City of Lebanon,
New Hampshire
Hazard Mitigation Plan

City of Lebanon Hazard Mitigation Committee

Eastman Hill 2008

Upper Valley Lake Sunapee Regional Planning Commission

August 2010 Update

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I. INTRODUCTION

A. BACKGROUND

The New Hampshire Homeland Security & Emergency Management (NH HSEM) has a goal for all communities within the State of New Hampshire to establish local hazard mitigation plans as a means to reduce future losses from natural or human-made hazard events before they occur. The NH has provided funding to the Upper Valley Lake Sunapee Regional Planning Commission (UVLSRPC), to update local Hazard Mitigation Plans with several of its communities. UVLSRPC assisted the City of Lebanon in preparation of their first plan approved by FEMA in January 2004. The UVLSRPC began updating the Hazard Mitigation Plan in January 2009. The *Lebanon Hazard Mitigation Plan* serves as a strategic planning tool for use by the City of Lebanon in its efforts to reduce future losses from natural and/or human-made hazard events before they occur.

The Lebanon Hazard Mitigation Committee prepared the *Lebanon Hazard Mitigation Plan* update with the assistance and professional services of the Upper Valley Lake Sunapee Regional Planning Commission (UVLSRPC) under contract with the New Hampshire Homeland Security & Emergency Management operating under the guidance of the Federal Emergency Management Agency (FEMA).

B. PURPOSE

The Lebanon Hazard Mitigation Plan is a planning tool for use by the City of Lebanon in its efforts to reduce future losses from natural and/or human-made hazards. This plan does not constitute a section of the City Master Plan, nor is it adopted as part of the Zoning Ordinance.

C. HISTORY

On October 30, 2000, President Clinton signed into law the Disaster Mitigation Act of 2000 (DMA 2000). The ultimate purpose of DMA 2000 is to:

- Establish a national disaster mitigation program that will reduce loss of life and property, human suffering, economic disruption, and disaster assistance costs resulting from disasters, and
- Provide a source of pre-disaster mitigation funding that will assist States and local governments in accomplishing that purpose.

DMA 2000 amends the Robert T. Stafford Disaster Relief and Emergency Assistance Act by, among other things, adding a new section: 322 – Mitigation Planning. This places new emphasis on local mitigation planning. It requires local governments to prepare and adopt jurisdiction-wide hazard mitigation plans as a condition to receiving Hazard Mitigation Grant Program (HMGP) project grants. Local governments must review and if necessary, update the mitigation plan annually to continue program eligibility.

Why develop a Mitigation Plan?
Planning ahead to lessen or prevent a disaster will reduce the human, economic, and environmental costs. The State of NH is vulnerable to many types of hazards, including floods, hurricanes, winter storms, wildfires, wind events, and earthquakes. All of these types of events can have significant economic, environmental, and social impacts. The full cost of the damage resulting from the impact of natural hazards – personal suffering, loss of lives, disruption of the economy, and loss of tax base – is difficult to quantify and measure.

D. SCOPE OF THE PLAN

The scope of the *Lebanon Hazard Mitigation Plan* includes the identification of natural hazards affecting the City, as identified by the Lebanon Hazard Mitigation Committee. The hazards were reviewed under the following categories as outlined in the State of New Hampshire Hazard Mitigation Plan:

- Dam Failure
- Flooding
- Hurricane
- Tornado & Downburst
- Thunderstorm/Lightning/Hail
- Erosion
- Landslide
- Severe Winter Weather
- Earthquake
- Drought
- Wildfire
- Extreme Heat
- Natural Contaminants
- Hazardous Materials Spill
- Terrorism

E. METHODOLOGY

Using the *Guide to Hazard Mitigation Planning for New Hampshire Communities* (2002) developed by the Southwest Regional Planning Commission (SWRPC), the Lebanon Hazard Mitigation Committee, in conjunction with the UVLSRPC, developed the content of the *Lebanon Hazard Mitigation Plan* by tailoring the nine-step process set forth in the guidebook as appropriate for the City of Lebanon. Many FEMA resources and multiple State and Federal websites were also used as well. The Committee held a total of four posted meetings beginning in August 2009. All meetings were posted at the City Offices inviting the general public. Notices were sent to the Town Offices of neighboring towns to invite town officials. For the notices and meeting agendas see Appendix C:

Meeting Documentation. The Committee's final draft plan was provided to the City Council for their review prior to sending it on for State and FEMA review.

The public will continue to be involved in future revisions as meetings will be posted publicly. Prior to the City of Lebanon approving the Plan, a public meeting was held to gain additional input from the citizens of Lebanon and to raise awareness of the ongoing hazard mitigation planning process.

There is an opportunity for partnerships between local boards, most notably the Conservation Commission and Planning Board, to implement the recommendations in this Plan.

- The City of Lebanon participates in a Mutual Aid Compact with neighboring communities for emergency response.
- Opportunities exist for partnership with the Mascoma Watershed Conservation Council (MWCC), a non-profit organization made up of members from Mascoma Watershed communities including Lebanon.
- UVLSRPC is working with other Mascoma Watershed communities to update local hazard mitigation plans, including Lebanon, Enfield, Canaan, and Hanover.
- The office of the New Hampshire Homeland Security and Emergency Management had an opportunity to participate in and comment on this planning process, as well as review the draft plan.

The following hazard mitigation meetings were vital to the development of this Plan:

September 10, 2008
August 24, 2009
September 16, 2009
October 26, 2009

To complete the update of this Plan, the Hazard Mitigation Committee revisited the following planning steps. The format of the plan was changed to accommodate the most recent requirements since the original plan was completed. Each section was reviewed and revised during the Committee meetings and by research of the various relevant departments of the City.

Step 1: Identify and Map the Hazards (August 2009)
Committee members identified areas where damage from natural disasters had previously occurred, areas of potential damage, and human-made facilities and infrastructure that were at risk for property damage and other risk factors. A GIS-generated base map provided by the City of Lebanon and the UVLSRPC was used in the process.

Step 2: Determine Potential Damage (August 2009)
Committee members identified facilities that were considered to be of value to the City for emergency management purposes, for provision of utilities and services, and for historic, cultural and social value. A GIS-generated map was prepared to show critical facilities identified by the Lebanon Hazard Mitigation Committee. A summary listing of "Critical Facilities" is presented in Chapter IV. Costs were determined for losses for each type of hazard.

Step 3: Identify Mitigation Plans/Policies Already in Place (August 2009)
Using information and activities in the handbook, the Committee and UVLSRPC staff identified existing mitigation strategies which are already implemented in the City related to relevant hazards. A summary chart and the results of this activity are presented in Chapter VI.

Step 4: Identify the Gaps in Protection/Mitigation (August 2009)
Existing strategies were then reviewed for coverage, effectiveness and implementation, as well as need for improvement. Some strategies are contained in the Emergency Action Plan and were reviewed as part of this step. The result of these activities is presented in Chapter VI.

Step 5: Determine Actions to be Taken (August 2009)
During an open brainstorming session, the Hazard Mitigation Committee developed a list of other possible hazard mitigation actions and strategies for the City of Lebanon. Ideas proposed included policies, planning, and public information. A list of potential mitigation strategies can be found in Chapter VII.

Step 6: Evaluate Feasible Options (August 2009)
The Hazard Mitigation Committee evaluated strategies based on eight criteria derived from the criteria listed in the evaluation chart found on page 27 of the *Guide to Hazard Mitigation Planning for New Hampshire Communities*. The eight criteria used for evaluation of potential mitigation strategies are listed in Chapter VII. Each strategy was rated (high (3), average (2), or low (1)) for its effectiveness in meeting each of the eight criteria (e.g., Does the mitigation strategy reduce disaster damage?). Strategies were ranked by overall score for preliminary prioritization then reviewed again under step eight. The ratings of the potential mitigation strategies can be found in Chapter VII.

Step 7: Coordinate with other Agencies/Entities (Ongoing)
UVLSRPC staff reviewed the Lebanon Master Plan. This was done in order to determine if any conflicts existed or if there were any potential areas for cooperation. City staff that is involved in preparing the updated Emergency Operations Plan participated in the hazard mitigation meetings, to avoid duplication and to share information.

Step 8: Determine Priorities (September 2009)
The Committee reviewed the preliminary prioritization list in order to make changes and determine a final prioritization for new hazard mitigation actions and existing protection strategy improvements identified in previous steps. UVLSRPC also presented recommendations for the Committee to review and prioritize. These are provided in Chapter VIII.

Step 9: Develop Implementation Strategy (September 2009)
Using the chart provided under step nine of the *Guide to Hazard Mitigation Planning for New Hampshire Communities*, the Committee created an implementation strategy which included person(s) responsible for implementation (who), a schedule for completion (when), and a funding source and/or technical assistance source (how) for each identified hazard mitigation actions. The prioritized implementation schedule can be found in Chapter VIII.

Step 10: Adopt and Monitor the Plan
UVLSRPC staff compiled the results of steps one through nine in a draft document, as well as helpful and informative materials from the *State of New Hampshire Natural Hazard Mitigation Plan* (2004), which served as a resource for the *Lebanon Hazard Mitigation Plan*. The process for monitoring and updating the Plan can be found in Chapter IX.

F. HAZARD MITIGATION GOALS

The City of Lebanon Hazard Mitigation Committee reviewed the hazard mitigation goals for the State of New Hampshire, and revised them for Lebanon. The goals were reviewed again during the update of the plan and determined to remain valid with one change in goal 9. changing the last word from "environment" to "resources."

They are as follows:

1. To improve upon the protection of the general population, the citizens and visitors of the City of Lebanon, from all natural and manmade hazards.
2. To reduce the potential impact of natural and manmade disasters on the City of Lebanon's Critical Support Services.
3. To reduce the potential impact of natural and manmade disasters on Critical Facilities in the City of Lebanon.
4. To reduce the potential impact of natural and manmade disasters on the City of Lebanon's infrastructure.
5. To improve Emergency Preparedness.
6. To improve the City's Disaster Response and Recovery Capability.
7. To reduce the potential impact of natural and manmade disasters on private property.
8. To reduce the potential impact of natural and manmade disaster's on the City's economy.
9. To reduce the potential impact of natural and manmade disasters on the City's natural resources.
10. To reduce the City's liability with respect to natural and manmade hazards generally.
11. To reduce the potential impact of natural and manmade disasters on the City's specific historic treasures and interests, as well as other tangible and intangible characteristics which add to the quality of life of the citizens and guests of the City.
12. To identify, introduce and implement cost effective Hazard Mitigation measures to accomplish the City's goals and objectives and to raise awareness and acceptance of hazard mitigation opportunities generally.
13. To raise public awareness of the City of Lebanon's limited resources and the need to prioritize funding and allocate resources accordingly.
14. To raise public awareness in Lebanon of the relationship between natural hazard events and the importance of land use planning.

G. ACKNOWLEDGEMENTS

The following people participated in the update of this plan as the Hazard Mitigation Committee:

Chris Christopoulos, Fire Chief
Christine Hall, City Engineer
Earl Labonte, Department of Public Works
Mike Lavalla, Director of Public Works
Ken Niemczyk, City Planner
Tracey Thibault, Associate Planner
Paul Hatch, NH Homeland Security and Emergency Management Office
Victoria Davis, Upper Valley Lake Sunapee Regional Planning Commission
Patricia Crocker, Upper Valley Lake Sunapee Regional Planning Commission

The Hazard Mitigation Committee was composed of local officials, representatives from state agencies (NH HSEM), and staff representatives of the UVLSPRC for meeting facilitation and plan development. Neighboring communities, agencies, businesses, academia, non-profits and other interested parties were invited to participate through the public posting of meeting times and agendas or through invitation. Historical information, relevant data, and potential future mitigation strategies were contributed by all parties involved in the planning process. For a record of all meeting topics see Appendix C: Meeting Documentation. The staff representative of the UVLSRPC gathered all information from local officials, agency representatives and public input and compiled the information to develop the Plan.

II. COMMUNITY PROFILE

A. INTRODUCTION[1]

Geographical Location and Information

The City of Lebanon is the regional commercial and population center for the Upper Valley area of New Hampshire, in southwest Grafton County, in Western New Hampshire. The city is approximately 45 miles northwest of Concord. It is bordered by Hanover to the north, Enfield to the east, Plainfield to the south, and the towns of Hartford and Hartland Vermont to the west along the Connecticut River. The population is estimated at 12,571 (*2000 US Census*)(13,638 estimated for 2008 by NH Office of Energy and Planning).

The City has a land area of approximately 37 square miles. Interstate 89 runs through Lebanon. This has attracted extensive commercial and industrial development, notably in a floodplain area near the confluence of the Connecticut and Mascoma Rivers. US Route 4, NH 12A, NH 10 and NH 120 are also major routes running through Lebanon. Most of Lebanon is located in the watershed of the Mascoma River, the source of the City's water supply and a tributary of the Connecticut River, which also flows through Lebanon.

Lebanon is characterized by ridgelines surrounding the bottomlands of the Mascoma and Connecticut Rivers. Elevations range from approximately 350 feet to over 1,500 feet. In the Mascoma watershed, Crafts Hill, Quarry Hill, Signal Hill and Mount Tug form the northern Rim, while Bass Hill, Storrs Hill and Farnum Hill define the southern boundary of the valley. Mount Finish, Bald Hill, Crafts Hill and Colburn Hill define the eastern rim of the Connecticut River valley.

Temperatures in central New Hampshire average from 69 degrees Fahrenheit in the summer to 18.2 F in the winter. Average annual precipitation in the region is 36.7 inches, with an average snowfall of 75 inches.

City Government Structure

The City of Lebanon operates under a City Council/City Manager form of government. A nine-member City Council is elected for two-year terms. The City Council is responsible for establishing City policies.

[1] City of Lebanon Master Plan (2002) and discussions with Committee

The City Manager is the Chief Executive Officer, appointed by the City Council. The City Manager is responsible for supervising and conducting the day-to-day operations and affairs of the City, and to carry out the policies established by the City Council.

Development Trends

Through the last three decades, the population has increased steadily in Lebanon. According to the 2000 US Census information, the population of Lebanon now stands at 12,571. The largest percentage increase in population within the last 30 years was between 1970 and 1980 when the population increased by 14.5 percent. Between 1980 and 1990, the percent change was 9.4 percent, and between 1990 and 2000, the percent change dropped to 3.2 percent. While the resident population is at 12,571, the daytime population has been estimated at anywhere from 20,000 – 40,000, as Lebanon is the economic and job center for the region.

According to the Upper Valley Housing Needs Assessment, prepared by Applied Economic Research for the UVLSRPC (July 2002), the Lebanon Labor Market Area will continue to experience strong employment, population, and household growth, as the principal growth generators within this LMA, Dartmouth College and the Dartmouth Hitchcock Medical Center, are continuing to expand. The Land Use chapter of the Lebanon Master Plan recognizes that "Outlying developments present a great challenge to the City, as they stretch the City's capacity to provide adequate public services." The Master Plan also recognizes the following (*page 7, Land Use Chapter, adopted July 22, 2002*):

> *"Some areas of the City have been developed despite the existence of natural constraints that make modern construction problematic. Developed areas with steep slopes (over 25 percent) lie primarily within residential or rural lands, with the exception of a few industrial and commercial uses that predate zoning, such as the old excelsior mill in the City's Riverdale neighborhood. Considerable commercial and industrial development has taken place in areas with hydric soils, such as Etna Road and the Airport Business Park, which supported industrial uses prior to zoning, and DHMC and Centerra, developed under contemporary zoning. Similarly, significant portions of the developed area on the west side of Route 12A lie within the 100-year floodplain of the Connecticut River. None of these issues alone is necessarily problematic, but cumulatively their impact has degraded the City's natural resources and increased potential hazards by reducing flood storage capacity and causing slope destabilization and soil erosion."*

The total number of housing permits in Lebanon has held steady in the last decade, despite the increasingly critical housing shortage in the Upper Valley region. The expansion of both Dartmouth College and the Dartmouth Hitchcock Medical Center will bring many new jobs and may vastly increase the housing deficit.

The City of Lebanon, in its current master planning effort, is encouraging housing solutions that focus on development in centralized, built up areas rather than rural, outlying areas. This development or re-development could take the form of converting single family dwellings to duplexes or multi-family dwellings, creation of "granny flats", etc. The City is encouraging any new housing developments in outlying areas to utilize the principles of conservation design, to limit impacts on natural resources and city services. The paradox, however (as described in the Master Plan chapter above), in this kind of 'smart growth' is that some of the areas where growth will continue to be encouraged are in the floodplains. This area is a sensible location for development for many reasons - its proximity to services, for instance - but it does lie within the 100-year floodplain. The City of Lebanon will have to balance these issues and determine how to meet housing and development needs while minimizing impacts from hazards to natural resources, infrastructure and property.

Table II-1: AREA POPULATION TRENDS

Area	1970	1980	Avg. Annual Growth 70-80	1990	Avg. Annual Growth 80-90	2000	Avg. Annual Growth 90-00	30 Yr. Avg. Annual Rate
Lebanon	**9,725**	**11,134**	**0.1%**	**12,191**	**9.4%**	**12,571**	**3.2%**	**0.9%**
Enfield	2,345	3,175	*35%*	3,979	*25.3%*	4,618	*16.1%*	*2.3%*
Canaan	1,923	2,456	2.48%	3,045	2.17%	3,319	0.87%	1.84%
Plainfield	1323	1749	3.2%	2,059	1.8%	2,254	.09%	1.8%
Hanover	8,494	9,119	0.71%	9,212	0.10%	10,850	1.65%	0.82%
Grafton County	*54,914*	*65,806*	*1.83%*	*74,929*	*1.31%*	*81,743*	*0.87%*	*1.33%*
New Hampshire	*737,681*	*920,610*	*2.24%*	*1,109,252*	*1.88%*	*1,235,786*	*1.09%*	*1.73%*

Source: US Census

Table II-2: POPULATION PROJECTIONS FOR LEBANON

	1970	1980	1990	2000	2010	2020	2030
Population	9,725	11,134	12,191	12,571	13,530	13,860	14,180
Decade Change in Population		.14	.09	.03	.08	.02	.02

Source: 1970 – 2000 US Census & 2010 – 2030 NH Office of Energy & Planning

Table II-3 : OCCUPIED HOUSING UNIT PROJECTIONS BY TYPE FOR LEBANON

	2000	2010	2020	2030
Single-Family Units (.49)	2,675	2,893	2,963	3,032
Multi-Family Units (.47)	2,596	2,775	2,843	2,908
Mobile Home Units (.04)	229	236	242	247
TOTAL OCCUPIED UNITS	*5,500*	*5,904*	*6,048*	*6,187*

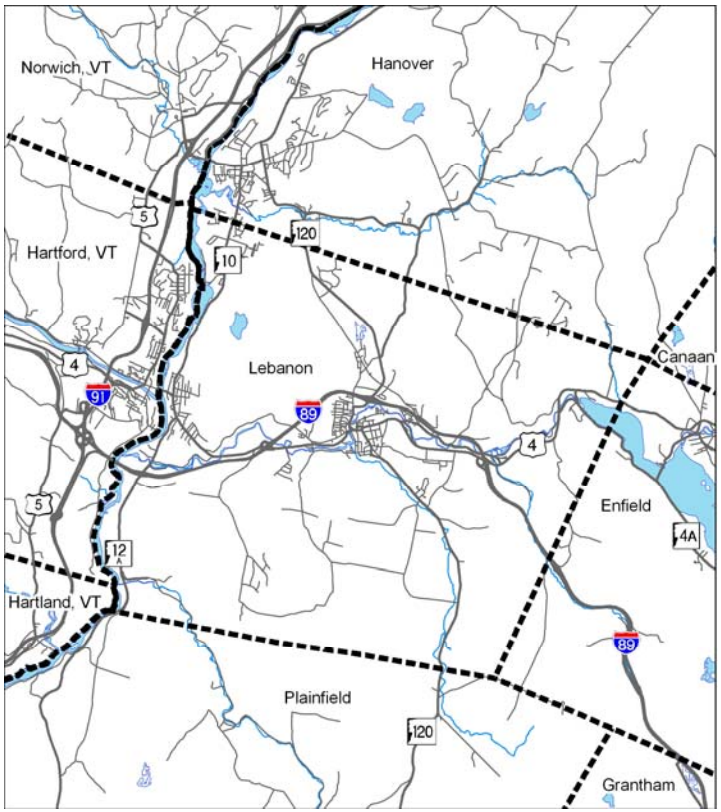
Source: US Census PHC 2-31Table 18 for unit type proportions in 2000; assumed all vacant units are single-family; projected totals based on persons/occupied unit (2.20)

Table II-4: TOTAL HOUSING UNIT PROJECTIONS BY OCCUPANCY FOR LEBANON

	2000	2010	2020	2030
Seasonal or Vacation Vacant (.01)	52	61	63	65
Other Vacant Units (.03)	155	185	189	193
Occupied Units (.96)	5,500	5,904	6,048	6,187
TOTAL ALL UNITS	*5,707*	*6,150*	*6,300*	*6,445*

Source: US Census PHC-1-31 Table 12 for 2000; total units projected as percentage of occupied units; other units projected in proportion of total in 2000.

