – No		Deerfield Conservation Commission		bdejnak@comcast.net
Skip Olmstead - No		Deerfield Finance Committee		skipolmstead@verizon.net
Dan Nitzsche		FRCOG Emergency Preparedness	210 Upper Road Deerfield, MA 01342	USPS 1/10/18
Brian Nartowicz		Deerfield Water Superintendent		deerfieldfire@crocker.com
		MassDOT		
Max Antes - No		Planning Board		maxantes@comcast.net
Bruce St. Peters - No		Finance Committee		brucestp100@yahoo.com
Erin Rodgers, Ph.D.		Western New England Project Coordinator	Trout Unlimited Brattleboro, VT	Erin.Rodgers@tu.org
Kimberly Noake MacPhee, P.G., CFM		FRCOG Land Use & Natural Resources Planning Program Manager	Franklin Regional Council of Governments 12 Olive Street, Suite 2 Greenfield, MA 01301	KMacPhee@frcog.org

APPENDIX D. WORKHOP ATTENDEES LIST

SIGN IN SHEET
Deerfield Municipal Vulnerability Preparedness Workshop
(Please print legibly)

Name	Address	Email	Phone
Paul Chapley	405 Greenfield Rd		413 335 1692
Laurie McComb	20 King Philip Ave	ljlankowski@yahoo.com	413 522-682
Rich Hubbard	Franklin Land Trust	rhhubbard@verizon.net	413/625-9571
Tami Gaylor	11 Jackson Rd	Tami@RealtorGaylor.com	413-522-4461
Brian Martowicz	180 Shilwalee Rd	deerfieldfirecracker@gmail.com	(413) 768 0558
Zachary Smith	8 Conway St	zsmith@town.deerfield.ma.us	665-1400 x
Kevin Scarborough	8 conway ST	KScarborough@Town.Deerfield.MA.US	
William Sweeney	84 Greenfield Rd	wsweeney@smithfieldsnow.org	
Ken Luddeback	~~36 Stagecoach~~ Bement School	kruddeback@bement.org	413 774-7001
Skip Olmsted	45 Shillyalee Rd	skipolmsted@verizon.net	413-665-24
John Paciorek Jr.	8 Conway St. DPW	JPACIOREK@yahoo.deerfield.ma.us	413 665-24
Molly Hale	96 Oak St. Florence 01062	mollyh@conservationworks llc.com	413 585-07
Pete Westover	170 Long Plain, Whately	westover03@comcast.net	413-665-40
Chris Curtis	88 S. Mill River, S. Deerfield	chcurtis89@gmail.com	413-522-598

SIGN IN SHEET
Deerfield Municipal Vulnerability Preparedness Workshop
(Please print legibly)

Name	Address	Email	Phone
Trevor McDaniel	5 Sherman Dr, S.Deerfield.	Trevor.d.McDaniel@gmail.com	1-413-575-0871
Erin Rodgers	55 Kipling Rd Bratt, VT	erodgers@fv.org	603-852-8110
Kimberly MacPhee	12 Olive Street, Greenfield	kmacphee@frcog.org	413-774-3167 x
George Holmes	84B Old Main St, Deerfield	gholmes@historic-deerfield.org	775-7181
Carolyn Shores Ness	10 Old Albany Rd Deerfield	acornhillfarm@hotmail.com	774-5824
Kathie Williams	500 Greenfield Rd	rck@richardsonscandy.com	772-0443
Milton (Chuck) Williams.	Deerfield Academy	CWilliams@deerfield.edu	774-5?0
Laurie Boosahda	193 N. Main SDfld.	laurieboosahda@hotmail.com	
Joe Rogers	34 N... Hill Rd, Williamsburg	geojoerogers@yahoo.com	218-2959
Adam Sokoloski	8 Conway St S.Deerfield	asokoloski@police.deerfield.ma	413 665-2...
Josh Solomon	14 Hope St Greenfield	jsolomon@recorder.com	772-026
Kip Komosa	304 Greenfield Rd Deerfield	kkomosa@Town.Deerfield	413-775-3165
Kyle Scott	Building Inspector		