Location Map



Lebanon is currently a participating member of the National Flood Insurance Program. Updated maps for all towns within Grafton County were finalized in February 2008. Most 100-Year Special Flood Areas in the city fall within the AE Zone, with base flood elevations determined. A small area is within the A Zone, with no base flood elevations determined. See Appendix D for a map showing these areas. The Lebanon Hazard Mitigation Committee identified other areas that have been flooded on a regular basis. Special Flood Hazard Areas and the Committee identified flood areas are shown a map in Appendix D.

III. HAZARD IDENTIFICATION

The Lebanon Hazard Mitigation Committee reviewed the list of hazards provided in the *State of New Hampshire Hazard Mitigation Plan*, and some hazard history for the State of New Hampshire and Grafton County in particular. A list of past hazard events in Lebanon, Grafton County, and the State of New Hampshire can be found in the following discussion and tables. After reviewing this information and the Emergency Operations Plan, the Committee conducted a Risk Assessment. The resulting risk designations are provided in the heading of each hazard table below as well as a more detailed discussion further into this chapter.

A. WHAT ARE THE HAZARDS IN LEBANON?

Lebanon is prone to a variety of natural and human-made hazards. The hazards that Lebanon is most vulnerable to were determined through gathering historical knowledge of long time residents and City officials; research into the CRREL Ice Jam Database, FEMA and NOAA documented disasters, and local land use restrictions; and from the input of representatives from state agencies (NH HSEM). The hazards affecting the City of Lebanon are dam failure, flooding, hurricane, tornado and downburst, thunderstorm (including lightning and hail), severe winter weather (including extreme cold and ice storms), earthquake, drought, extreme heat, wildfire, natural contaminants to air and water, and hazardous materials spills. Each of these hazards and the past occurrences of these hazards are described in the following sections. Hazards that were eliminated from assessment are those that have not had a direct impact on the City of Lebanon, and are not anticipated to have an impact as determined by the Hazard Mitigation Committee, representatives from state agencies and citizens of the City of Lebanon.

Eliminated hazards include Expansive Soils, Subsidence, and Snow Avalanches due to factors such as topography, soils, and location of development. Due to topography, snow avalanches are not a concern in Lebanon.

An evaluation of Natural Contaminants was added to reflect radon as examined in the State Plan and including other natural contaminants found in the State. A category for Hazardous Materials was added due to a major route through Lebanon and the possibility of a fuel spill anywhere in the city.

B. DESCRIPTIONS OF HAZARDS

An assessment of each hazard relevant to Lebanon is provided below. An inventory of previous and potential hazards is provided. Past events are shown in the following tables and the potential for future events is then discussed and shown on a map in Appendix D. The "risk" designation for each hazard was determined after evaluations discussed later in this chapter.

- Dam Failure
- Flooding
- Hurricane
- Tornado & Downburst
- Thunderstorm/Lightning/Hail
- Erosion
- Landslide
- Severe Winter Weather
- Earthquake
- Drought
- Wildfire
- Extreme Heat
- Natural Contaminants
- Hazardous Materials Spill
- Terrorism

Dam Failure

Dam failure results in rapid loss of water that is normally held by the dam. These kinds of floods pose a significant threat to both life and property. Appendix D is a map with the location of dams within Lebanon that were determined to have a significant or high hazard potential. Their potential inundation areas are also shown.

Table III-1: DAMS

DAMS – POTENTIAL FAILURE: LOW-MEDIUM RISK									
Dam #	**Class**	**Dam Name**	**Water Body**	**Owner**	**Status**	**Type**	**Impoundment Area in Acres**	**Height of Dam (Ft)**	**Drainage Area in Acres**
134.32	-	Benwood Subdivision	Runoff	K&J Associates	Not built	Earth	0.980	56.00	0.30
134.16	-	Boston Excelsior	Mascoma River	K&J Manuf Corp.	Removed	Timber/Stone	0.000	20.00	169.00
134.17	S	Boston Lot Lake Dam	T/R Connecticut River	City of Lebanon	Active	Earth	44.000	25.00	0.81
134.27	NM	Car Store Pond	Mink Brook Extension	Charles F. Folliott	Active	Concrete	0.500	5.00	2.00
134.05	-	Cummings Tannery	Mascoma River	Sandell Dev Corp.	Ruins	Timber/Stone	8.000	17.00	172.00
134.28	L	Dartmouth	Unnamed Stream	DHMC	Active	Earth	2.000	15.50	0.60

DAMS – POTENTIAL FAILURE: LOW-MEDIUM RISK									
Dam #	**Class**	**Dam Name**	**Water Body**	**Owner**	**Status**	**Type**	**Impoundment Area in Acres**	**Height of Dam (Ft)**	**Drainage Area in Acres**
		Hitchcock Pond							
134.30	NM	Densmore Det Pond	Runoff	C. R. Wilson Properties NH Inc.	Active	Earth	0.530	6.00	0.01
134.33	-	Detention Pond	Runoff	CDA Development LLS	Exempt	Earth	0.180	8.00	0.00
134.20	NM	Farm Pond	Natural Swale	Karen Moulton	Active	Earth	1.500	11.00	0.04
134.22	NM	Farm Pond Dam	Natural Swale	Grand Ayr Farm	Active	Earth	0.360	6.00	0.01
134.11	-	Glen Hydro Dam	Mascoma River	City of Lebanon	Breached	Timber/Stone	30.000	23.00	194.00
134.12	L	Glen Road Dam	Mascoma River	Enel North America Inc.	Active	Concrete	7.000	21.00	193.00
134.29	NM	Hazlett Beaver Pond Dam	T/R Martin Brook	Robert Hazlett	Active	Earth	4.000	6.00	0.86
134.31	NM	Keane Recreation Pond Dam	Unnamed Stream	Chris Keane	Active	Earth	0.150	14.00	0.30
134.36	L	LCS Settling Pond	N/A	Pike Industries	Active	Earth	6.600	15.00	0.00
134.18	-	Lebanon Reservoir Dam	Unnamed Stream	City of Lebanon	Breached	Concrete	0.410	22.00	0.00
134.04	S	Lebanon Water Treatment Intake	Mascoma River	City of Lebanon	Active	Concrete	0.400	16.00	169.00
134.08	-	Lower Falls Hydro	Mascoma River	Kendall Davis Co	Ruins	Timber/Stone	0.000	12.00	188.00
134.01	S	Mascoma Lake	Mascoma River	NH Water Resources Council	Active	Concrete	1155.000	18.00	153.00
134.14	NM	Mascoma River	Mascoma River	City of Lebanon	Active	Concrete	2.000	8.00	194.00
134.13	-	Mascoma River Dam	Mascoma River	Unknown	Ruins	-	0.000	0.00	0.00
134.02	-	Mascoma River I Dam	Mascoma River	Ronald Houston	Ruins	Timber/Stone	0.000	12.00	146.20

DAMS – POTENTIAL FAILURE: LOW-MEDIUM RISK									
Dam #	**Class**	**Dam Name**	**Water Body**	**Owner**	**Status**	**Type**	**Impoundment Area in Acres**	**Height of Dam (Ft)**	**Drainage Area in Acres**
134.03	-	Mascoma River II Dam	Mascoma River	William Spence	Ruins	-	0.000	0.00	148.00
134.10	NM	Plant No. 1 Dam	Mascoma River	City of Lebanon	Active	Concrete	3.000	12.00	188.00
134.21	-	Poverty Lanes Orchard Dam	T/R Connecticut River	Poverty Lane Orchards	Exempt	Earth	0.100	3.80	0.01
134.19	-	Recreation Pond Dam	Blodgett Brook	E. S. Gile	Not Built	Timber/Stone	0.000	5.50	1.64
134.09	H	Rivermill Hydro Dam	Mascoma River	Rivermill Hydroelectric Inc.	Active	Concrete	20.000	21.70	188.00
134.07	-	Riverside Hydro Dam	Mascoma River	Lebanon Woolen Mills Corp.	Ruins	Concrete	0.000	14.00	187.00
134.24	NM	Sanborn Dam	Unnamed Stream	Joel Sanborn	Active	Earth	0.250	4.00	0.01
134.35	-	Shop'n Save Detention Pond Dam	Runoff	Hannaford Brothers Company	Exempt	Earth	0.090	4.60	0.00
134.37	-	Sleeper village Detention Pond 4	Runoff	Nyala Farms Corporate Center	Exempt	Earth	0.200	6.50	0.00
134.38	-	Sleeper Village Detention Pond 7	Runoff	Nyala Farms Corporate Center	Exempt	Earth	0.100	8.00	0.00
134.06	-	Split Ballbearing Dam	Mascoma River	City of Lebanon	Ruins	Timber/Stone	0.000	19.00	187.00
134.34	NM	Stillwater Drive Detention Basin	Runoff	Simpson Development Corp.	Active	Earth	0.350	15.00	0.08
134.23	NM	Stone Pond	Blodgett Brook	Hardy Hill Associates	Active	Earth	3.000	16.70	1.94
134.25	-	Wheelock Detention Pond Dam	Runoff	ITD Group Inc.	Exempt	Earth	0.030	3.00	0.00
134.15	H	Wilder Dam	Connecticut River	Transcanada Hydro Northeast	Active	Concrete	3100.000	39.00	9975.00

DAMS – POTENTIAL FAILURE: LOW-MEDIUM RISK									
Dam #	**Class**	**Dam Name**	**Water Body**	**Owner**	**Status**	**Type**	**Impoundment Area in Acres**	**Height of Dam (Ft)**	**Drainage Area in Acres**
134.26	-	Winona Detention Pond Dam	Runoff	Charles Jameson & David Olio	Not Built	Earth	0.100	4.00	4.00
Source: Dam information provided by the NH Dam Bureau in 2007; Significant & High Hazard dams must have an emergency action plan. The State of New Hampshire classifies dams into the following four categories: Blank- Non-Active; NM – Non-menace; L – Low hazard; S – Significant hazard; H – High Hazard									

Past Dam Failure Events

There have been no dam failures in Lebanon or any surrounding towns which impacted Lebanon. Several dams are rated by the State as "non menace" or "low" hazard structures. This means there is no possibility for loss of life if any of these dams fail. A "low" hazard dam failure could cause some structural damage to buildings and roads though a "non menace" dam failure would not. There are nine non menace dams and three low hazard dams. There are three dams rated as "significant" hazard. This means there is a significant hazard potential because the dam is in a location and of a size that failure or mis-operation of the dam would result in any of the following: Major economic loss to structures or property; structural damage roads; major environmental or public health losses.

The Wilder Dam on the Connecticut River is considered to be a "high" hazard risk. This means the dam has a high hazard potential because it is in a location and of a size that failure or mis-operation of the dam would result in probable loss of human life. In addition, two dams farther north on the Connecticut River could impact the City of Lebanon if there were a dam failure: the Comerford and the Moore Dams.

The inundation areas for all of the above-mentioned dams are shown on a map in Appendix D. It should be noted that TransCanada will be updating their dam inundation maps along the Connecticut River tentatively to be completed in 2010. Currently the inundation mapping information is not available digitally which impedes interpretation of structures within the inundation area. The updated information will be digital. The current data for the Comerford, Moore, and Wilder Dams is shown on maps in Appendix D. For current purposes the 100 year flood areas along the Connecticut River are assumed to be the same as the Connecticut River dam inundation areas. They area similar as can be seen by viewing the maps in Appendix D.

Table III-2: STRUCTURES IN DAM INUNDATION AREAS

	Residential – Number of Buildings			Commercial/Industrial (square feet)	Public Facilities (square feet)	Total Value
Dam	Single-Unit	Mobile Homes	Multi-Unit			
CT River Dams	0	0	3	1,112,695	9,245	$66,666,900
Boston Lot Dam	0	0	0	0	Dam and associated structures	$41,657,900
Rivermill Dam	14	0	0	27,380	0	$11,426,400
Mascoma Lake Dam	112	0	3	219,890	32,106	$59,578,950

Note: The Connecticut River dam inundation areas are assumed to be the same as the 100 year flood area until digital information becomes available.

Potential Future Dam Failure Events

According to the State's Mitigation Plan (2004), Grafton County has a low risk of dam failure. The Committee determined dam failure is a *Low-Medium* risk in Lebanon.

Flooding

Flooding is the temporary overflow of water onto lands that are not normally covered by water. Flooding results from the overflow of major rivers and tributaries, storm surges, and inadequate local drainage. Floods can cause loss of life, property damage, crop/livestock damage, and water supply contamination, and can disrupt travel routes on roads and bridges.

Floods in the Lebanon area are most likely to occur in the spring due to the increase in rainfall and snowmelt; however, floods can occur at any time of the year. A sudden winter thaw or a major summer downpour can cause flooding. Floodplains indicate areas potentially affected by flooding. There are several types of flooding.

100-Year Floods The term "100-year flood" does not mean that flooding will occur once every 100 years, but is a statement of probability to describe how one flood compares to others that are likely to occur. What it actually means is that there is a one percent chance of a flood in any given year. These areas were mapped for all towns in New Hampshire by FEMA.

River Ice Jams Ice forming in riverbeds and against structures presents significant hazardous conditions when storm waters encounter these ice formations that may create temporary dams. These dams may create flooding conditions where none previously existed (i.e., as a consequence of elevation in relation to normal floodplains). Additionally, there is the impact of the ice itself on structures such as highway and railroad bridges. Large masses of ice may push on structures laterally and/or may lift structures not designed for such impacts.

Rapid Snow Pack Melt Warm temperatures and heavy rains cause rapid snowmelt. Quickly melting snow coupled with moderate to heavy rains are prime conditions for flooding.

Severe Storms Flooding associated with severe storms can inflict heavy damage to property. Heavy rains during severe storms are a common cause of inland flooding.

Beaver Dams and Lodging Flooding associated with beaver dams and lodging can cause road flooding or damage to property.

Bank Erosion and Failure As development increases, changes occur that increase the rate and volume of runoff, and accelerate the natural geologic erosion process. Erosion typically occurs at the outside of river bends and sediment deposits in low velocity areas at the insides of bends. Resistance to erosion is dependent on the riverbank's protective cover, such as vegetation or rock riprap, or its soils and stability.

Past Flooding Events

Appendix D is a map that shows the locally identified flood area and the Flood Insurance Rate Map of Special Flood Hazard Areas. The following tables provide a list of floods in the State, County, and Lebanon. The most recent flood occurred in the Hardy Hill area in 2008 and resulted in a $25,000 flood claim to FEMA.

The Committee rated flooding events as "Highly Likely" events, as the Mahan Flats area floods annually, and there is a good likelihood of several other areas flooding in any given year. These flood-prone areas are listed on the following page and are identified on the GIS map at the end of this chapter.

Riverine flooding is the most common disaster event in the State of New Hampshire, according to the State of New Hampshire Natural Hazards Mitigation Plan. According to the Plan: "Localized street flooding occasionally results from severe thundershowers, or over larger areas, from more general rain such as tropical cyclones and coastal "northeasters." More general and disastrous floods are rare but some occur in the spring from large rainfall quantities combined with warm, humid winds that rapidly release water from

the snowpack…General flooding is also caused by major hurricanes that closely follow major rainstorms…As a result, New Hampshire has a high flood risk. (*State of NH Natural Hazards Mitigation Plan, Pages 12-13*)"

FEMA's 1990 Flood Insurance Study details much of Lebanon's flood history. Similar to many New Hampshire communities, the City of Lebanon developed along the waterways. According to this document, "Large magnitude floods, caused by heavy rainfall alone or by a combination of heavy rain and melting snow, have occurred on both the Mascoma and Connecticut Rivers in Lebanon. Repeated damage has occurred to structures in the floodplains of the streams during such floods as those that occurred in 1913, 1922, 1927, 1933, 1936, 1938, 1953, and 1973."

According to *History in a Nutshell: A Brief History of Lebanon, NH, 1761-1961* (1972, Bernard Chapman), the flood of November 1927 was the most devastating tributary flood in Connecticut River history and left extensive damage. FEMA also calls this flood the "maximum flood of record" with a discharge of 136,000 cubic feet per second (cfs) and a recurrence interval of well in excess of 100 years under present conditions.

The flood of March 1936 was the highest ever in Lebanon Village (on the Mascoma River) and caused nearly $50,000 damage in five days. This flood had a discharge of 5,800 cfs and a recurrence interval of approximately 45 years. The 1953 flood had a discharge of 73,300 cfs on the Connecticut River and 4,900 cfs on the Mascoma River, with a recurrence interval of approximately 15 years on the Connecticut and 30 years on the Mascoma, according to FEMA.

The USGS gage on the Mascoma River is located just downstream of Mascoma Lake and measures runoff from 153 of the total 194-square mile Mascoma River watershed. According to FEMA's 1990 Flood Insurance Study: "The lake has a desynchronizing effect on flood flows; consequently, peak discharges in Lebanon are principally a function of runoff from the 153-square mile watershed above the gage, with some contribution to peak runoff from the steep and mountainous local area below the gage."

Table III-3: FLOODING – FEMA DISASTER DECLARATIONS, LOCAL RECOLLECTIONS & CRREL ICE JAM INFORMATION

Hazard	Date	Location	Description of Areas Impacted	Damages
Flood	March 11-21, 1936	NH State; around Lebanon	Damage to Road Network. Flooding caused by simultaneous heavy snowfall totals, heavy rains and warm weather. Run-off from melting snow with rain overflowed the rivers.	Unknown
Flood/Hurricane	September 21, 1938	Statewide; around Lebanon	Flooding in several locations with damage to buildings and bridges	Unknown

Hazard	Date	Location	Description of Areas Impacted	Damages
Flooding	June 15-16, 1943	Upper CT River	Intense rain exceeding four inches	
Flooding	March 1953	Lebanon	Damage to buildings and bridges	
Flooding	August 1955	CT River Basin	Heavy rains caused extensive damage throughout basin	
Flood	June 1973	Localized flooding in Lebanon	Flooding in several locations with damage to buildings and bridges	Unknown
Ice Jam	February 2, 1976	Connecticut River, Lebanon (just downstream of I-89 bridge and can cause water backup in Mascoma River)	Sewer pipe damaged causing raw sewage discharge into river	
Flooding	April 1976	Connecticut River	Rain and snowmelt	
Ice Jam	March 7, 1979	Connecticut River, West Lebanon	Unknown	
Ice Jam	February 12, 1981	Connecticut River, West Lebanon	Unknown	
Flooding	July - August 1986	Statewide	Severe summer storms: heavy rains, tornados flash flood, and severe winds (FEMA DR-771-NH)	
Flood / Severe Storm	April 16, 1987	Cheshire, Carroll, Grafton, Hillsborough, Merrimack, Rockingham, & Sullivan Counties, NH	FEMA Disaster Declaration # 789-DR (Presidentially Declared Disaster). Flooding of low-lying areas along river caused by snowmelt and intense rain.	$4,888,889 in damage.
Ice Jam	January 27, 1990	Connecticut River, West Lebanon	Unknown	
Flood	August 7-11, 1990	Belknap, Carroll, Cheshire, Coos, Grafton, Hillsborough, Merrimack & Sullivan Counties, NH	FEMA Disaster Declaration #876-DR. Flooding caused by a series of storm events with moderate to heavy rains.	$2,297,777 in damage.
Flooding	August 19, 1991	Statewide	Hurricane Bob - effects felt statewide	
Ice Jam	March 18, 1995	Connecticut River, West Lebanon	Unknown	
Flooding	October - Nov. 1995	North/West NH	Grafton County Declared: FEMA DR-1144-NH	
Ice Jam	January 19, 1996	Great Brook, Lebanon	Flooding in Logan Ballfield	
Flood	October 29, 1996	Grafton, Hillsborough, Merrimack, Rockingham, Strafford & Sullivan Counties, NH	FEMA Disaster Declaration # 1144-DR. Flooding caused by heavy rains.	$2,341,273 in damage.
Ice Jam	January 8, 1998	Connecticut River, West Lebanon (due to ice jam letting go on White River)	Unknown	

Hazard	Date	Location	Description of Areas Impacted	Damages
Ice Jam	February 28, 2000	Connecticut River, West Lebanon	Unknown	
Ice Jam	March 28, 2005	Stoney Brook, Lebanon	Severely damaged house	
Flood	October 26th 2005	Cheshire, Grafton, Merrimack, Sullivan, and Hillsborough Counties	FEMA Disaster Declaration #1610-DR. Severe storms and flooding.	$30,000,000 in damages.
Ice Jam	January 16, 2006	Connecticut River, West Lebanon (upstream from Wilder Dam)		
Flood	May 13 -17, 2006	Belknap, Carroll, Grafton, Hillsborough, Rockingham, Strafford Counties	FEMA Disaster Declaration #1643-DR	Unknown
Flood	April 16, 2007	All counties, NH	FEMA Disaster Declaration #1695. Severe storms and flooding.	$27,000,000 in damages; 2,005 home owners and renters applied for assistance in NH.
Flood	Whenever excess rainfall and heavy snow melt	Ruddsboro Road	Not in FEMA determined flood area	Floods and erodes driveways; flooded at least one mobile home
Flood	Seasonal every several years	Lebanon's Riverdale Area: Riverdale Parkway, Walnut Street, Barnes Street, Lilac Street, Benton Street, Cedar Street	FEMA designated flood area	Has not occurred recently
Flood	2008 and another time in last 10 years	Great Brook/Mascoma confluence with Connecticut River and Stoney Brook in the Upper Valley Plaza and K-Mart Plaza	FEMA designated flood area	Unknown; washed riverbank behind TJ Maxx store and threatened water lines to commercial complex; water in parking lot 12-13 years ago
Flood	Every couple years	Spencer, Mayhan, and Thompson Streets including Emerson Gardens and other residences	FEMA designated flood area	Evacuated 4-5 times in last 10 years
Flood	Seasonal most years with heavy rains and snow melt	Franklin Street and Pumping Station Road	Not in FEMA determined flood area; Water Treatment Plant and Pumping Station Road (every 4 years or so, an additional 3 feet higher than past flooding events would threaten water supply)	Flooded two houses
Flood	Seasonal most years with heavy rains and snow melt	Pasture Lane	Not in FEMA determined flood area	

Table III-4: STRUCTURES IN FEMA FLOOD INSURANCE RATE MAP 100 YEAR SPECIAL FLOOD HAZARD

	Residential – Number of Buildings			Commercial/Industrial (square feet)	Public Facilities (square feet)	Total Value
Area	Single-Unit	Mobile Homes	Multi-Unit			
Mascoma River	115	0	3	244,937	32,106	$60,851,100
Connecticut River	0	0	3	1,112,695	9,245	$66,666,900

Potential Future Flooding Events

According to the State's Mitigation Plan, flooding is a high hazard risk in the county. The Committee determined flooding is a *Medium-High* risk in Lebanon.

The City of Lebanon has been a participant in the National Flood Insurance Program since 1980. The current effective NFIP map is dated February 2008. There are approximately 121 structures located in the FEMA designated Special Flood Hazard Areas as noted in the above table. There are currently 89 NFIP flood insurance policy holders in the City of Lebanon, with $19.7 million in coverage. Since 1978, 17 NFIP claims have been made, and $25,030 dollars have been paid. There is one repetitive loss property in Lebanon and loss payments have totaled $4,026.

Hurricane

A hurricane is an intense tropical weather system with a well-defined circulation and maximum sustained winds of 74 mph (64 knots) or higher. Hurricane winds blow in a large spiral around a relative calm center known as the "eye." The "eye" is generally 20 to 30 miles wide, and the storm may extend outward 400 miles. As a hurricane nears land, it can bring torrential rains, high winds, and storm surges. A single hurricane can last for more than 2 weeks over open waters and can run a path across the entire length of the eastern seaboard. August and September are peak months during the hurricane season that lasts from June 1 through November 30. Damage resulting from winds of this force can be substantial, especially considering the duration of the event, which may last for many hours (*NH Natural Hazard Mitigation Plan*; FEMA website).

Past Hurricane Events

There have been several hurricanes over the years which have impacted New England and New Hampshire. These are listed below. The Hurricane of 1938 caused estimated $150,000 damage in Lebanon, and possibly $300,000 more in timber loss. Buildings were unroofed or flattened, streets and cars were ruined, and 300-400 trees were downed in the villages (*History in a Nutshell*).

Table III-5: HURRICANES & TROPICAL STORMS

HURRICANES AND TROPICAL STORMS – LOW-MEDIUM RISK				
Hazard	**Date**	**Location**	**Description of Areas Impacted**	**Damages**
Hurricane	August, 1635	n/a		Unknown
Hurricane	October 18-19, 1778	n/a	Winds 40-75 mph	Unknown
Hurricane	October 9, 1804	n/a		Unknown
Gale	September 23, 1815	n/a	Winds > 50mph	Unknown
Hurricane	September 8, 1869	n/a		Unknown
Hurricane	September 21, 1938	New England; substantial damage in Lebanon	Flooding caused damage to road network and structures. 13 deaths, 494 injured throughout NH. Disruption of electric and telephone services for weeks. 2 Billion feet of marketable lumber blown down. Total storm losses of $12,337,643 (1938 dollars). 186 mph maximum winds.	Unknown
Hurricane (Carol)	August 31, 1954	Southern New England	Category 3, winds 111-130 mph. Extensive tree and crop damage in NH, localized flooding	Unknown
Hurricane (Edna)	September 11, 1954	Southern New England	Category 3 in Massachusetts. This Hurricane moved off shore but still cost 21 lives and $40.5 million in damages throughout New England. Following so close to Carol it made recovery difficult for some areas. Heavy rain in NH	Unknown
Hurricane (Donna)	September 12, 1960	Southern and Central NH	Category 3 (Category 1 in NH). Heavy flooding in some parts of the State.	Unknown
Tropical Storm (Daisy)	October 7, 1962	Coastal NH	Heavy swell and flooding along the coast	Unknown
Tropical Storm (Doria)	August 28, 1971	New Hampshire	Center passed over NH resulting in heavy rain and damaging winds	Unknown

HURRICANES AND TROPICAL STORMS – LOW-MEDIUM RISK				
Hazard	**Date**	**Location**	**Description of Areas Impacted**	**Damages**
Hurricane (Belle)	August 10, 1976	Southern New England	Primarily rain with resulting flooding in New Hampshire. Category 1	Unknown
Hurricane (Gloria)	September, 1985	Southern New England	Category 2, winds 96-110 mph. Electric structures damaged; tree damages. This Hurricane fell apart upon striking Long Island with heavy rains, localized flooding, and minor wind damage in NH	Unknown
Hurricane (Bob)	August 19, 1991	Southern New England	Structural and electrical damage in region from fallen trees. 3 persons were killed and $2.5 million in damages were suffered along coastal New Hampshire. Federal Disaster FEMA-917-DR	Unknown
Hurricane (Edouard)	September 1, 1996	Southern New England	Winds in NH up to 38 mph and 1 inch of rain along the coast. Roads and electrical lines damaged	Unknown
Tropical Storm (Floyd)	September 16-18, 1999	Southern New England	FEMA DR-1305-NH. Heavy Rains; Lebanon received damage	Unknown
Hurricane (Katrina)	August 29, 2005 & continuing	East Coast of US and more	FEMA-3258-EM. Heavy rains and flooding devastating SE US	Unknown
Tropical Storm (Tammy)	October 5-13, 2005	East Coast of US	Remnants of Tammy contributed to the October 2005 floods, which dropped 20 inches of rain in some places in NH.	Unknown

Potential Future Hurricane Events

Hurricane events will affect the entire City. It is impossible to predict into the future what damage will occur in the City. According to the State's mitigation plan, Grafton County has a low risk for hurricanes. The Committee determined the hurricane risk to be *Low-Medium* in Lebanon.

Tornado & Downburst

"A tornado is a violent windstorm characterized by a twisting, funnel shaped cloud. These events are spawned by thunderstorms and, occasionally by hurricanes, and may occur singularly or in multiples. They develop when cool air overrides a layer of warm air, causing the warm air to rise rapidly. Most vortices remain suspended in the atmosphere. Should they touch down, they become a force of destruction." (*NH Natural Hazard Mitigation Plan*). The Fujita Scale is the standard scale for rating the severity of a tornado

as measured by the damage it causes. Most tornadoes are in the F0 to F2 Class. Building to modern wind standards provides significant property protection from these hazard events. New Hampshire is located within Zone 2 for Design Wind Speed for Community Shelters, which suggests that buildings should be built to withstand 160 mph winds.

Significantly high winds occur especially during tornadoes, hurricanes, winter storms, and thunderstorms. Falling objects and downed power lines are dangerous risks associated with high winds. In addition, property damage and downed trees are common during severe wind occurrences. A downburst is a severe, localized wind blasting down from a thunderstorm. These "straight line" winds are distinguishable from tornadic activity by the pattern of destruction and debris. Downbursts fall into two categories: 1. Microburst, which covers an area less than 2.5 miles in diameter, and 2. Macroburst, which covers an area at least 2.5 miles in diameter. Most downbursts occur with thunderstorms, but they can be associated with showers too weak to produce thunder.

Past Tornado & Downburst Events

A severe windstorm in 1999 ripped off the City Hall roof. The Working Group was unclear of the hazard event responsible for this destruction, but it may have been caused by a tornado or downburst. The following table displays tornadoes occurring in Grafton County between 1950 and 1995 as provided by the "Tornado Project" (www.tornadoproject.com) and the *NH Natural Hazard Mitigation Plan*. In 2007, a severe downburst damaged structures and knocked down stands of trees in neighboring towns. However, Lebanon did not sustain much damage.

Table III-6: TORNADOES IN GRAFTON COUNTY

TORNADOES & DOWNBURSTS – MEDIUM-HIGH RISK			
	Date	**Fujita Scale**	**Damages**
Tornado	July 14, 1963	F1	No deaths or injuries; costs unknown
Tornado	June 27, 1964	F0	No deaths or injuries; costs unknown
Tornado	August 11, 1966	F2	No deaths or injuries; costs unknown
Tornado	August 25, 1969	F1	No deaths or injuries; costs unknown
Tornado	July 21, 1972	F1	No deaths or injuries; costs unknown
Tornado	May 11, 1973	F2	No deaths or injuries; costs unknown
Tornado	June 11, 1973	F0	No deaths or injuries; costs unknown
Wind Event	1991	NA	Damage in area along Route 4A at Grafton/Lebanon city line
Downburst	July 6, 1999	NA	Damage along Route 4A (Goodhue Road) and Boys Camp Road
Tornado	August 13, 1999	F1	No deaths or injuries; costs unknown

TORNADOES & DOWNBURSTS – MEDIUM-HIGH RISK			
	Date	**Fujita Scale**	**Damages**
Downburst	August 2001	NA	Falling trees
Downburst	April 15, 2007	NA	Many swaths or trees were knocked down in Lebanon and neighboring towns; Debris removal-Federal Disaster Declaration FEMA-1695-DR-NH $20,700

Potential Future Tornado & Downburst Events

It is impossible to predict where a tornado or wind event will occur or what damage it will inflict. **The** Lebanon Committee does not recall tornadoes in Lebanon. The FEMA website places the State of NH in the Zone 2 Wind Zone which provides that a community shelter should be built to a 160 mph "design wind speed." According to the State's mitigation plan, Grafton County has a medium risk for tornadoes. The Committee determined there is a *Medium-High* risk for tornadoes and downbursts in Lebanon.

Thunderstorms

A thunderstorm is a rain shower during which you hear thunder. Since thunder comes from lightning, all thunderstorms have lightning. A thunderstorm is classified as "severe" when it contains one or more of the following: hail three-quarter inch or greater, winds gusting in excess of 50 knots (57.5 mph), or a tornado. Hail is a form of precipitation that occurs when updrafts in thunderstorms carry raindrops upward into extremely cold areas of the atmosphere where they freeze into ice. When the hail particle becomes heavy enough to resist the updraft, it falls to the ground. The resulting wind and hail can cause death, injury, and property damage.

An average thunderstorm is 15 miles in diameter and lasts an average of 30 minutes. Winter thunderstorms are rare because the air is more stable, strong updrafts cannot form because the surface temperatures during the winter are colder.

Lightning is a giant spark of electricity that occurs within the atmosphere or between the atmosphere and the ground. As lightning passes through the air, it heats the air to a temperature of about 50,000 degrees Fahrenheit, considerably hotter than the surface of the sun. Fires are a likely result of lightning strikes, and lightning strikes can cause death, injury, and property damage. It is impossible to predict where lightning will strike.

Past Thunderstorm Events

There have been lightening strikes in Lebanon, but the Committee has recollection of minor damage. Some buildings have been hit and the Whipple Building was recently hit in 2009.

Potential Future Thunderstorm Events

It is inevitable that thunderstorms will occur in Lebanon's future. Lightening, hail, or wind from a thunderstorm could impact the entire City. It is not possible to estimate possible damage. According to the State's mitigation plan, Grafton County has a medium risk of a lightening hazard. The risk for future thunderstorm damage was determined by the Committee to be *Low-Medium* risk in Lebanon.

Erosion

Soil erosion, although a natural process, can be greatly accelerated by improper construction practices. Because of the climate in New Hampshire and the general nature of the topography, eroded soils can be quickly transported to a wetland, stream, or lake. The New Hampshire Department of Environmental Services (DES) regulates construction activities of 50,000 square feet in the Shoreland Protection Area and 100,000 square feet elsewhere to minimize impacts upon these resources. A properly conducted construction project should not cause significant soil erosion. The Federal government regulates construction activities of an acre or more.

Soil becomes vulnerable to erosion when construction activity removes or disturbs the vegetative cover. Vegetative cover and its root system play an extremely important role in preventing erosion by: (1) Shielding the soil surface from the impact of falling rain drops; (2) Reducing the velocity of runoff; (3) Maintaining the soil's capacity to absorb water, and (4) Holding soil particles in place. Because of the vegetation's ability to minimize erosion, limiting its removal can significantly reduce soil erosion. In addition, decreasing the area and duration of exposure of disturbed soils is also effective in limiting soil erosion. The designer must give special consideration to the phasing of a project so that only those areas actively under construction have exposed soils. Other factors influencing soil erosion are: (1) Soil types, (2) Land slope, (3) Amount of water flowing onto the site from up-slope, and (4) Time of year of disturbance.

Past Erosion Events

There have been several erosion events in Lebanon. Many were primarily road washes associated with flooding and are addressed in that section. There are also several road washes associated with major storms, most recently in August 2008, April 2007 and October 2005.

Table III-7: EROSION AREAS

Date	Area	Description	Damages
Seasonal with heavy rains and snow melt	Slayton Hill	Wash-outs due to gouging of drainage systems from heavy water flows on steep sloped roads	Road wash-out
Seasonal with heavy rains and snow melt	Kinne Street	Wash-outs due to gouging of drainage systems from heavy water flows on steep sloped roads	Road wash-out
Seasonal with heavy rains and snow melt	Eagle Ridge and Stevens Road	Wash-outs due to gouging of drainage systems from heavy water flows on steep sloped roads	Road wash-out
Seasonal with heavy rains and snow melt	Brook Road & Hardy Hill Road	Wash-outs due to gouging of drainage systems from heavy water flows	Took out edge of road near culvert mouths; $8-10,000 in 2008
Seasonal with heavy rains and snow melt	Sunset Hill Road	Wash-outs due to gouging of drainage systems from heavy water flows	Road wash-out
Heavy rains	Interchange Drive	Run-off from airport	Road wash-out
Seasonal with heavy rains and snow melt	Manchester Drive and Monica Street	Erosion over steep slopes	Road wash-out
Most heavy rains	Mill Road Trail	Riverbank erosion of glacial till; affects Route 4 and force main; just above water plant and Mascoma River	Bank slides annually

Potential Erosion Events

Due to the topography and types of soils of the city, there is always potential for erosion. As properties are developed there will be less vegetative buffer to protect the city from erosion during rainstorms. The Committee determined that erosion is a *Medium* risk in Lebanon.

Landslide

A landslide is the downward or outward movement of sloped materials reacting under the force of gravity, including mudslides, debris flows, and rockslides. The type of material and moisture content determine the susceptibility to a landslide. Formations of

sedimentary deposits along the Connecticut River also create potential landslide conditions. Landslides can damage or destroy roads, homes, railroads, electrical and phone lines, and other structures.

Past Landslide Events
There have been landslide/erosion events on Bank Street Extension near Winona Circle and Dorothy Perley Road during 1999 Hurricane Floyd. There was substantial rain and the travel lane of the river side of the road collapsed leaving a hanging sewer line and unsupported guardrails. Around 2002 on Jenkins Road, a private leach field (Thayer) washed across the road with three feet of materials. There are no other known landslide areas.

Potential Landslide Events
There is always the potential for a landslide in an extreme weather event. It is possible that the above areas could be impacted again, but only during an extreme event. The Committee considers landslide events to have a *Low-Medium* risk.

Severe Winter Weather

Ice and snow events typically occur during the winter months and can cause loss of life, property damage, and tree damage.

Heavy Snow Storms A heavy snowstorm is generally considered one that deposits four or more inches of snow in a twelve-hour period… A blizzard is a winter storm characterized by high winds, low temperatures, and driving snow. According to the official definition given in 1958 by the U.S. Weather Bureau, the winds must exceed 35 miles per hour and the temperatures must drop to 20°F (-7°C) or lower. Therefore, intense Nor'easters, which occur in the winter months, are often referred to as blizzards. The definition includes the conditions under which dry snow, which has previously fallen, is whipped into the air and diminishes visual range. Such conditions, when extreme enough, are called "white outs."

Ice Storms Freezing rain occurs when snowflakes descend into a warmer layer of air and melt completely. When these liquid water drops fall through another thin layer of freezing air just above the surface, they don't have enough time to refreeze before reaching the ground. Because they are "super cooled," they instantly refreeze upon contact with anything that that is at or below 0 degrees C, creating a glaze of ice on the ground, trees, power lines, or other objects. A significant accumulation of freezing rain lasting several hours or more is called an ice storm. This condition may strain branches of trees, power lines and even transmission towers to the breaking point and often creates treacherous conditions for highway travel and aviation. Debris impacted roads make emergency access, repair and cleanup extremely difficult.

"Nor'easters" Nor'easters can occur in the eastern United States any time between October and April, when moisture and cold air are plentiful. They are known for dumping heavy amounts of rain and snow, producing hurricane-force winds, and creating high surfs that cause severe beach erosion and coastal flooding. A Nor'easter is named for the winds that blow in from the northeast and drive the storm up the east coast along the Gulf Stream, a band of warm water that lies off the Atlantic coast.

There are two main components to a Nor'easter: Gulf Stream low-pressure system (counter-clockwise winds) generate off the coast of Florida. The air above the Gulf Stream warms and spawns a low-pressure system. This low circulates off the southeastern U.S. coast, gathering warm air and moisture from the Atlantic. Strong northeasterly winds at the leading edge of the storm pull it up the east coast. As the strong northeasterly winds pull the storm up the east coast, it meets with cold Arctic high-pressure system (clockwise winds) blowing down from Canada. When the two systems collide, the moisture and cold air produce a mix of precipitation.

Winter conditions make Nor'easters a normal occurrence, but only a handful actually gather the force and power to cause problems inland. The resulting precipitation depends on how close you are to the converging point of the two storms. Nor'easter events which occur toward the end of a winter season may exacerbate the spring flooding conditions by depositing significant snow pack at a time of the season when spring rains are poised to initiate rapid snow pack melting.