APPENDIX E. CRB RISK MATRIX WORKSHEETS

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	Tornado/ Windstorms	Hurricane/ Tropical Storms	Floods/ Dam Failure	Severe Winter Storms/ Ice Storms	Priority H - M - L	Time Short Long Ongoing
Infrastructural									
Deerfield Water and Wastewater Treatment plants	See map	Deerfield F.D. , T	V	Bank stabilization/ armament, floodproof generators &plant				M	S
Great Hydro Dams upstream on Deerfield River	See map	Great Hydro	V	Emergency communication plan, notification of dam releases, pre-storm dam releases, penalties/liabi				M	S
I-91 Bridge, Stillwater Bridge, Routes 5 and 10	See map	Public	V/S	Monitor tree conditions, set emergency protocols for re-routes				H	S
Communication towers, powerlines	See map	Verizon, Warner	V/S	Bury power lines where possible, Update technology to prevent tower collapse				M	L
Schools: Frontier, Bement, Deerfield Academy, Eaglebrook	See map	Public, private	V/S	Better communications w/Great Hydro, notification of dam releases, evac plan/drill for dam failures				H	S
Culverts: Wapping Rd, Rte 5, Mill Village N,Broughtons Por	See map	Public	V	Replacement with open bottom culverts				H	S
Societal									
Vulnerable neighborhoods: floodprone areas, elderly hou	See map	Private	V	Reverse 911 warning: increase recruitment, include cellphone users. Outreach to millenials				M	L
Businesses with hazardous chemicals (Pelican, Yankee Can	See map	Private	V	Continue pro-active disaster training				M	O
Senior Center, Town Halls	See map	Public	V/S	Plan for use as shelters in extreme weather events				M	O
Private and public schools	See map	Public, private	V	Make contingency and evacuation plans, use for shelters and stock points for emergency supplies				H	S
Gas stations, Melnik farm methane digester,	See map	Private	V	Concerns about release of pollutants in severe weather				M	L
Solar arrays	See map	Public, private	S	Reduces greenhouse gas emissions				M	O
Environmental									
Sugarloaf State Park, Connecticut River Greenway	See map	Public	S	Protects sensitive environmental areas				L	O
Floodplain and riparian areas	See map	Private	S/V	NRCS farmer floodplain payments, re-establish pre-Irene riverbanks, improve flood maps & zoning				H	S
Water Protection Zoning District	See map	Private	S	Protects sensitive environmental areas				L	O
Agricultural Preservation Restrictions (in floodplain)	See map	Private	S	Protect key flood storage areas, including Deerfield Academy, Old Deerfield, West Deerfield				H	S
Umass Farm; Fuller Swamp	See map	Public, private	S	Protects sensitive environmental areas				M	M
Creating Resilient Communities Group	See map	Public	S	Helps coordinate 20 communities, watershed approach to protect flood storage, North & South River				H	O

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Features	Location	Ownership	V or S	Tornado/ Windstorms	Hurricane/ Tropical Storms	Floods/ Dam Failure	Severe Winter Storms/ Ice Storms	Priority H - M - L	Time Short Long Ongoing
Infrastructural									
Municipal water wells	See map	Town	V	Vulnerable to flooding, need emergency generators				M	L
Stillwater Bridge	See map	Town	V	Vulnerable to flood damage				L	L
Old Deerfield including museum, schools	See map	Public, private	V	Periodic flooding when Deerfield River overflows				M	L
Septic systems in homes near Richardsons	See map	Private	V	Periodic flooding of septic systems				M	L
East Deerfield Railroad Yard	See map	Private	V	Possibility of flooding of hazardous materials				L	L
Buildings in Bloody Brook drainage	See map	Private	V	Need better FEMA maps and Floodplain zoning to require floodproofing in construction				M	L
Societal									
Franklin Medical Center	Greenfield	Private	S	Establish shelter for special medical needs, better communication between Fire Dept and EMTs				L	L
Franklin Regional Transit Authority	Greenfield	Public	S	Asset for evacuation				L	O
Emergency shelters: Frontier, Deerfield Elementary, SDFD	See map	Town	S	Identify emergency shelters, send to adjacent communities, stock points for emergency supplies				M	M
Evacuation and Emergency Communications Plan	n.a.	n.a.	V	Need robust, up-to-date evacuation plans. Need central communication on road flooding.				H	S
CodeRED emergency communications	Town	Public	S	Expand enfrollment, to include cell phone numbers				M	O
Cable TV station, Faith community	Town	Public, private	S	Good options for information dissemination				M	O
Environmental									
Flood storage areas	See map	misc.	S	NRCS farmer floodplain payments/agreements esp in upstream towns, protect Deerfield Acad storag				H	M
Deerfield Riverbanks, CT River, Bloody Brook	See map	misc.	V	Riverbanks reduced in elevation due to Irene, reinforce & restore riverbanks, restrict driving to river				H	M
Beaver dams	See map	n.a.	V/S	Regular monitoring for condition to predict possible downstream flooding in case of failure				M	M
Trees	n.a.	misc.	V/S	Need for DEP-approved stockpile site, debris management, possibly Montague Plains or private farm				L	L
Farmland and farming practices	n.a.	Farmers	V	No till agriculture to avoid phosphorus & nitrogen pollution,				H	L
Joint Mosquito Control District and wetland maintenance		mis.	S	Can help to improve flood drainage as well				H	M