Past Extreme Winter Weather Events

Extreme winter weather events occur annually in Lebanon but usually have minimal impacts on infrastructure and property. The following table provides a list of past extreme winter weather events in New Hampshire and Lebanon.

Table III-8: EXTREME WINTER WEATHER

EXTREME WINTER WEATHER – MEDIUM RISK				
Hazard	**Date**	**Location**	**Description of Areas Impacted**	**Damages**
Ice Storm	December 17-20, 1929	New Hampshire	Unprecedented disruption and damage to telephone, telegraph and power system. Comparable to 1998 Ice Storm (see below)	Unknown
Ice Storm	Dec. 29-30, 1942	New Hampshire	Glaze storm; severe intensity	Unknown
Blizzard	February 14-17, 1958	New Hampshire	20-30 inches of snow in parts of New Hampshire	Unknown
Snow Storm	March 18-21, 1958	New Hampshire	Up to 22 inches of snow in south central NH	Unknown

EXTREME WINTER WEATHER – MEDIUM RISK				
Hazard	**Date**	**Location**	**Description of Areas Impacted**	**Damages**
Snow Storm	December 10-13, 1960	New Hampshire	Up to 17 inches of snow in southern NH	Unknown
Snow Storm	January 18-20, 1961	New Hampshire	Up to 25 inches of snow in southern NH	Unknown
Snow Storm	February 2-5, 1961	New Hampshire	Up to 18 inches of snow in southern NH	Unknown
Snow Storm	January 11-16, 1964	New Hampshire	Up to 12 inches of snow in southern NH	Unknown
Blizzard	January 29-31, 1966	New Hampshire	Third and most severe storm of 3 that occurred over a 10-day period. Up to 10 inches of snow across central NH	Unknown
Snow Storm	December 26-28, 1969	New Hampshire	Up to 41 inches of snow in west central NH; ice storm took out power around Goose Pond Road for a week.	Unknown
Snow Storm	February 18-20, 1972	New Hampshire	Up to 19 inches of snow in southern NH	Unknown
Snow Storm	January 19-21, 1978	New Hampshire	Up to 16 inches of snow in southern NH; Rip Road in Lebanon particularly hard hit.	Unknown
Blizzard	February 5-7, 1978	New Hampshire	New England-wide. Up to 25 inches of snow in central NH	Unknown
Ice Storm	January 8-25, 1979	New Hampshire	Major disruptions to power and transportation	Unknown
Snow Storm	February, 1979	New Hampshire	President's Day storm	Unknown
Snow Storm	April 5-7, 1982	New Hampshire	Up to 18 inches of snow in southern NH	Unknown
Ice Storm	February 14, 1986	New Hampshire	Fiercest ice storm in 30 yrs in the higher elevations in the Monadnock region. It covered a swath about 10 miles wide from the MA border to New London NH	Unknown
Extreme Cold	November-December, 1988	New Hampshire	Temperature was below 0 degrees F for a month	Unknown
Ice Storm	March 3-6, 1991	New Hampshire	Numerous outages from ice-laden power lines in southern NH	Unknown
Snow Storm	1997	New Hampshire	Power outages throughout Lebanon due to heavy snowfall	Unknown
Ice Storm	January 15, 1998	New Hampshire; I-89 Exits 14-15 areas heavily	Federal disaster declaration DR-1199-NH, 20 major road closures, 67,586 without electricity, 2,310	Unknown

EXTREME WINTER WEATHER – MEDIUM RISK				
Hazard	**Date**	**Location**	**Description of Areas Impacted**	**Damages**
		impacted in Lebanon	without phone service, $17+ million in damages to Public Service of NH alone	
Snow Storm	2000	Regional	Heavy snow	Unknown
Snow Storm	March 5-7, 2001	Lebanon	Heavy snow.	$22,500
Snow Storm	December 6-7, 2003	Lebanon	Heavy snow. Federal Disaster Declaration FEMA-3193-NH	$29,200
Ice Storm	2004	Regional	Ice storm resulted in many trees down and loss of power.	Unknown
Snow Storm	February 10-12, 2005	Lebanon	Heavy snow. Federal Disaster Declaration FEMA-3208-NH	$32,700
Ice Storm	2008	Regional	Ice storm resulted in many trees down and loss of power.	$135,000

Potential Future Severe Winter Events

All areas of Lebanon are at risk from severe winter weather and ice storms. There is the potential for severe winter damage every year. The event would affect the entire City. According to the State's mitigation plan, Grafton County has a high risk for severe winter weather. The Committee determined severe winter weather to be a *Medium* risk in Lebanon.

Earthquake

New England is considered a moderate risk earthquake zone. An earthquake is a rapid shaking of the earth caused by the breaking and shifting of rock beneath the earth's surface. Earthquakes can cause buildings and bridges to collapse, disrupt gas, electric and phone lines, and cause landslides, flash floods and fires. The magnitude and intensity of an earthquake is determined by the use of scales such as the Richter scale and the Mercalli scale.

Past Earthquake Events

The following is a list of earthquakes that impacted New England, New Hampshire, and Lebanon.

Potential Future Earthquake Damage:

A United States Geographic Survey mapping tool on the web (geohazards.cr.usgs.gov/ projects) projects a 5 – 6 peak ground acceleration (pga) with 10% probability of exceedance in 50 years for the City of Lebanon. This pga rating is equivalent to a Modified Mercalli Intensity of "V" with moderate perceived shaking and very light potential damage. An earthquake event would impact the entire City. According to the State's mitigation plan, Grafton County has a medium risk for earthquakes. The Committee determined the risk to be *Low/Medium* in Lebanon.

Table III-9: EARTHQUAKES

EARTHQUAKES – LOW-MEDIUM RISK			
Date	**Location**	**Magnitude**	**Damage**
1638	Central NH	Estimated 6.5-7	
October 29, 1727	Off NH/MA coast	NA	Widespread damage Massachusetts to Maine: cost unknown
December 29, 1727	Off NH/MA coast	NA	Widespread damage Massachusetts to Maine: cost unknown
November 18, 1755	Cape Ann, MA	Estimated 6.0	Much damage: cost unknown
1800s	Statewide	NA	Unknown
1900s	Statewide	NA	Unknown
March 18, 1926	Manchester, NH	Felt in Hillsborough Co	Unknown
Dec 20, 1940	Ossipee, NH	Both earthquakes 5.5	Damage to homes, water main rupture: cost unknown.
December 24, 1940	Ossipee, NH	NA	Unknown
December 28, 1947	Dover-Foxcroft, ME	4.5	Unknown
June 10, 1951	Kingston, RI	4.6	Unknown
April 26, 1957	Portland, ME	4.7	Unknown
April 10, 1962	Middlebury, VT	4.2	Unknown
June 15, 1973	Near Quebec Border	4.8	Unknown
January 19, 1982	West of Laconia	4.5	Structure damage 15 miles away in Concord: cost unknown
October 20, 1988	Near Berlin, NH	4	Unknown
April 2002	Plattsburg, NY	5.1	Felt though no damage in Lebanon

Drought

A drought is defined as a long period of abnormally low precipitation. The effects of drought are indicated through measurements of soil moisture, groundwater levels and stream flow; however, not all of these indicators will be low during a drought. Costs can include loss of agricultural crops and livestock.

Past Drought Events

The following is a list of past drought events that had an impact on the State and Lebanon:

Table III-10: DROUGHT

DROUGHT – LOW-MEDIUM RISK			
Date	**Location**	**Description**	**Damages**
1929-1936	Statewide	Regional. Recurrence Interval 10 to > 25 years	Unknown
1939-1944	Statewide	Severe in southeast and moderate elsewhere. Recurrence Interval 10 to > 25 years	Unknown
1947-1950	Statewide	Moderate. Recurrence Interval 10 to > 25 years	Unknown
1960-1969	Statewide	Regional longest recorded continuous spell of less than normal precipitation. Encompassed most of the Northeastern US. Recurrence Interval > 25 years	Unknown
2001-2003	Statewide; Lebanon	Affected residential wells and agricultural water sources	Unknown

Potential Future Drought Events

Drought will affect the entire City, especially those will individual wells. The damage will depend upon the crops being grown at the time of the drought. No cost has been assigned to residential wells going dry though new wells may have to be dug or drilled. According to the State's mitigation plan, Grafton County has a medium risk for drought. The Committee determined drought to be a *Low-Medium* risk in Lebanon.

Wildfire

Wildfire is defined as any unwanted and unplanned fire burning in the forest, shrub or grass. Wildfires are frequently referred to as forest fires, shrub fires or grass fires, depending on their location. They often occur during drought and when woody debris on the

forest floor is readily available to fuel the fire. The threat of wildfires is greatest where vegetation patterns have been altered by past unsafe land-use practices, fire suppression and fire exclusion. Vegetation buildup can lead to more severe wildfires.

Increased severity over recent years has decreased capability to extinguish wildfires. Wildfires are unpredictable and usually destructive, causing both personal property damage and damage to community infrastructure, cultural and economic resources. Negative short term effects of wildfires include destruction of timber, forage, wildlife habitats, scenic vistas and watersheds. Some long term effects include erosion and lowered water quality.

There are many types and causes of fires. Wildfires, arson, accidental fires and others all pose a unique danger to communities and individuals. Since 1985, approximately 9,000 homes have been lost to urban/wild land interface fires across the United States (Northeast States Emergency Consortium: www.nesec.org). The majority of wildfires usually occur in April and May, when home owners are cleaning up from the winter months, and when the majority of vegetation is void of any appreciable moisture making them highly flammable.

The threat of wildland fires for people living near wildland areas or using recreational facilities in wilderness areas is real. Dry conditions at various times of the year and in various parts of the United States greatly increase the potential for wildland fires. Advance planning and knowing how to protect buildings in these areas can lessen the devastation of a wildland fire. To reduce the risk to wildfire, it is necessary to consider the fire resistance of structures, the topography of property and the nature of the vegetation in the area.

Past Wildfire Events

There have been very few wildfires in the City of Lebanon. There is strict enforcement of outside burning and fire permits. The greatest danger is weather driven during periods of drought especially in spring before the grass has greened up.

Potential Future Wildfire Events

There are many large, contiguous forest tracts in Lebanon. Where development interfaces with the forested areas is called the “urban interface.” These are the areas where structures could be impacted by a wildfire. The Committee considers all structures within Lebanon to be in an urban interface, and wildfire could affect the entire City in structural and timber loss. According to the State’s mitigation plan, the county has a high probability of wildfire. However, the Committee determined that the risk of wildfire in Lebanon is *Low*.

Extreme Heat

Extreme heat is characterized by abnormally high temperatures and/or longer than average time periods of high temperatures. These event conditions may impact the health of both humans and livestock.

Past Extreme Heat Events

The following table lists the extreme heat events in the past which included the Northeast and New Hampshire.

Table III-11: EXTREME HEAT

Date	Location	Description	Damage
July, 1911	New England	11-day heat wave in New Hampshire	Unknown
Late June to September, 1936	North America	Temps to mid 90s in the northeast	Unknown
Late July, 1999	Northeast	13+ days of 90+ degree heat	Unknown
Early August, 2001	New Hampshire	Mid 90s and high humidity	Unknown
August 2-4, 2006	New Hampshire	Regional heat wave and severe storms	Unknown

Potential Future Extreme Heat Events

Extreme heat would impact the entire City though those with air conditioning in their homes would have less impact. The costs of extreme heat are most likely to be in human life. The elderly are especially susceptible to extreme heat. The State did not develop a county risk factor for extreme heat in its *NH Hazard Mitigation Plan*. The Committee determined extreme heat to be a *Low-Medium* risk in Lebanon.

Natural Water & Air Contaminants

Radium, radon and uranium are grouped together because they are radionuclides, unstable elements that emit ionizing radiation. These three particular substances are a health risk only if taken into the body by ingestion or inhalation. They occur naturally in the environment, uranium and radium as solids in rock while radon exists as a gas. Radionuclides are undetectable by taste, odor, or color, so only analytical testing can determine if they are present in water. Because they are associated with rock, wells drilled into bedrock are more likely to contain elevated levels of radionuclides than shallow or dug wells.

Radon gas can also be found in the soil. Openings between the soil and buildings, such as foundation cracks and where pipes enter, provide conduits for radon to move into structures. The difference in air pressure, caused by heated indoor air moving up and out of buildings, results in a flow of soil gas toward the indoors, allowing radon to potentially accumulate in structures. Air quality in a home can also be tested for radon.

There are many other natural contaminants which can render drinking water unsafe such as arsenic. The Drinking Water and Groundwater Bureau of the NH Department of Environmental Services has several fact sheets available to address these natural materials and suggests which materials to be included in testing. See their list of fact sheets at http://www.des.state.nh.us/dwg.htm.

Past Natural Water & Air Contaminant Events

No known events have occurred in Lebanon although radon has been recorded in the area. Below is a table from the NH Office of Community and Public Health. A substantial percentage of homes tested exceed the EPA's "action level" of 4.0 picoCuries per liter.

Table III-12: RADON

RADON					
County	**# Tests**	**G. Mean**	**Maximum**	**% tested > 4.0 picoCuries/liter**	**% tested > 12.0 picoCuries/liter**
Belknap	744	1.3	22.3	14.4	1.3
Carroll	1042	3.5	478.9	45.4	18
Cheshire	964	1.3	131.2	15.6	2.3
Coos	1072	3.2	261.5	41	17
Grafton	**1286**	**2.0**	**174.3**	**23.2**	**5.2**
Hillsborough	2741	2.1	202.3	29.6	6.8
Merrimack	1961	2.0	152.8	25.2	6
Rockingham	3909	3.0	155.3	40	9.5
Strafford	1645	3.4	122.8	44	13
Sullivan	466	1.4	29.4	15.7	2.1
STATEWIDE	**15860**	**2.4 pCi/L**	**478.9 pCi/L**	**32.4**	**8.6**

Source: Summary Table of Short-term Indoor Radon Test Results in NH's Radon Database 11/04/2003

Potential Future Natural Air & Water Contaminant Damage:

Although there are no known records of illness that can be attributed to radium, radon, or uranium or other contaminants in Lebanon, residents should be aware that they are present. Houses with granite and dirt cellars are at increased risk to radon gas infiltration. According to the table above, Grafton County radon levels are below average for the State. According to the State's mitigation plan, Grafton County has a medium probability of a radon related hazard.

In addition radium, radon, and uranium as well as other natural materials can be present in drinking water. Residents, especially with bedrock wells, should be aware of the possibility of water contamination and the availability of testing and remediation. The Committee determined that the risk of natural contaminants is a *Low* risk in Lebanon.

Hazardous Materials Spills

Hazardous materials spills or releases can cause damage of loss to life and property. Short or long-term evacuation of local residents and businesses may be required, depending on the nature and extent of the incident.

Past Hazardous Waste Spill Events

In 1993, the hazardous materials response plan states, the City of Lebanon responded to 65 hazardous materials incidents. There are many facilities in the City with a potential for spills each year.

Potential Future Hazardous Waste Spill Events

There conceivably could be other spills near any home in Lebanon due to home heating fuel delivery. The property owner is responsible for clean-up. The State oversees these reported spills.

The Lebanon Hanover Emergency Planning Committee (LEPC) developed a hazardous materials response plan, to develop policies and procedures for responding to hazardous materials incidents.

The highest potential for incidents is fuels being used by the public for transportation or heating. The Hazardous Materials Response Plan also lists fixed facilities of concern: Water Treatment Plant; Valley Heating Oils, Irving Oil; Suburban Propane, Route 4, and Campion Ice Rink, Route 10 near Hanover.

The Police, Fire and Emergency Medical Services are all charged with responding to incidents involving hazardous materials. Public Works is used as a support organization to supply such needs as sand, heavy equipment, and manpower. The Lebanon Police Department, trained to hazardous materials "awareness" levels is the initial responder on the scene. The hazardous materials response plan lays out notification and response protocol.

The local emergency Local Emergency Planning Committee (LEPC) established that one of the potential problems with hazardous materials is transportation of these materials. I-89 is a major thoroughfare for truck traffic going from New England to Canada. The Port of Highgate in Vermont has some of the highest trafficking of hazardous materials of any Canadian border site in the country, and many of the vehicles traveling through that Port pass through Lebanon. Two intersections are considered to have an especially high potential for an accidental release: NH 120 and I-89 and NH 12A and I-89. The State did not determine county risk for hazardous waste spills in the *NH Hazard Mitigation Plan*. The Committee determined that a hazardous waste spill is a *Medium* risk.

Terrorism

Terrorism has been defined in many ways. The word terrorism is derived from the Latin term "terrere" which means to frighten. Under current United States law, set forth in the US Patriot Act, acts of domestic terrorism are those which: "(A) involve acts dangerous to human life that are a violation of the criminal laws of the United States or of any State; (B) appear to be intended— (i) to intimidate or coerce a civilian population; (ii) to influence the policy of a government by intimidation or coercion; or (iii) to affect the conduct of a government by mass destruction, assassination, or kidnapping; and (C) occur primarily within the territorial jurisdiction of the United States."

Past Terrorism Events

There have been no known terrorism events in Lebanon.

Potential Future Terrorism Events

Due to the proximity of Dartmouth College, as well as Dartmouth Hitchcock Medical Center and the Lebanon Airport, there is potential for both terrorism and civil unrest incidents; however, the Hazard Mitigation Committee determined the risk of Terrorism in Lebanon as *Low-Medium*.

C. HAZARD RISK RATINGS

The City of Lebanon Hazard Mitigation Committee reviewed each potential hazard and rated the probability of occurrence and vulnerability (cost if the hazard actually occurs) to come up with an overall risk rating. The ratings were based on past occurrences of hazards affecting the State of New Hampshire, Grafton County, and the City of Lebanon. Flooding and Tornado/Downburst were ranked the highest risk in Lebanon.

Lebanon has made recent efforts to reduce the vulnerability to hazards. For example, the City mailed educational letters to landowners in the flood zones; is completing its Natural Resources Inventory which could be used to designate prime wetlands; is amending its Subdivision and Site Plan Review regulations to meet 25-year storm event requirements; and is updating its Hazardous Materials Plan.

Assessing Probability

The process involved assigning a number to each hazard type based on its potential of occurring determined using the committee's knowledge of past events. For relative comparison the ratings were designated as shown below:

1 – Unlikely: may occur after 25 years
2 – Possible: may occur within 10-25 years
3 – Likely: may occur within 10 years

An n/a score was given if there was insufficient evidence to make a decision. As a comparison, the plan also identifies the probability of occurrence from the State Hazard Plan for Grafton County as shown in Table III-13. The Committee determined probability of each hazard event is shown in the second column of Table III-15.

Table III-13: PROBABILITY OF HAZARDS IN GRAFTON COUNTY FROM STATE PLAN

Flood	Dam Failure	Drought	Wildfire	Earth-quake	Land-slide	Radon	Tornado	Hurricane	Lightning	Severe Winter	Avalanche
H	L	**L**	**M**	M	M	M	**L**	**M**	**L**	H	L

Assessing Vulnerability

A relative scale of 1 to 3 was used to determine the potential impact and cost for human death and injury, property losses and damages, and business/agricultural impact *if the hazard occurred*: 1 – limited damage and cost; 2 - moderate amount of damage and cost, and 3 – high damage and cost.

Table III-14: COMMITTEE ASSESSMENT OF VULNERABILITY

Committee Assessment of Vulnerability	Human Impact	Property Impact	Economic Impact	Vulnerability
	Probability of death or injury	Physical losses and damages	Cottage businesses & agriculture	Avg. of human/ property/ business impact
Dam Failure	3	3	3	3.00
Flooding	1	3	3	2.33
Hurricane	1	2	2	1.67
Tornado & Downburst	2	2	2	2.00
Thunderstorm/Lightning/Hail	1	2	1	1.33
Erosion	1	2	2	1.67
Landslide	1	1	1	1.00
Severe Winter/Ice Storms	1	2	2	1.67
Earthquake	1	2	2	1.67
Drought	1	2	2	1.67
Wildfire	1	2	1	1.33
Extreme Heat	2	1	1	1.33
Natural Contaminants	1	1	1	1.00
HazMat Spills	2	2	1	1.67
Terrorism	3	3	3	3.00

Assessing Risk

The vulnerability and probability values were multiplied to arrive at the estimated overall risk the hazard has on the community. The overall risk or threat posed by a hazard over the next 25 years was determined to be high, medium, or low. The last column of Table III-15 provides the result of this evaluation.

HIGH (3)**:** There is strong potential for a disaster of major proportions during the next 25 years; or (2) history suggests the occurrence of multiple disasters of moderate proportions during the next 25 years. The threat is significant enough to warrant major program effort to prepare for, respond to, recover from, and mitigate this hazard. This hazard should be a major focus of the City's emergency management training and exercise program.

MEDIUM (2): There is moderate potential for a disaster of less than major proportions during the next 25 years. The threat is great enough to warrant modest effort to prepare for, respond to, recover from, and mitigate this hazard. This hazard should be included in the City's emergency management training and exercise program.

LOW (1)**:** There is little potential for a disaster during the next 25 years. The threat is such as to warrant no special effort to prepare for, respond to, recover from, or mitigate this hazard. This hazard need not be specifically addressed in the City's emergency management training and exercise program except as generally dealt with during hazard awareness training.

Table III-15: RISK ASSESSMENT

Hazards	Probability based on Committee Review	Vulnerability based on Committee Review	Risk Rating (Probability x Vulnerability)	Risk
Dam Failure	1	3.00	**3.00**	Low/Medium
Flooding	3	2.33	**6.99**	**Medium/High**
Hurricane	2	1.67	**3.34**	Low/Medium
Tornado/Downburst	3	2.00	**6.00**	**Medium/High**
Thunderstorm	3	1.33	**3.99**	Low/Medium
Erosion	3	1.67	**5.01**	Medium
Landslide	3	1.00	**3.00**	Low/Medium
Severe Winter	3	1.67	**5.01**	Medium
Earthquake	2	1.67	**3.34**	Low/Medium
Drought	2	1.67	**3.34**	Low/Medium
Wildfire	1	1.33	**1.33**	Low
Extreme Heat	2	1.33	**2.66**	Low/Medium
Natural Contaminants	3	1.00	**1.00**	Low
Hazardous Materials Spill	3	1.67	**5.01**	Medium
Terrorism	1	3.00	**3.00**	Low/Medium
0-1.9 Low 2-3.9 Low/Med 4-5.9 Medium 6-7.9 Med/High 8-9 High				

IV. CRITICAL FACILITIES & LOCATIONS

The Critical Facilities list identified by the Hazard Mitigation Committee is divided into three categories. The first category contains facilities needed for emergency response in the event of a disaster. The second category contains non-emergency response facilities that are not required in an event, but that are considered essential for the everyday operation of the City of Lebanon. The third category contains facilities and structures that the Committee wishes to protect in the event of a disaster due to dense populations or community values such as historic buildings. All facilities could be subject to earthquakes. Most would be subject to hurricanes, and tornados or downbursts; the term "Wind Events" is used for the latter hazards in the following tables. Values were obtained from City tax records using the 2009 current value figures for main structures.

Table IV-1: EMERGENCY RESPONSE FACILITIES, SERVICES & STRUCTURES

Map #	Critical Facility	Notes & Tax Map #	Hazard Vulnerability	Value
1	Police Station (back-up Emergency Operations Center)	117/1	None	$3,129,600
2	Central Fire Station #1 (Emergency Operations Center)	91/253	HazMat	$1,658,600
3	West Lebanon Fire Station #2	72/15	None	$706,600
4	Mascoma Fire Station #3	84/11	None	$226,100
--	Evacuation Routes – Interstates 89 & 91; Routes 4, 10, 120, 12A	--	HazMat	Unknown
5	City Public Works Facility	108/23	Flood	$3,760,700
6	Senior High School, Hanover Street (primary shelter) Hanover Street School (secondary shelter)	64/33	HazMat	$22,037,200

Table IV-2: NON-EMERGENCY RESPONSE FACILITIES AND SERVICES

Map #	Critical Facility	Notes & Tax Map #	Hazard Vulnerability	Value
7	Carter Witherall Complex, Taylor St (other shelter)	92/25	HazMat, Flood	$3,452,000
8	Old Carter Witherall Building, Campbell St (other shelter)	92/64	Haz Mat	467,000
9	Lebanon Airport	131/1	HazMat	928,800
10	City Hall	91/246	HazMat	3,556,900
11	Water Treatment Plant (includes tank and pumping station)	101/2	Dam Failure, Flood	1,589,000
12	Wastewater Treatment Facility	101/2	Flood	3,421,700
13	Crafts Hill Water Tank	73/90	None	75,000
14	DHMC Water Tank	5/1	None	Unknown
15	Farnum Hill Water Tank	132/10	None	Unknown

Table IV-3: FACILITIES AND POPULATIONS TO PROTECT

Critical Facility	Notes & Tax Map #	Hazard Vulnerability	Value
COMMUNITY FACILITIES			
Hannah House, Inc.	107/89	None	320,200
Grafton County Senior Center, Campbell St	92/23	HazMat	975,300
Lebanon Landfill & Recycling Center	157/3	None	924,300
Alice Peck Day Hospital	90/59	None	8,862,200
Dartmouth Hitchcock Medical Center	10/8-200	None	233,448,100 exc. Dr. Office Condos
West Central Behavioral Health	91/243	HazMat	701,400

Critical Facility	Notes & Tax Map #	Hazard Vulnerability	Value
Lebanon Library (historic)	92/126	None	1,821,600
West Lebanon Library (historic)	72/14	None	657,200
Lebanon College	91/242	HazMat	2,049,800
Franklin Pierce College	130/10	HazMat	2,463,400
Campion Rink	5/2	None	18,100
Municipal Pool	108/23	Flood, Dam Failure	Unknown
Courthouse	10/11-400	None	2,542,400
Lebanon Post Office	92/127	None	549,700
West Lebanon Post Office	72/11	None	64,400
Lebanon Postal Warehouse	10/11-3200	None	862,900
LARGE EMPLOYERS/COMMERCIAL AREAS:			
Timken	104/2	HazMat	$6,297,500
Thermal Dynamics	115/3	HazMat	7,086,800
Hypertherm (140 employees)	26/24; 145/8; 130/3	HazMat	2,154,800
Route 12 commercial		Flood	Unknown
Airpark Industrial/Commercial		HazMat	Unknown
Centerra Park area		None	Unknown
Etna Road industrial area		None	Unknown
West Lebanon Central Business District		None	Unknown

Critical Facility	Notes & Tax Map #	Hazard Vulnerability	Value
Lebanon Central Business District		Erosion, HazMat, Flood	Unknown
RETIREMENT/SENIOR HOUSING:			
Harvest Hill Retirement Community	76/4	None	4,110,000
Quail Hollow Elderly Housing	8/2-200 & 8/2-100	None	9,115,500
Genasys	50/32	HazMat	3,615,500
Rogers House Elderly Housing	92/12	HazMat	1,847,800
Lebanon Towers Elderly Housing	77/129	HazMat	2,991,500
Maple Street Manor	87/35	None	1,621,500
DAYCARE FACILITIES:			
Children's Center of the Upper Valley	105/12	None	461,800
DHMC Child Care Center	10/8-701	None	817,900
Kids Club at River Valley Club – Fit Kids Daycare	10/11-700	None	3,716,700
Lebanon Area Headstart at Hanover St School/Leb. HS	64/33	HazMat	22,037,200
Loretta's Family Child Care	91/97	None	110,200
White Mountain Children's Center	64/12	HazMat	321,700
Aquila's Home Day Care	102/42	None	143,200
Montessori Discovery School of the Twin States	73/67	None	365,300
Romano After School Program at Romano Circle	101/20	HazMat, Flood	2,392,000
Stinehour's Day Care	72/38	None	191,100
Twin River Children's Center	102/13	None	143,800

Critical Facility	Notes & Tax Map #	Hazard Vulnerability	Value
RESIDENTIAL AREAS:			
Olympic Trailer Park, Route 4A	98/22	None	1,267,700
Jensen's Mobile Home Park	90/42	None	2,000,400
Mascoma Meadows Cooperative	56/15	Flood	1,225,000
Sachem Village	5/1	None	25,559,500
R1 Zoning Districts		Flood, HazMat	
R2 Zoning Districts		Erosion, Flood, Ice Jam	
R3 Zoning Districts		Erosion, Flood, HazMat	
DAMS:			
Wilder Dam	n/a	Dam Failure, Flood	
Boston Lot Dam	22/1	None	
Glen Rd Dam	n/a	Dam Failure, Flood	
Rivermill Dam	n/a	Dam Failure, Flood	
Mascoma Lake Dam	n/a	Flood	
Pool Dam	n/a	Dam Failure, Flood	

Table IV-4: HAZARD-PRONE AREAS AND THEIR DEVELOPMENT POTENTIAL

Vulnerable Area	Hazard Vulnerability	Development Trends/Potential	Comments
Lebanon Village and Heater Road	Flooding; HazMat	Development encouraged in existing high density areas.	
West Lebanon Village	Flooding, HazMat	Development encouraged in existing high density areas.	
Airport Business Park	HazMat	Development encouraged in existing high density areas.	

Note: Mention of future development in DHMC/Centerra, Prospect Street, Rock Ridge – but no hazard areas there

Table IV-5: BRIDGES BY STATE CONDITION CATEGORY

Bridge #	Owner	Road	Feature	Location	Year Built/ Reconstructed	Recom-mended Posting	Bridge Condition
099/144	State	NHRR(ABD)	I-89	6.7 miles from Enfield T/L	1966	NPR	Black
121/127	State	Pedestrian Walkway	I-89	4.3 miles from Enfield T/L	1966	NPR	Black
150/044	State	NH 120	Great Brook	1.0 miles from Plainfield T/L	1930/2001	NPR	Green
049/064	State	NH 12A	Blood Brook	.4 miles from Plainfield T/L	1954	NPR	Green
150/084	State	NH 120	Great Brook	2.2 miles from Plainfield T/L	1944/1993	NPR	Green
141/093	City	Daisy Hill Road	Great Brook	.09 Miles from NH 120	1955	E-2	Green
152/060	City	Great Brook Road	Great Brook	380 ft. from NH 120	1936/1993	NPR	Green
184/074	City	Methodist Hill Road	Stony Brook	Enfield T/L	1940/2002	NPR	Green
177/089	State	I-89	Stony Brook	.74 miles from Enfield T/L	1966	NPR	Green
053/099	State	I-89 SB	NH 12A	.5 miles from VT S/L	1966	NPR	Green
053/100	State	I-89 NB	NH 12A	.5 miles from VT. S/L	1966	NPR	Green
055/103	City	NH 12A	Mascoma River	2.7 miles from N. Plainfield T/L	1977	E-2	Green
087/105	State	Poverty Lane	I-89	2.3 miles from VT S/L	1966/1993	NPR	Green
160/105	State	I-89 NB	U.S. 4	3.0 miles from Enfield T/L	1966/1986	NPR	Green
160/106	State	I-89 SB	U.S. 4	1.9 miles from Enfield T/L	1966/1987	NPR	Green
167/106	State	U.S. 4	Stony Brook	2.8 miles from Enfield T/L	1966	NPR	Green
121/108	City	Spring Street	Great Brook	.3 miles from NH 120	1953/2004	NPR	Green
103/116	State	Mascoma Street	I-89	5.5 miles from Enfield T/L	1966/1993	NPR	Green

Bridge #	Owner	Road	Feature	Location	Year Built/ Reconstructed	Recom-mended Posting	Bridge Condition
098/111	State	I-89 SB	Truck Road, Mascoma River	5.9 miles from Enfield T/L	1966	NPR	Green
097/112	State	I-89 NB	Truck Road, Mascoma River	5.9 miles from Enfield T/L	1966	NPR	Green
094/108	State	I-89 SB	U.S. 4	2.6 miles from VT S/L	1966	NPR	Green
160/112	State	I-89 NB	Riverside Drive, Mascoma River	2.0 miles from Enfield T/L	1966/1987	NPR	Green
159/114	State	I-89 NB	NHRR(ABD)	2.1 miles from Enfield T/L	1966/1987	NPR	Green
165/109	City	Riverside Drive	Stony Brook	.21 miles from Jct. U.S. 4	1997	NPR	Green
139/120	City	Bank Street Exit	Mascoma River	.07 miles from Jct. U.S. 4	1985	E-2	Green
120/118	City	NH 120	Mascoma River	.7 miles from Jct. I-89	1969	E-2	Green
131/125	City	Spencer Street	Mascoma River	65 ft. from Inv. No. 218	1930	BRC	Green
128/126	State	NH 120	I-89	.7 miles from Jct. Route 4	1966/1999	NPR	Green
206/129	State	U.S. 4	Huppe Brook	.08 miles from Enfield T/L	1945/1994	NPR	Green
149/086	State	NH 120	Great Brook	2.3 miles from Plainfield T/L	1935	E-2	Pink
059/063	City	Trues Brook Road	Bloods Brook	.9 miles from Plainfield T/L	1949	E-2	Pink
044/103	State	I-89 SB	Connecticut River, NECRR	.04 miles from VT S/L	1966	NPR	Pink
044/104	State	I-89 NB	Connecticut River. NECERR	.04 miles from VT S/L	1966	NPR	Pink
077/104	City	BMRR	Glen Road	West Lebanon	1901	NPR	Pink
120/115	City	U.S. 4, NH 10	Mascoma River	6.4 miles from Hanover T/L	1954	E-2	Pink
108/113	State	NHRR(ABD)	Mascoma Road	North of U.S. 4	1928	NPR	Pink

Bridge #	Owner	Road	Feature	Location	Year Built/ Reconstructed	Recom-mended Posting	Bridge Condition
107/109	City	Slayton Hill Road	Mascoma River	.09 miles from U.S. 4	1972	E-2	Pink
100/110	City	U.S. 4, NH 10	Mascoma River	5.4 miles from Hanover T/L	1977	E-2	Pink
099/111	State	I-89 SB on ramp	Truck Road, Mascoma River	2.7 miles from VT S/L	1966	NPR	Pink
093/109	State	I-89 NB	U.S. 4	2.6 miles from VT S/L	1966	NPR	Pink
159/112	State	I-89 SB	Riverside Drive, Mascoma River	2.0 miles from Enfield T/L	1966/1987	NPR	Pink
158/114	State	I-89 SB	NHRR (ABD)	2.1 miles from Enfield T/L	1966/1987	NPR	Pink
155/117	State	I-89 SB	Hardy Hill Road	2.5 miles from Enfield T/L	1966/1975	NPR	Pink
141/123	State	I-89 NB	Heater Road	.6 miles from Hardy Hill Road	1966	NPR	Pink
140/124	State	I-89 SB	Heater Road	.6 miles from Hardy Hill Road	1966	NPR	Pink
062/117	City	S. Main St. (NH 12A)	BMRR	100 ft. from Jct. Route 10	1949	E-2	Pink
192/128	State	Payne Road	Mascoma River	.19 miles from Jct. U.S. 4	1938	E-2	Pink
066/059	City	True's Brook Road	Bloods Brook	.4 miles from Plainfield T/L	1952/1986	E-2	Red
154/113	City	Riverside Drive (Packard)	Mascoma River	1.0 mile from Jct. U.S. 4	1991	10	Red
121/117	City	NH 120	NHRR(ABD), Park Lot, Pedestrian	.1 miles from Jct. Route 4	1969	E-2	Red
077/107	City	U.S. 4	BMRR, Mascoma River	4.3 miles from Lebanon T/L	1945	E-2	Red
156/117	State	I-89 NB	Hardy Hill Road	2.5 miles from Enfield T/L	1966	NPR	Red
188/126	State	U.S. 4	NHRR(ABD), Mascoma River	1.2 miles from Enfield T/L	1930/1957	E-2	Red
192/129	State	Payne Road	NHRR(ABD)	.1 miles from Jct. U.S. 4	1946/2004	15	Red

Bridge #	Owner	Road	Feature	Location	Year Built/ Reconstructed	Recom-mended Posting	Bridge Condition
058/127	State	U.S. 4	Connecticut River	.1 miles from VT S/L	1936/1976	E-2	Red

State Bridge Condition Category: Red – Red List priority for repair; Pink – Close to priority list; Yellow – Needs repair, non-priority; Green – Does not need repair
The E-2 designation is to exclude all combination and single unit certified (weights per NH RSA 266-18-b) vehicles from crossing a specific bridge.

V. DETERMINING HOW MUCH WILL BE AFFECTED

A. IDENTIFYING VULNERABLE FACILITIES

It is important to determine which critical facilities and other structures are the most vulnerable and to estimate potential losses. The first step is to identify the facilities most likely to be damaged in a hazard event. To do this, the locations of critical facilities were compared to the location of past and potential hazard events. Facilities and structures located in federally and locally determined flood areas, wildfire prone areas, etc. were identified and included in the analysis. Potential future development will primarily fall within the village areas of Lebanon (including Heater Road) and West Lebanon as well as the Air Park. Other areas were identified, but they are not in any hazard areas.

Table V-1: VULNERABILITY OF EXISTING STRUCTURES, INFRASTRUCTURE, AND NATURAL RESOURCES

Area	Hazard	Critical Facilities	Buildings		Infrastructure	Total Known Building Value
			Residential - Number	Non-Residential – Square Feet		
Connecticut River Floodplain	Flooding	**None**	3	1,112,695	Roads & one bridge	$66,666,900
Mascoma River Floodplain	Flooding	**None**	118	244,937	Roads & 13 bridges	$60,851,100
Mascoma Lake Dam Inundation Area	Dam Failure	**None**	115	219,890	Roads & 13 bridges	$59,578,950
Rivermill Hydro Dam Inundation Area	Dam Failure	**None**	14	27,380	Roads & two bridges	$11,426,400
Boston Lot Dam Inundation Area	Dam Failure	**None**	0	0	Dam and associated structures	$41,657,900
CT River Dams Inundation Areas	Dam Failure	**None**	3	1,112,695	Roads & one bridge	$66,666,900
Erosion Areas (throughout city)	Erosion	**None**	0	Unknown	Roads & bridges	Unknown

Table V-2: VULNERABILITY OF POTENTIAL DEVELOPMENT

Area	Hazard	Projected Buildings	Projected Infrastructure	Projected Value
Lebanon Village & Heater Road	Flood; HazMat	Unknown	Unknown	Unknown
West Lebanon Village	Flood; HazMat	Unknown	Unknown	Unknown

B. IDENTIFYING VULNERABLE SPECIAL POPULATIONS

There are several centers of special populations in Lebanon such as elderly housing or schools as identified in Table IV-3. The elderly and physically or mentally impaired residents are also located within the community, but scattered throughout the City in their homes. City-wide programs will have to take this into account. City officials having knowledge of its residents will assist in protection of those with special needs.

C. POTENTIAL LOSS ESTIMATES

This section identifies areas in the City that are most vulnerable to hazard events and estimates potential losses from these events. It is difficult to ascertain the amount of damage caused by a natural hazard because the damage will depend on the hazard's extent and severity, making each hazard event quite unique. In addition, human loss of life was not included in the potential loss estimates, but could be expected to occur. FEMA's *Understanding Your Risks: Identifying Hazards and Estimating Losses* (August 2001) was used in estimating loss evaluations. The value of structures was determined by using City records. The City's tax maps were used to determine number of units within each hazard area. The land damage cost, structure content loss costs, and function loss cost were not determined.

Dam Failure – Low-Medium Risk - $38.5 Million Estimated Cost
Assuming a 28% structural damage to the buildings valued at $137.7 million, the damage could total an estimated $38.5 million. In addition the Boston Lot Dam owned by the City is valued at $41.7 million including associated structures.

Flooding – Medium-High Risk - $32 Million Estimated Cost
There are approximately 115 single-unit houses and six multi-family houses located within the FEMA designated Special Flood Hazard 100-Year Floodplains. The total value of the houses is about $26 million. There are no mobile homes located in these areas. There are also about 1.4 million square feet of commercial or industrial buildings within these floodplains at a total value of $88.5 million. The critical facilities within the floodplain include 41,351 square feet or $600,000 in value. The total value of these non-

residential structures is $115.1 million. Assuming a 28% structural damage to the houses and non-residential structures, the damage would total close to $32 Million.