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Features	Location	Ownership	V or S	Tornado/ Windstorms	Hurricane/ Tropical Storms	Floods/ Dam Failure	Severe Winter Storms/ Ice Storms	Priority H - M - L	Time Short Long Ongoing
Infrastructural									
Railyard with hazardous chemicals, Amtrak railline	See map	Private	V/S	Plan for danger of chemical explosions due to severe weather, Use of Amtrak line for emergencies				L	L
Fire/ambulance station, DPW garage, Water Dept	See map	Public, private	V/S	Strength for shelter, emergency communications				L	O
Small dam	See map	Private	V	Needs removal				M	L
Power lines	along all roads	Private	V	Move key lines underground, establish tree management plan along powerlines				M	L
Roads: Rte 5/10; Mill Village Rd; Stilwater Rd	See map	Public	V	Replace culverts, raise riverbanks, raise level of roadways				H	M
Societal									
FEMA Floodplain Maps	townwide	Public	V/S	Need to be updated using LiDar technology and climate change projections				H	S
Floodprone Structures	See map	Private	V	Need to be relocated				M	L
Environmental									

APPENDIX F. ATTENDEES AT TOWNWIDE LISTENING SESSION

Deerfield Municipal Vulnerability Preparedness Project
Listening Session – September 26, 2018, 6:00 p.m.
Attendees List

Tim Hilchey	330 Greenfield Road		Resident
Pat Ryan	330 Greenfield Road	ryanhil@ymail.com	Resident
Michael Martin	136 North Main Street	mrdad3255@gmail.com	Resident
Kevin Scarborough	11 West Street		Resident
Betheny Foley	248 Stillwater Road	bethenyfoley@comcast.net	Resident
Jeanine Downie	36 South Main Street	j9downie@comcast.net	Resident
William Marrapese	16 Capt. Lathrop Dr.	wmarrapese@gmail.com	Resident
Karen Dodge	142 North Main St.	kjd127@gmail.com	Resident
Jack Cavacco	123 North Hillside Rd.	jack.cavacco@gmail.com	Resident
Trevor McDaniel	5 Sherman Drive	tmcdaniel@town.deerfield.ma.us	Selectboard/Board of Health
Laurie Boosahda	193 North Main Street	laurieboosahda@hotmail.com	Resident
Lindsay Wan	140 North Main Street	lindzerella1452@gmail.com	Resident
Michael Killeen	112 Sunderland Road	sunderlandroofspecialists@gmail.com	Resident
Kathy Foley	16 South Main Street		Resident

Ralph Foley	16 South Main Street	rfoley8439@comcast.net	Resident
Carolyn Shores Ness	10 Old Albany Road	acornhillfarm@hotmail.com	Resident
Bruce St. Peters	6 Robs Way		Resident
Dave Purington	18 Meadow Wood Drive		Resident
Douglas Montminy	76 Hillside Road	ecogroove@comcast.net	Resident
Tom Vega	38 Eastern Avenue	t.vega@comcast.net	Resident
Wesley Dickinson	11 Stillwater Road		Resident
Chris Curtis	88 So Mill River Road	chcurtis89@gmail.com	Resident
Wendy Foxmyn			Town Administrator