Hurricane – Low-Medium Risk – No Estimated Cost
It is random which structures would be impacted and how much. Hurricane Floyd in 1999 produced severe damage on Bank Street Extension at a cost of approximately $451,000.

Tornado & Downburst – Medium-High Risk – No Recorded or Estimated Cost
Tornadoes, downbursts, and microbursts are relatively uncommon natural hazards in New Hampshire, although a microburst in 2007 caused substantial tree damage. On average, about six tornado events strike each year. In the State of NH, the average annual cost of tornadoes between 1950 and 1995 was $197,000 (The Disaster Center). These wind events occur in specific areas, so calculating potential City-wide losses is not possible. There is no standard loss estimation model available for tornadoes due to their random nature.

Thunderstorm/Lightning/Hail – Low-Medium Risk – No Recorded or Estimated Cost
According to the Federal Alliance for Safe Homes, in an average year, hail causes more than $1.6 billion worth of damage to residential roofs in the United States, making it, year in and year out, one of the most costly natural disasters. Lightning is one of the most underrated severe weather hazards, yet it ranks as the second-leading weather killer in the United States. More deadly than hurricanes or tornadoes, lightning strikes in America each year killing an average of 73 people and injuring 300 others, according to the National Weather Service. There is no cost estimation model for thunderstorms due to their random nature.

Erosion – Medium Risk – $127,000 Estimated Annual Cost
Over the years, the City of Lebanon has spent a substantial amount of money on road improvement and repair due to erosion. The Department of Public Works estimates that the City spends about $127,000 per year on erosion damage to their roads.

Landslide – Low-Medium Risk – Unknown
There was a landslide event during the 1999 Hurricane Floyd and another in 2002.

Severe Winter Weather – Medium Risk – Unknown
Ice storms often cause widespread power outages by downing power lines, and these storms can also cause severe damage to trees. New England usually experiences at least one or two severe snowstorms, with varying degrees of severity, each year. All of these impacts are a risk to the community and put all residents, especially the elderly, at risk.

According to a study done for the Institute for Catastrophic Loss Reduction (Canada) and the Institute for Business and Home Safety (U.S.), the 1998 Ice Storm inflicted $1.2 billion (U.S.) worth of damage in the U.S. and Canada. In New Hampshire alone, over 67,000 people were without power (http://www.meteo.mcgill.ca/extreme/Research_Paper_No_1.pdf site last visited 10/19/09). The U.S. average insurance claim was $1,325 for personal property, $1,980 for commercial property, and $1,371 for automobiles. In 1998, an ice storm in Lebanon cost the City an estimated $40,000.

Earthquake – Low-Medium Risk – $150.6 Million Estimated Cost
Earthquakes can cause buildings and bridges to collapse, disrupt gas, electric and phone lines, and precipitate landslide and flash flood events. Four earthquakes in NH between 1924 and 1989 had a magnitude of 4.2 or more. Two of these occurred in Ossipee, one west of Laconia, and one near the Quebec border. Buildings in Lebanon have not been subject to any seismic design level requirement for construction and would be susceptible to structural damage. The dams, bridges, and roads would be vulnerable to a sizable earthquake event.

FEMA's *Understanding Your Risks: Identifying Hazards and Estimating Costs,* August 2001 provides that an earthquake with a 5% peak ground acceleration (as determined by the US Geologic Survey for the area) could cause damage to single-family residences by around 10% of the structural value. If all buildings in Lebanon (total value $1.5 billion) were impacted by an earthquake, the estimated damage could be around $150.6 million.

Drought – Low-Medium Risk – No Recorded or Estimated Cost
A long drought would cause damage to crops and dry up wells. There is no cost estimate for this hazard in Lebanon.

Wildfire – Low Risk – No Recorded or Estimated Cost
The risk of fire is difficult to predict based on location. About 97% of the City is in the current use taxation program which indicates larger lots which are primarily forested. Forest fires are more likely to occur during drought years. In addition, areas and structures that are surrounded by dry vegetation that has not been suitably cleared are at high risk. Fire danger is generally universal, however, and can occur practically at any time. Dollar damage would depend on the extent of the fire and the number and type of buildings burned. Since the entire developed area of Lebanon interfaces with forest, all structures are potentially vulnerable to wildfire. The estimated value of these structures is approximately $1,858,000,000. According to the Grafton County Forester, there are no reliable figures for the value of timber in New Hampshire; and excluding the last big fires of the early 1940s, the acres and timber values affected by fires would not be supportive of major investment in fire prevention in this region (v. fire-prone western regions).

Extreme Heat – Low-Medium Risk – No Recorded or Estimated Cost

The cost of an extreme heat event is not estimated in this document as the cost is unpredictable and would be human life and wellness.

Natural Contaminants – Low Risk – No Recorded or Estimated Cost

The cost of a natural contamination hazard would be the health of individuals exposed to the contaminant. No cost estimate is provided for this hazard.

Hazardous Material Spills – Medium Risk – No Recorded or Estimated Cost

The cost of a hazardous material spill would depend upon the extent of the spill, the location of the spill in relation to population, structures, infrastructure, and natural resources, as well as the type of hazardous material. The cost of any clean-up would be imposed upon the owner of the material. However, other less tangible costs such as loss of water, soil, and air quality might be borne by the community. No cost estimate has been provided for this possible hazard. There are several hazardous waste generators in Lebanon due to the many industries and hospitals and accompanying laboratories. Other spills would be from heating fuel delivery or transport of materials through the City on Routes 4, 4A, 10, 12A and 120 and I-89. These are major transportation routes in the area.

Terrorism Risk – Low-Medium Risk - No Recorded or Estimated Cost

The cost of any terrorism event is unpredictable and not estimated in this document.

VI. EXISTING MITIGATION ACTIONS

The next step involves identifying existing mitigation actions for the hazards likely to affect the City and evaluating their effectiveness. Table VI-1 is a list of current policies, regulations and programs in the City of Lebanon that protect people and property from natural and human-made hazards as well as effectiveness and proposed improvements.

Table VI-1: EXISTING MITIGATION ACTIONS

Existing Mitigation Action	Description	Hazard Type/Service Area	Responsible Local Agent	Effectiveness (Low, Average, High)/ Changes from Previous Hazard Mitigation Plan	Proposed Improvements
Multi-Hazard	Provide portable generator to use in emergency shelters and able to support school	Entire City	EMD	Average/An implemented proposed action	None
911 Numbering	Enforce numbering and require replacement of illegible numbers for emergency notification and location; GIS system	Multi-Hazard/ Entire City	City Engineer	High/None	None
Building Code and Permit	The International Building Code requires new construction and major renovations to meet national standards for flood, wind, earthquake, fire & snow. City always adopts most current code.	Multi-Hazard/ Entire City	Zoning Administrator	High/In process of being updated	None
ICS (Incident Command System) & NIMS (National Incident Management System)	Provides training for town personnel	Multi-Hazard/ Entire City	EMD	Average/None	Provide additional training to City and school personnel
Comprehensive Emergency Management Program for Schools (CEMPS)	Lebanon schools have been involved in this NH Office of Emergency Management program.	Multi-Hazard/ Entire City	SAU, State, EMD	Low/None	Update plan per State requirement; provide more training for key SAU personnel

Existing Mitigation Action	Description	Hazard Type/Service Area	Responsible Local Agent	Effectiveness (Low, Average, High)/ Changes from Previous Hazard Mitigation Plan	Proposed Improvements
City of Lebanon Emergency Management Plan	Describes the preparation and response necessary for the Town to address emergency situations	Multi-Hazard/ Entire City	EMD/Fire Chief	High/Updated plan in 2007	Provide training and exercises for key city personnel
Mutual Aid Compact	Lebanon has an informal compact with all communities in the Upper Valley, to maximize use of resources to address and respond to hazard events for fire, police and EMS.	Multi-Hazard/ Entire City	Fire Chief	High/None	Formalize mutual aid agreements among towns
Manufactured Housing Tie-downs Requirement in Building Code	Attach manufactured housing to the ground to prevent destruction during hazard event	Multi-Hazard/ Entire City	Zoning Administrator/ Entire City	High/law now requires a pad	None
Tree Inventory/ Maintenance	Trim trees as needed to prevent or restore electric or telephone service after hazard event.	Multi-Hazard/ Entire City	Public Works Department; Recreation Department; and National Grid	Low/None	None
Subdivision Regulations - Cluster Design and Planned Unit Development Subdivisions	Current regulations allow these forms of subdivision to provide greater open space.	Multi-Hazard/ Entire City	Planning Board	High/None	Amend regulations after adoption of City Master Plan update to allow conservation design subdivisions with no development in hazard areas.
Natural Resources Inventory	Floodplain and other hazard areas will be included as a component of this plan (e.g. identifying undeveloped floodplain lands for protection or passive recreational usage)	Multi-Hazard/ Entire City	Conservation Commission & Planning Department	Low (as incomplete)/ Began process since last plan	None

Existing Mitigation Action	Description	Hazard Type/Service Area	Responsible Local Agent	Effectiveness (Low, Average, High)/ Changes from Previous Hazard Mitigation Plan	Proposed Improvements
Emergency Notification System	Door-to-door notification if anticipated hazard event	Multi-Hazard/ Entire City	Fire Chief & EMD	Low/None	Explore use of code red reverse notification system with Grafton County
Dam Maintenance/ Enforcement	B and C class dams must have Emergency Action Plans. The Department of Environmental Services inspects B dams every four years and C dams every two years.	Dam Failure/ Entire City	State and Public Works Department	High/None	None
Floodplain Management Ordinance	Requires elevation of new or improved structures above the 100-year flood line	Flooding/ Entire City	Zoning Administrator & City Engineer	Average/None	Review need for required compensatory flood storage areas. Amend the ordinance prohibit development in the floodplains.
National Flood Insurance Program	The City participates in this program to provide affordable insurance options to its residents	Flooding/ Entire City	FEMA & Planning Board to meet criteria	High/None	None
Zoning Ordinance - Wetlands Regulations	The Conservation Commission has a "no net loss" policy if wetlands are impacted.	Flooding/ Entire City	Zoning Administrator	Average/ Completing Natural Resources Inventory which will be the basis of wetland re-designation	Designate appropriate wetlands as prime for greater protection.
Public Education	Provide flood preparedness information by mail to every residence in the floodplain. Sent out every few years. Provide flood maps and ordinance on the City web page.	Flooding/ Entire City	Department Heads; Zoning Administrator and City Engineer; EMD	Average/ Sent out mailing	Apply to FEMA's Community Rating System (CRS) program. Add information to web page to let residents know that the insurance is available outside the flood zones.

Existing Mitigation Action	Description	Hazard Type/Service Area	Responsible Local Agent	Effectiveness (Low, Average, High)/ Changes from Previous Hazard Mitigation Plan	Proposed Improvements
Shoreland Protection Act	This act establishes minimum standards for the future subdivision, use, and development of the shoreland within 250 feet of the state's public waters classified as "Fourth Order" or higher. Repairs, improvements, or expansions to existing development must conform.	Flooding & Erosion/ Entire City	State	Average/Law has been changed	None
Zoning Ordinance - Steep slopes restrictions	Restricts development including on slopes greater than 25% in certain zones.	Erosion/ RL3 Zoning District	Zoning Administrator	Low/None	Expand requirement to entire city
Subdivision and Site Plan Review Regulations - Storm Water Management	Require storm water management. The federal storm water regulations will also cover the City.	Erosion/ Entire City	Planning Board & Zoning Administrator	Average/In process of amending regulations to meet 25 year storm event requirements	None
Subdivision and Site Plan Review Regulations - Erosion and Sedimentation Control Requirements	Construction provision to reduce erosion and sedimentation.	Erosion/ Entire City	Planning Board & Zoning Administrator	Average/None	Amend regulations for more stringent requirements; in the process of updating regulations.
Hazardous Materials Plan	Provides emergency response to hazardous materials spills	HazMat/ Entire City & the Town of Hanover	Local Emergency Planning Committee	Average/ Currently updating plan	Provide more training and exercises

Table VI-2 examines the proposed improvements and evaluates them as 1: Low; 2: Average; and 3: High for effectiveness looking at several criteria as shown in the table. The totals are then ranked to prioritize the improvements to help the Committee focus on the most effective strategy improvements.

Table VI-2: PRIORITIZING EXISTING MITIGATION STRATEGY IMPROVEMENTS

Rank	Strategy Improvement	Social	Technical	Administrative	Political	Legal	Economic	Environmental	TOTAL SCORE	Mitigate Existing or New
1	ICS & NIMS - Provide additional training to City and school personnel	2	3	3	3	3	3	3	20	Both
1	CEMPS - Update plan per State requirement; provide more training for key SAU personnel	2	3	3	3	3	3	3	20	Both
1	City Emergency Management Plan - Provide training and exercises for key city personnel	2	3	3	3	3	3	3	20	Both
1	Mutual Aid Compact - Formalize mutual aid agreements among towns	2	3	3	3	3	3	3	20	Both
1	Emergency Notification System – Explore use of Code Red reverse notification system with Grafton County	2	3	3	3	3	3	3	20	Both
1	Public Education – Add information on web to educate the public about flood insurance availability outside the flood zones	3	3	3	3	3	2	3	20	Both
1	Hazardous Materials Plan – Provide more training and exercises	2	3	3	3	3	3	3	20	Both
2	Public Education - Apply to FEMA's Community Rating System (CRS) program.	3	3	1	3	3	3	3	19	Both
2	Zoning Ordinance – Expand steep slopes requirements to entire City	2	3	2	3	3	3	3	19	New
2	Site Plan & Subdivision Regulations – More stringent erosion and sedimentation control requirements	2	3	2	3	3	3	3	19	New
3	Subdivision Regulations - Amend regulations after adoption of City Master Plan update to allow conservation design subdivisions with no development in hazard areas.	2	2	2	3	3	3	3	18	New
3	Floodplain Management Ordinance - Review need for required compensatory flood storage areas. Amend the ordinance prohibit development in the floodplains.	2	3	2	2	3	3	3	18	Both
3	Zoning Ordinance - Designate appropriate wetlands as prime for greater protection.	2	2	2	3	3	3	3	18	Both

VII. GOALS AND NEWLY IDENTIFIED MITIGATION ACTIONS

A. GOALS & OBJECTIVES

The Lebanon Hazard Mitigation Committee reviewed its goals and developed objectives to meet these goals. The goals and objectives were re-evaluated during the updating of the plan to insure they remain valid and effective with one change.

Goals

1. To improve upon the protection of the general population, the citizens and visitors of the City of Lebanon, from all natural and human-made hazards.
2. To reduce the potential impact of natural and man-made disasters on the City of Lebanon's Critical Support Services.
3. To reduce the potential impact of natural and man-made disasters on Critical Facilities in the City of Lebanon.
4. To reduce the potential impact of natural and human-made disasters on the City of Lebanon's infrastructure.
5. To improve Emergency Preparedness.
6. To improve the City's Disaster Response and Recovery Capability.
7. To reduce the potential impact of natural and human-made disasters on private property.
8. To reduce the potential impact of natural and human-made disaster's on the City's economy.
9. To reduce the potential impact of natural and human-made disasters on the City's natural resources.
10. To reduce the City's liability with respect to natural and human-made hazards generally.
11. To reduce the potential impact of natural and man-made disasters on the City's specific historic treasures and interests, as well as other tangible and intangible characteristics which add to the quality of life of the citizens and guests of the City.
12. To identify, introduce and implement cost effective Hazard Mitigation measures so as to accomplish the City's goals and objectives and to raise awareness and acceptance of hazard mitigation opportunities generally.
13. To increase feelings of security among residents of the City of Lebanon.
14. To raise awareness and educate residents of the City of Lebanon about natural and human-made hazards.

Objectives

- Protect structures and roads in known flood areas.
- Amend the master plan to address natural and human-made hazards and support land use regulations.
- Protect houses in the wildland – urban interface from wildfire.
- Educate the public to prepare for all hazard emergencies.
- Provide emergency communication to effectively deal with mitigation and emergency management

B. POTENTIAL MITIGATION ACTIONS

Summary of New Strategies

Table VII-1: PROPOSED MITIGATION ACTIONS

Hazard Type	Description of Proposed Mitigation Action	Service Area	Changes from Previous Hazard Mitigation Plan
Flooding & Erosion	Detailed engineering flood study of Mascoma - The FEMA study is outdated and flood maps need updating. City will work with USGS and FEMA to update the NFIP study for the Mascoma River.	Flood Zones	None/FEMA ran out of money before coming to Lebanon
Flooding & Erosion	Zoning Ordinance – Add stream set-back requirement	Entire City	None/Not implemented as failed in 2008 public referendum; going back for vote in 2011
	Stream bank stabilization projects – Stream bank stabilization work is needed in two areas on the Connecticut River, to decrease siltation and flooding impacts on commercial properties.	*(Remove from agenda as not within jurisdiction of City.)*	*Completed area behind the Kmart Plaza on Rt. 12A; unknown intent for natural river wear behind Upper Valley Plaza on private land. The Bridge Street Bridge in West Lebanon is being done in phases to be completed in 2012 (?)*
	Cathotic (grounding) of sewer lines to prevent electrical current damage	*(Remove from agenda as determined not to be an electrical problem)*	
Erosion	Ruddsboro Road – study and correct drainage	Ruddsboro Road Area	New
Erosion	Franklin Street & Pumping Station Road – new drainage system	Franklin Street & Pumping Station Road Area	New
Erosion	Pasture Lane – new drainage system and change inflow	Pasture Lane Area	New
Erosion	Slayton Hill – study and correct drainage	Slayton Hill Area	New

Hazard Type	Description of Proposed Mitigation Action	Service Area	Changes from Previous Hazard Mitigation Plan
Erosion	Kinne Street – closed drainage system	Kinne Street Area	New
Erosion	Eagle Ridge and Stevens Road – change drainage characteristics	Eagle Ridge and Stevens Road Area	New
Erosion	Brook Road & Hardy Hill Road – improve drainage; concrete headers on culverts	Brook Road and Hardy Hill Road Area	New
Erosion	Sunset Rock Road – pave road	Sunset Rock Road Area	New
Erosion	Eastman Hill Road – improve drainage	Eastman Hill Road Area	New
Erosion	Interchange Drive – study and correct drainage	Interchange Drive Area	New
Erosion	Westview Lane Area; Hardy Hill Road – study and correct drainage	Westview Lane and Hardy Hill Road Area	New
Erosion	Manchester Drive & Monica Street – improve drainage with dykes	Manchester Drive and Monica Street Area	New
Erosion	Mill Road Trail – study and correct drainage and slope stabilization	Mill Road Trail Area	New

The Lebanon Hazard Mitigation Committee brainstormed potential mitigation actions at a meeting. The proposed measures are organized by the type of hazard event that the mitigation action is expected to mitigate. Some actions have been moved to the existing actions table as noted in that table. Other items have been deleted as they are no longer deemed appropriate, e.g. tree warden. A note in parentheses tells if the action is remaining from the previous plan and why or if it is new.

C. SUMMARY OF CRITICAL EVALUATION

The Lebanon Hazard Mitigation Committee reviewed each of the newly identified mitigation strategies using the following factors of the STAPLEE method:

- Social: Community Acceptance, Effect on Segment of Population
- Technical: Technical Feasible, Long-term Solution, Secondary Impacts
- Administrative: Staffing, Funding Allocated, Maintenance and Operation
- Political: Political Support, Local Champion, Public Support
- Legal: State Authority, Existing Local Authority, Potential Legal Challenge
- Economic: Benefit of Action, Cost of Action, Contribute to Economic Goals, Outside Funding Required

- Environmental: Effect on Land and Water, Endangered Species, and HazMat Sites; Consistent with Community Goals and Federal Laws

Each mitigation strategy was evaluated and assigned a score (High – 3; Average – 2; and Low – 1) based on the criteria.

Table VII-2: PRIORITIZING PROPOSED MITIGATION STRATEGIES

Rank	Strategy	Social	Technical	Administrative	Political	Legal	Economic	Environmental	TOTAL SCORE	Mitigate Existing or New Development or Both
1	Stream bank stabilization projects – Stream bank stabilization work is needed in an area on the Connecticut River to decrease siltation and flooding impacts on commercial properties. (in the City's Capital Improvement Plan).	3	3	3	3	3	3	3	21	Both
2*	Mill Road Trail – study & correct drainage and slope stabilization	3	3	2	3	3	2	3	19	Both
2	Detailed engineering flood study of Mascoma - The FEMA study is outdated and flood maps need updating. City will work with USGS and FEMA to update the NFIP study for the Mascoma River.	2	3	3	3	3	2	3	19	Both
2	Zoning Ordinance – Stream set-back requirement	2	3	3	3	3	2	3	19	
2	Ruddsboro Road – study and correct drainage	3	3	2	3	3	2	3	19	Both
2	Franklin Street & Pumping Station Road – new drainage system	3	3	2	3	3	2	3	19	Both
2	Pasture Lane – new drainage system and change inflow	3	3	2	3	3	2	3	19	Both
2	Slayton Hill – study and correct drainage	3	3	2	3	3	2	3	19	Both
2	Kinne Street – closed drainage system	3	3	2	3	3	2	3	19	Both
2	Eagle Ridge and Stevens Road – change drainage characteristics	3	3	2	3	3	2	3	19	Both
2	Brook Road & Hardy Hill Road – improve drainage; concrete headers on culverts	3	3	2	3	3	2	3	19	Both
2	Eastman Hill Road – improve drainage	3	3	2	3	3	2	3	19	Both
2	Interchange Drive – study and correct drainage	3	3	2	3	3	2	3	19	Both
2	Westview Lane Area; Hardy Hill Road – study and correct drainage	3	3	2	3	3	2	3	19	Both
2	Manchester Drive & Monica Street – improve drainage with dykes	3	3	2	3	3	2	3	19	Both
3	Sunset Rock Road – pave road	1	2	1	1	2	1	1	9	Both

*Although this scored as a "2" ranking, the Committee felt it is still a higher priority than the other road work.

The Lebanon Hazard Mitigation Committee assigned the following scores to each strategy for its effectiveness related to the critical evaluation factors listed above, and actions had the following scores, with the highest scores suggesting the highest priority.

VIII. PRIORITIZED IMPLEMENTATION SCHEDULE

The Lebanon Hazard Mitigation Committee created the following action plan for implementation of priority mitigation strategies:

Table VIII-1: PRIORITIZED IMPLEMENTATION SCHEDULE FOR EXISTING PROGRAM IMPROVEMENTS

Mitigation Action	Who (Leadership)	When (Fiscal Year)	How (Funding Sources)	Cost (Estimated)
ICS & NIMS - Provide additional training to City and school personnel	Fire Chief	2010	Grants	0
CEMPS - Update plan per State requirement; provide more training for key SAU personnel	EMD	2010	Grants	0
City Emergency Management Plan - Provide training and exercises for key city personnel	EMD	2010	Grants	$20-30,000
Mutual Aid Compact - Formalize mutual aid agreements among towns	Fire & Police Chiefs	2011	NA	0
Emergency Notification System – Explore use of code red reverse notification system with Grafton County	EMD/Fire Chief	2009	NA	0
Public Education – Add information on web to educate the public about flood insurance availability outside the flood zones	DPW Engineer	2010	Taxes	salary
Hazardous Materials Plan – Provide more training and exercises	EMD & Emergency Plan Committee	2010	Grants	$20-30,000
Public Education - Apply to FEMA's Community Rating System (CRS) program.	DPW Engineer & EMD	2011	Taxes	salary
Zoning Ordinance – Expand steep slopes requirements to entire City	Planning Office & City Council	2010	Taxes	salary
Site Plan & Subdivision Regulations – More stringent erosion and sedimentation control requirements	Planning Office & Planning Board	2010	Taxes	salary & volunteers
Subdivision Regulations - Amend regulations to allow conservation design to provide greater open space in subdivisions after adoption of City Master Plan update.	Planning Office & Planning Board	2010	Taxes	salary & volunteers
Floodplain Management Ordinance - Review need for required compensatory flood storage areas. Amend the ordinance prohibit development in the floodplains.	DPW Engineer & City Council	2010	Taxes	salary
Zoning Ordinance - Designate appropriate wetlands as prime for greater protection.	Planning Office & City Council	2011	Taxes	salary

Table VIII-2: PRIORITIZED IMPLEMENTATION SCHEDULE FOR PROPOSED PROGRAMS

Mitigation Action	Who (Leadership)	When (Fiscal Year)	How (Funding Sources)	Cost (Estimated)
Stream bank stabilization projects – Stream bank stabilization work is needed in an area on the Connecticut River to decrease siltation and flooding impacts on commercial properties. (in the City's Capital Improvement Plan).	NH DOT	Unknown	Grants	None to the City
Mill Road Trail – study & correct drainage and slope stabilization	DPW Engineer	2009-2012	Taxes & Grants	$100,000
Detailed engineering flood study of Mascoma - The FEMA study is outdated and flood maps need updating. City will work with USGS and FEMA to update the NFIP study for the Mascoma River.	DPW Engineer	Unknown	Grants	Unknown
Zoning Ordinance – Stream set-back requirement	Planning Board	2010-11	Taxes	0
Ruddsboro Road – study and correct drainage	DPW Engineer	TBD	Taxes & Grants	$470,000
Franklin Street & Pumping Station Road – new drainage system	DPW Engineer	TBD	Taxes & Grants	$130,000
Pasture Lane – new drainage system and change inflow	DPW Engineer	TBD	Taxes & Grants	$367,600
Slayton Hill – study and correct drainage	DPW Engineer	TBD	Taxes & Grants	$350,000
Kinne Street – closed drainage system	DPW Engineer	TBD	Taxes & Grants	$150,000
Eagle Ridge and Stevens Road – change drainage characteristics	DPW Engineer	TBD	Taxes & Grants	$700,000
Brook Road & Hardy Hill Road – improve drainage; concrete headers on culverts	DPW Engineer	TBD	Taxes & Grants	$50,000
Eastman Hill Road – improve drainage	DPW Engineer	TBD	Taxes & Grants	$50,000
Interchange Drive – study and correct drainage	DPW Engineer	TBD	Taxes & Grants	$500,000
Westview Lane Area; Hardy Hill Road – study and correct drainage	DPW Engineer	TBD	Taxes & Grants	$50,000
Manchester Drive & Monica Street – improve drainage with dykes	DPW Engineer	TBD	Taxes & Grants	$30,000

Ruddsboro Road based on Study $50,000 and roadway/drainage @ $100/Ft 4200 feet
Franklin St based on study $30,000 and 500 ft @ $200/ft
Eagle Ridge/ Stevens based on Study $50,000 5860 ft @ 110/ft
Brook and Hardy based on $10,000 engineering $40,000 headers and culverts improvements
Eastman Hill based on $10,000 engineering $40,000 headers and culverts improvements
Interchange Drive Study $50,000 drainage earth work maybe required to continue to river
Manchester/Monica $5,000 engineering $25,000 for erosion dikes ditch repairs
Slayton Hill Study $50,000 3,000 feet @ $100/ft

IX. ADOPTION & IMPLEMENTATION OF THE PLAN

A good plan needs to provide for periodic monitoring and evaluation of its successes and challenges, and to allow for updates of the Plan where necessary. In order to track progress and update the Mitigation Strategies identified in the Plan, the City of Lebanon will revisit the Hazard Mitigation Plan annually, or after a hazard event. The Lebanon Emergency Management Director will initiate this review and should consult with the Hazard Mitigation Committee. Changes will be made to the plan to accommodate for projects that have failed, or that are not considered feasible after a review for their consistency with the evaluation criteria, the timeframe, the community's priorities, and funding resources. Priorities that were not ranked highest, but that were identified as potential mitigation strategies, will be reviewed as well during the monitoring and update of this plan, to determine feasibility for future implementation. The plan will be updated and submitted for FEMA approval at a minimum every five years as required by the Disaster Mitigation Act 2000.

A. IMPLEMENTATION THROUGH EXISTING PROGRAMS

The Plan will be adopted locally as an Annex to the updated Emergency Operations Plan (EOP), and it will be updated annually along with the EOP. In addition, the City Council, during the Capital Improvement Process, will review and include any proposed structural projects outlined in this plan. As other City documents are updated, they will include hazard risks and mitigation strategies from this plan. This would include the City Master Plan.

B. CONTINUED PUBLIC INVOLVEMENT

The public will continue to be involved in the hazard mitigation planning process. In future years, a public meeting will be held (separate from the adoption meeting) to inform and educate members of the public and to take public comment for incorporation into any updates of the plan. Additionally information will be posted on the City website.

The public has been involved in hazard mitigation planning through public hearings and the City meeting when explaining programs and expenses.

Copies of future updated Hazard Mitigation Plans will be sent to the following parties for review and comment:

- Emergency Management Directors, neighboring towns
- Field Representative, NH Homeland Security & Emergency Management

- Lebanon City Manager
- Lebanon City Council
- Lebanon Planning Department
- Lebanon Public Works Department
- Upper Valley Lake Sunapee Regional Planning Commission

RESOURCES USED IN THE PREPARATION OF THIS PLAN

Guide to Hazard Mitigation Planning for New Hampshire Communities, prepared for NH Bureau of Emergency Management (now NH Homeland Security & Emergency Management) by the Southwest Regional Planning Commission (October 2002)

FEMA *Multi-Hazard Mitigation Planning Guidance Under the Disaster Mitigation Act of 2000* (March 2004, Last Revised June 2007)

FEMA 386-1 *Getting Started: Building Support for Mitigation Planning* (September 2002)

FEMA 386-2 *Understanding Your Risks: Identifying Hazards and Estimating Costs* (August 2001)

FEMA 386-3 *Developing the Mitigation Plan: Identifying Mitigation Actions and Implementation Strategies* (April 2003)

Ice Storm '98 by Eugene L. Lecomte et al for the Institute for Catastrophic Loss Reduction (Canada) and the Institute for Business & Home Safety (U.S.) (December 1998) www.meteo.mcgill.ca/extreme/Related_Info.htm#disname

Lucey, Bernie, P.E. NH Department of Environmental Services, Drinking Water & Groundwater Bureau, Phone Discussion 01/29/08

City of Lebanon Emergency Operations Plan (1985; Update to be completed in 2008)

City of Lebanon Master Plan (2002)

NH Department of Environmental Services, Drinking Water & Groundwater Bureau Fact Sheets: *ARD-EHP-22 Radium, Radon, and Uranium: Health Information Summary (2007); WD-WSEB-3-11 Dissolved Mineral Radioactivity In Drinking Water (2004); WD-WSEB-2-1 Suggested Water Quality Testing for Private Wells (2003)*

NH Bureau of Emergency Management (now NH Homeland Security & Emergency Management)'s *State of New Hampshire Natural Hazard Mitigation Plan* (2004)

www.fema.gov/news/disasters.fema: Website for FEMA's Disaster List

www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms: Website for National Oceanic & Atmospheric Administration Disaster List

www.tornadoproject.com: Website for The Tornado Project

www.crrel.usace.army.mil/: Website for Cold Regions Research and Engineering Laboratory Website (CRREL)

www.nesec.org: Website for Northeast States Emergency Consortium

http://earthquake.usgs.gov/research/hazmaps/products_data/2002/ceus2002.php: Website for area earthquake information

APPENDICES

Appendix A: **Technical Resources**

Appendix B: **Hazard Mitigation Assistance Grants**

Appendix C: **Meeting Documentation**

Appendix D: **Maps**

Map 1 – Floodplains and Flood-Prone Areas
Map 2 – Flooded Areas in Event of Failure of Mascoma Lake Dam & Rivermill Hydro Dam
Map 3 – Inundation Map Boston Lot Dam
Map Set 4 – Moore Dam Inundation Area
Map Set 5 – Comerford Dam Inundation Areas
Map Set 6 – Wilder Dam Inundation Areas
Map 7 – Erosion Hazard Areas
Map 8 – Hazardous Materials Spill Risk Areas
Map 9 – Critical Facilities

Appendix E: **Plan Approval Documents**

APPENDIX A:

TECHNICAL RESOURCES

1) Agencies

New Hampshire Homeland Security & Emergency Management 271-2231
Federal Emergency Management Agency .....(617) 223-4175
NH Regional Planning Commissions:
  Upper Valley Lake Sunapee Regional Planning Commission 448-1680
NH Executive Department:
  Governor's Office of Energy and Community Services 271-2611
  New Hampshire Office of State Planning 271-2155
NH Department of Cultural Affairs: 271-2540
  Division of Historical Resources 271-3483
NH Department of Environmental Services: 271-3503
  Air Resources 271-1370
  Waste Management 271-2900
  Water Resources 271-3406
  Water Supply and Pollution Control 271-3504
  Rivers Management and Protection Program 271-1152
NH Office of Energy and Planning 271-2155
NH Municipal Association 224-7447
NH Fish and Game Department 271-3421
NH Department of Resources and Economic Development: 271-2411
  Natural Heritage Inventory 271-3623
  Division of Forests and Lands 271-2214
  Division of Parks and Recreation 271-3255
NH Department of Transportation 271-3734
Northeast States Emergency Consortium, Inc. (NESEC) .....(781) 224-9876
US Department of Commerce:
  National Oceanic and Atmospheric Administration:

National Weather Service; Gray, Maine 207-688-3216

US Department of the Interior:
US Fish and Wildlife Service 225-1411
US Geological Survey 225-4681
US Army Corps of Engineers..... (978) 318-8087
US Department of Agriculture:
Natural Resource Conservation Service 868-7581

2) Mitigation Funding Resources

404 Hazard Mitigation Grant Program (HMGP) ..... NH Homeland Security & Emergency Management
406 Public Assistance and Hazard Mitigation ..... NH Homeland Security & Emergency Management
Community Development Block Grant (CDBG)..... NH Homeland Security, NH OEP, also refer to RPC
Dam Safety Program ..... NH Department of Environmental Services
Disaster Preparedness Improvement Grant (DPIG) ..... NH Homeland Security & Emergency Management
Emergency Generators Program by NESEC‡ ..... NH Homeland Security & Emergency Management
Emergency Watershed Protection (EWP) Program ..... USDA, Natural Resources Conservation Service
Flood Mitigation Assistance Program (FMAP) ..... NH Homeland Security & Emergency Management
Flood Plain Management Services (FPMS) ..... US Army Corps of Engineers
Mitigation Assistance Planning (MAP) ..... NH Homeland Security & Emergency Management
Mutual Aid for Public Works..... NH Municipal Association
National Flood Insurance Program (NFIP) † ..... NH Office of Energy and Planning
Power of Prevention Grant by NESEC‡ ..... NH Homeland Security & Emergency Management
Project Impact..... NH Homeland Security & Emergency Management
Roadway Repair & Maintenance Program(s) ..... NH Department of Transportation
Section 14 Emergency Stream Bank Erosion & Shoreline Protection..... US Army Corps of Engineers
Section 103 Beach Erosion..... US Army Corps of Engineers
Section 205 Flood Damage Reduction..... US Army Corps of Engineers
Section 208 Snagging and Clearing ..... US Army Corps of Engineers
Shoreland Protection Program..... NH Department of Environmental Services
Various Forest and Lands Program(s)..... NH Department of Resources and Economic Development
Wetlands Programs..... …..NH Department of Environmental Services

‡NESEC – Northeast States Emergency Consortium, Inc. is a 501(c)(3), not-for-profit natural disaster, multi-hazard mitigation and emergency management organization located in Wakefield, Massachusetts. Please, contact NH OEM for more information.

† Note regarding National Flood Insurance Program (NFIP) and Community Rating System (CRS):
The National Flood Insurance Program has developed suggested floodplain management activities for those communities who wish to more thoroughly manage or reduce the impact of flooding in their jurisdiction. Through use of a rating system (CRS rating), a community's floodplain management efforts can be evaluated for effectiveness. The rating, which indicates an above average floodplain management effort, is then factored into the premium cost for flood insurance policies sold in the community. The higher the rating achieved in that community, the greater the reduction in flood insurance premium costs for local property owners. The NH Office of State Planning can provide additional information regarding participation in the NFIP-CRS Program.

3) Websites

Sponsor	Internet Address	Summary of Contents
Natural Hazards Research Center, U. of Colorado	http://www.colorado.edu/litbase/hazards/	Searchable database of references and links to many disaster-related websites.
Atlantic Hurricane Tracking Data by Year	http://wxp.eas.purdue.edu/hurricane	Hurricane track maps for each year, 1886 – 1996
National Emergency Management Association	http://nemaweb.org	Association of state emergency management directors; list of mitigation projects.
NASA – Goddard Space Flight Center "Disaster Finder:	http://www.gsfc.nasa.gov/ndrd/disaster/	Searchable database of sites that encompass a wide range of natural disasters.
NASA Natural Disaster Reference Database	http://ltpwww.gsfc.nasa.gov/ndrd/main/html	Searchable database of worldwide natural disasters.
U.S. State & Local Gateway	http://www.statelocal.gov/	General information through the federal-state partnership.
National Weather Service	http://nws.noaa.gov/	Central page for National Weather Warnings, updated every 60 seconds.
USGS Real Time Hydrologic Data	http://h20.usgs.gov/public/realtime.html	Provisional hydrological data
Dartmouth Flood Observatory	http://www.dartmouth.edu/artsci/geog/floods/	Observations of flooding situations.
FEMA, National Flood Insurance Program, Community Status Book	http://www.fema.gov/fema/csb.htm	Searchable site for access of Community Status Books

Sponsor	Internet Address	Summary of Contents
Florida State University Atlantic Hurricane Site	http://www.met.fsu.edu/explores/tropical.html	Tracking and NWS warnings for Atlantic Hurricanes and other links
National Lightning Safety Institute	http://lightningsafety.com/	Information and listing of appropriate publications regarding lightning safety.
NASA Optical Transient Detector	http://www.ghcc.msfc.nasa.gov/otd.html	Space-based sensor of lightning strikes
LLNL Geologic & Atmospheric Hazards	http://wwwep.es.llnl.gov/wwwep/ghp.html	General hazard information developed for the Dept. of Energy.
The Tornado Project Online	http://www.tornadoroject.com/	Information on tornadoes, including details of recent impacts.
National Severe Storms Laboratory	http://www.nssl.uoknor.edu/	Information about and tracking of severe storms.
Independent Insurance Agents of America IIAA Natural Disaster Risk Map	http://www.iiaa.iix.com/ndcmap.htm	A multi-disaster risk map.
Earth Satellite Corporation	http://www.earthsat.com/	Flood risk maps searchable by state.
USDA Forest Service Web	http://www.fs.fed.us/land	Information on forest fires and land management.

APPENDIX B:
HAZARD MITIGATION ASSISTANCE GRANTS

Hazard Mitigation Assistance (HMA) grant programs of the Department of Homeland Security (DHS) Federal Emergency Management Agency (FEMA), presents a critical opportunity to protect individuals and property from natural hazards while simultaneously reducing reliance on Federal disaster funds. The HMA programs provide pre-disaster mitigation grants annually to local communities. The statutory origins of the programs differ, but all share the common goal of reducing the loss of life and property due to natural hazards. Eligible applicants include State-level agencies including State institutions; Federally recognized Indian Tribal governments; Public or Tribal colleges or universities (PDM only); and Local jurisdictions that are participating in the National Flood Insurance Program (NFIP).

The HMA grant assistance includes four programs:

1. *The Pre-Disaster Mitigation (PDM) program*: This provides funds for hazard mitigation planning and the implementation of mitigation projects prior to a disaster event. Funding these plans and projects reduces overall risks to the population and structures, while also reducing reliance on funding from actual disaster declarations. PDM grants are awarded on a competitive basis.

2. *The Flood Mitigation Assistance (FMA) program*: This provides funds so that cost-effective measures can be taken to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insured under the NFIP. The long-term goal of FMA is to reduce or eliminate claims under the NFIP through mitigation activities.

3. *The Repetitive Flood Claims (RFC) program*: This program provides funding to reduce of eliminate the long-term risk of flood damage to structures insured by NFIP that have had one or more claim payments for flood damages. The long-term goal of the RFC program is to reduce or eliminate claims under the NFIP through mitigation activities that are in the best interest of the NFIP.

4. *The Severe Repetitive Loss (SRL) program*: This program provides funding to reduce or eliminate the long-term risk of flood damage to severe repetitive loss residential structures insured under the NFIP.

Potential eligible projects are shown in the following table by grant program. For further information on these programs visit the following FEMA websites:

PDM – www.fema.gov/government/grant/pdm/

FMA – www.fema.gov/government/grant/fma

RFC – www.fema.gov/government/grant/rfc

SRL – www.fema.gov/government/grant/srl

Mitigation Project:	PDM	FMA	RFC	SRL
1. Property Acquisition and Demolition or Relocation Project				
Property Elevation	**X**	**X**	**X**	**X**
2. Construction Type Projects				
Property Elevation	**X**	**X**	**X**	**X**
Mitigation Reconstruction[1]				**X**
Localized Minor Flood Reduction Projects	**X**	**X**	**X**	**X**
Dry Flood proofing of Residential Property[2]		**X**		**X**
Dry Flood proofing of Non-residential Structures		**X**	**X**	
Stormwater Management	**X**	**X**		
Infrastructure Protection Measure	**X**			
Vegetative Management/Soil Stabilization	**X**			
Retrofitting Existing Buildings and Facilities (Wind/Earthquake)	**X**			
Safe room construction	**X**			
3. Non-construction Type Projects				
All Hazard/Flood Mitigation Planning	**X**	**X**		

1. The SLR Program allows Mitigation Reconstruction projects located outside the regulatory floodway or Zone V as identified on the effective Flood Insurance Rate Map (FIRM), or the mapped limit of the 1.5-foot breaking wave zone. Mitigation Reconstruction is only permitted if traditional elevation cannot be implemented.
2. The residential structure must meet the definition of "Historic Structure" in 44 CFR§59.1.

Source: "Hazard Mitigation Assistance Program Guidance," FEMA, June 19, 2008

Appendix C

Meeting Documentation

AGENDAS:

Meeting # 1: September 10, 2008 (1 hour)

- Discuss requirements of update
- Membership of Hazard Mitigation Committee
- Determine City personnel to obtain updated information for recent hazard events and value of structures within hazard areas

Meeting #2 August 24, 2009 (3 hours)

- Identify and map past/potential hazards (update map and lists in Appendix D & Section II)
- Identify areas all structures which could be damaged within above areas
- Potential development areas in City (especially in hazard areas)
- Identify critical facilities (update map and App. D)
- Identify hazard mitigation efforts already in place (update)
- Identify gaps in the current mitigation efforts/programs (update)
- Review previously determined potential mitigation efforts (were they implemented? If not, are they still on the table to be implemented?)
- Brainstorm potential mitigation efforts

Meeting #3 September 16, 2009 (3 hours)

- Evaluate the past and potential mitigation efforts
- Develop a prioritized implementation schedule and discuss the adoption and monitoring of the plan

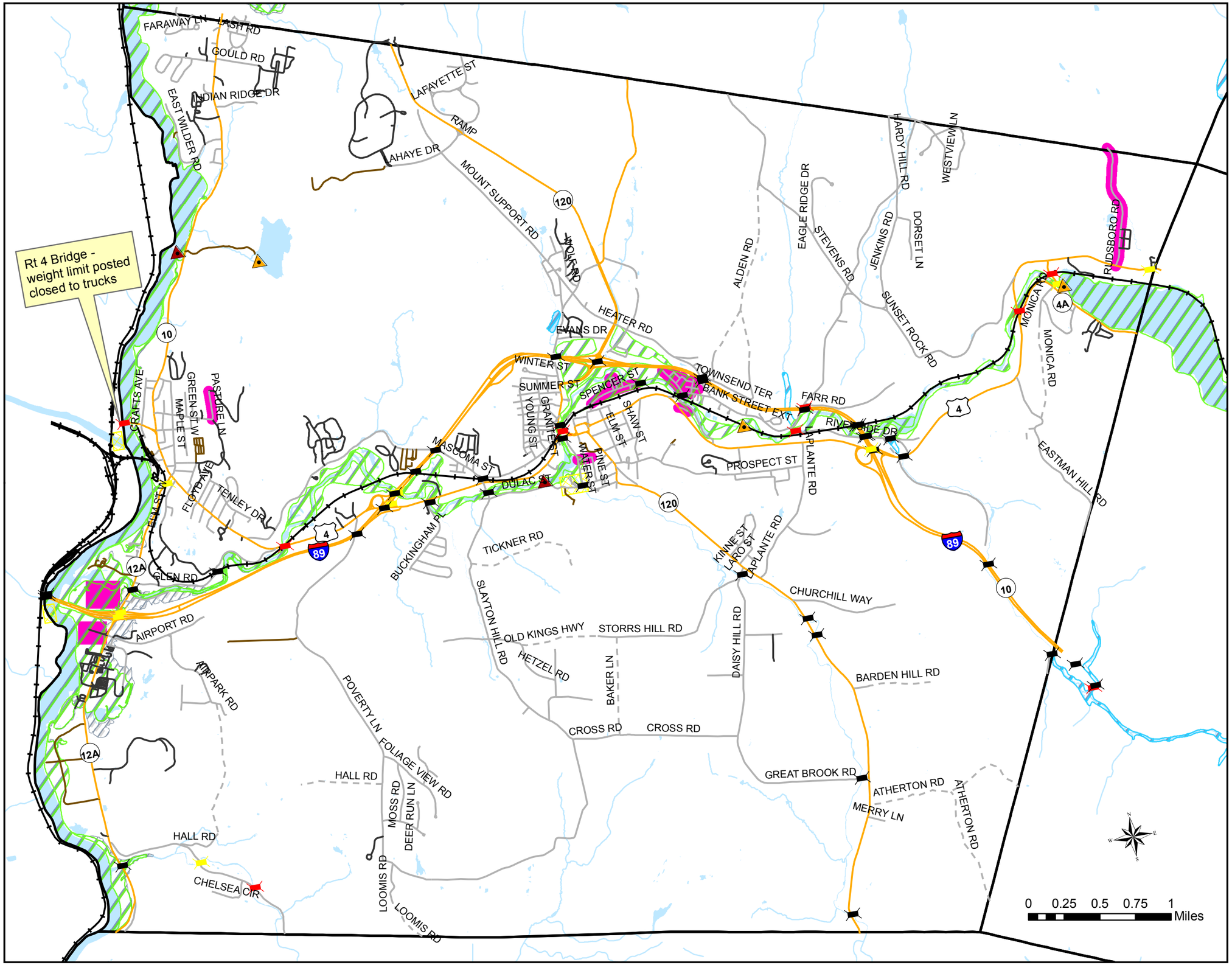
Meeting #3 October 26, 2009 (2 hour)

- Review and revise draft plan

APPENDIX D

Maps

Map 1. Floodplains and Flood-Prone Areas Lebanon, NH



Legend

Dams by Hazard Class
- High hazard potential
- Significant hazard potential

Bridges by Condition
- Red List: More Frequent Inspection Required
- Structurally Deficient or Functionally Obsolete
- Other Bridges

Transportation
- Railroads

Roadways
- State and Interstate Highway
- City Roads (Class V)
- Class VI
- Public Works Access
- Private Roads/Driveways

Political Boundaries
- Town Lines
- Ice Jam Area

Floodplains, FEMA
- 100-Yr Floodplain, Zone A
- 100-Yr Floodplain, Zone AE
- 500- Year Flood Plain, FEMA

Flood-Prone Areas
- Areas ID'd by City Public Works Dept

Waterbodies
- Lake or Pond; River or Stream
- Streams

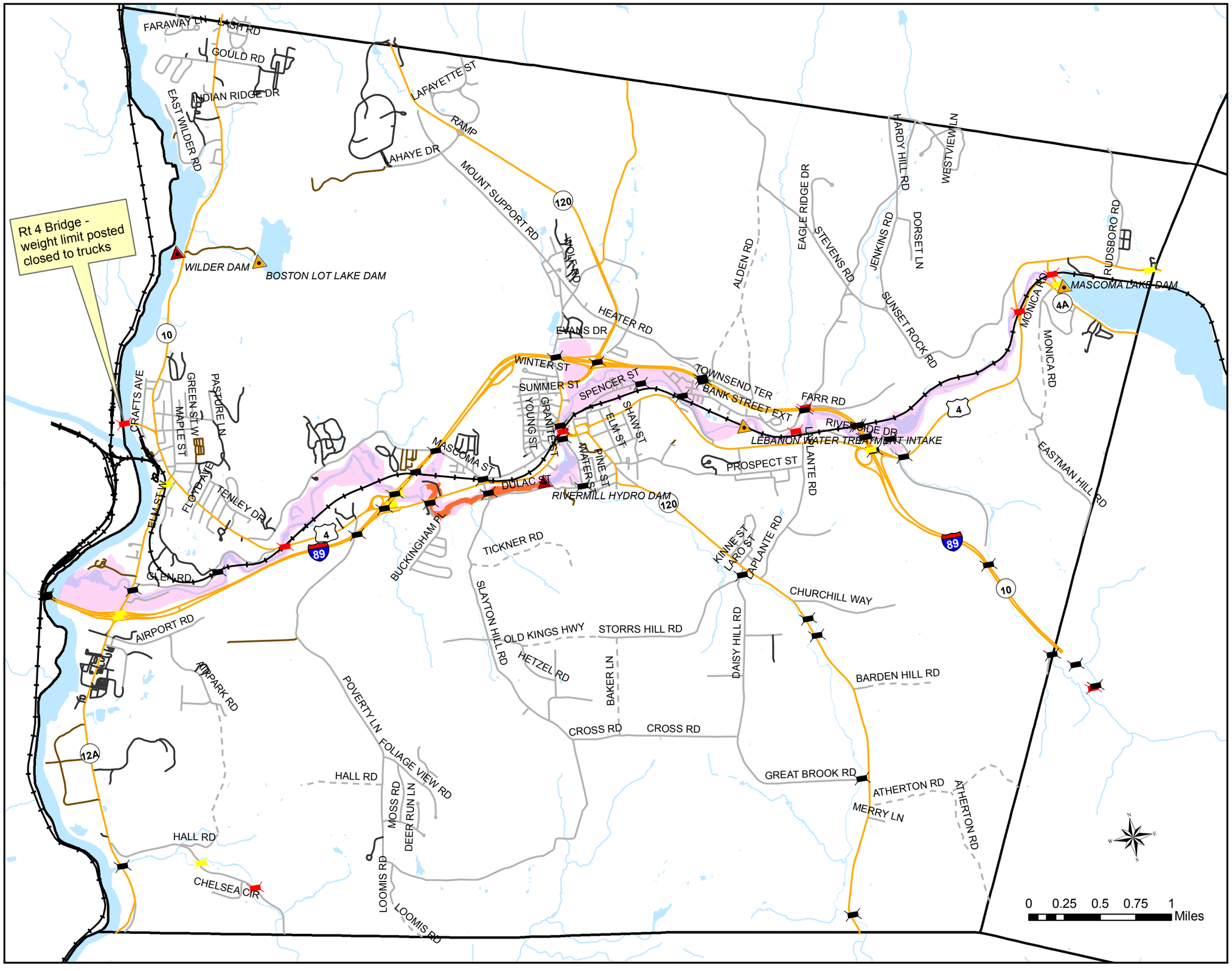
DATA SOURCES:
Roads and Waterbodies from City of Lebanon.
Town lines and railroads from NH GRANIT at the University of New Hampshire.
Floodplains from FEMA's dFIRMs for Grafton County, 2008, distributed by NH GRANIT.
Ice jam areas identified by Cold Regions Research and Environmental Lab, US Army Corps of Engineers, various dates.
Flood-prone locations identified by City of Lebanon staff, 2009.
Bridge locations from NHDOT, condition last updated April 2008.
Dams from NHDES Dam Bureau, date of last update unknown.

Disclaimer: No claim is made as to the the validity of reliability or to any implied uses of these data.

UVLSRPC

Map created by Upper Valley Lake Sunapee Regional Planning Commission for the City of Lebanon, Hazard Mitigation Plan, 2009.

Map 2. Flooded Areas In Event of Failure of Mascoma Lake Dam & Rivermill Hydro Dam Lebanon, NH



Legend

Area Flooded in Case of Dam Failure 100-Year Conditions
- Mascoma Lake Dam 134.01
- Rivermill Hydro Dam 134.09

Political Boundaries
- Town Lines

Transportation
- Railroads

Roadways
- State and Interstate Highway
- City Roads (Class V)
- Class VI
- Public Works Access
- Private Roads/Driveways

Dams by Hazard Class
- High hazard potential
- Significant hazard potential

Bridges by Condition
- Red List: More Frequent Inspection Required
- Structurally Deficient or Functionally Obsolete
- Other Bridges

Waterbodies
- Lake or Pond; River or Stream
- Streams

DATA SOURCES:
Roads and Waterbodies from City of Lebanon.
Town lines and railroads from NH GRANIT at the University of New Hampshire.
Bridge locations from NHDOT, condition last updated April 2008.
Dams and inundation areas from NHDES Dam Bureau, date of last update unknown.

Disclaimer: No claim is made as to the the validity of reliability or to any implied uses of these data.

UVLSRPC

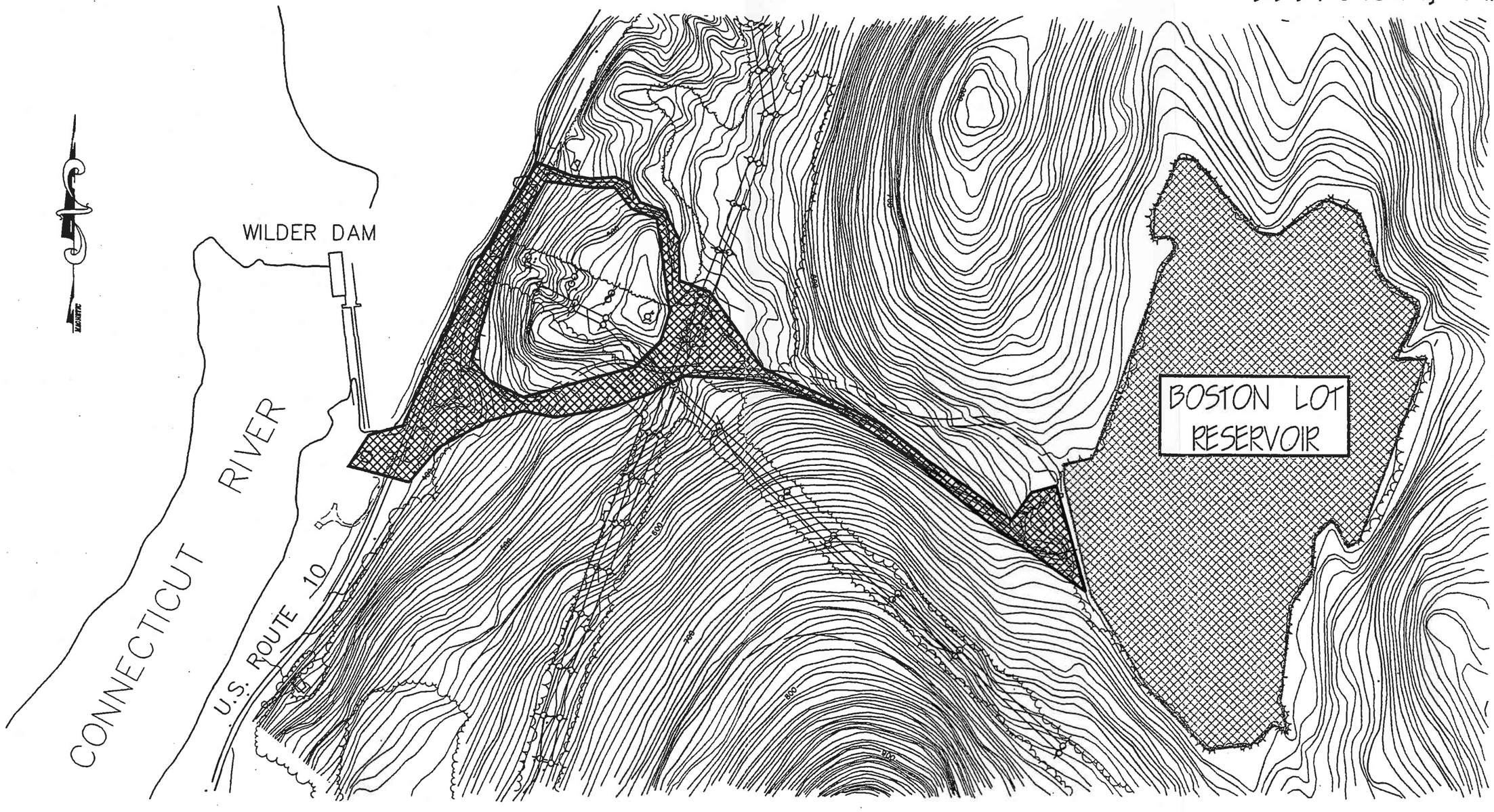
Map created by Upper Valley Lake Sunapee Regional Planning Commission for the City of Lebanon, Hazard Mitigation Plan, 2009.

INUNDATION MAP
BOSTON LOT DAM
LEBANON, NH

LEGEND

INUNDATION AREA

RESERVOIR AREA



See Sheet 12

Norwich

Goodrich Four Corners Rd

5

10

91

25. Hanover		68.9 Miles
	Sunny Day	PMF
Arrival Time:	5.6 Hrs.	606 Hrs.
Peak Flood Time:	21.1 Hrs.	21.1 Hrs.
Peak Elevation:	389.8 Ft.	406.3 Ft.

Hanover

So. Main St

Connecticut River

Mink Brook

26

Hartford

Oakridge Rd

10

Boston and Maine Railroad

Lebanon

See Sheet 14

Moore Development

- Dams
- Bridges
- Cross Section
- Roads
- Powerlines
- Railroads
- Streams
- Town Lines
- Structures
- Water
- Sunny Day
- PMF
- Towns

The inundated areas shown on this map reflect events of an extremely remote nature. These results are not in any way intended to reflect upon the integrity of the Connecticut River Projects.

N

0.25 0 0.25 Miles

Sheet 13 of 41

PG&E Generating

TERRA-MAP
Lebanon, New Hampshire
(603)442-9300

See Sheet 13

PMF inundation ends here on the White River.

West Hartford

White River

Sunny Day inundation ends here on the White River.

27. Wilder Dam — 71.7 Miles

	Sunny Day	PMF
Arrival Time:	5.9 Hrs.	6.9 Hrs.
Peak Flood Time:	21.6 Hrs.	22.6 Hrs.
Peak Elevation:	388.9 Ft.	398.8 Ft.

Hartford

Lebanon

Central Vermont Railway

28. West Lebnon at Gaging Station — 73.3 Miles

	Sunny Day	PMF
Arrival Time:	6 Hrs.	7.8 Hrs.
Peak Flood Time:	22 Hrs.	22.8 Hrs.
Peak Elevation:	356 Ft.	385.5 Ft.

Connecticut River

Main St

Airport Rd

Moore Development

- Dams
- Bridges
- Cross Section
- Roads
- Powerlines
- Railroads
- Streams
- Town Lines
- Structures
- Water
- Sunny Day
- PMF
- Towns

The inundated areas shown on this map reflect events of an extremely remote nature. These results are not in any way intended to reflect upon the integrity of the Connecticut River Projects.

N

0.25 0 0.25 Miles

Sheet 14 of 41

See Sheet 15

PG&E Generating

TERRA-MAP
Lebanon, New Hampshire
(603)442-9300

See Sheet 14

Hartford

Lebanon

Hartland

Plainfield

Plainfield Rd

Brook Rd

Clay Hill Rd

Clay Hill Rd

Central Vermont Railway

River Rd

River Rd

Connecticut River

Beaver Brook

Old County Road

12A

91

5

30

29. Ottauquechee 77.8 Miles

	Sunny Day	PMF
Arrival Time:	7 Hrs.	9 Hrs.
Peak Flood Time:	22.8 Hrs.	23.8 Hrs.
Peak Elevation:	342.1 Ft.	371.4 Ft.

Moore Development

- Dams
- Bridges
- Cross Section
- Roads
- Powerlines
- Railroads
- Streams
- Town Lines
- Structures
- Water
- Sunny Day
- PMF
- Towns

The inundated areas shown on this map reflect events of an extremely remote nature. These results are not in any way intended to reflect upon the integrity of the Connecticut River Projects.

N

0.25 0 0.25 Miles

Sheet 15 of 41

See Sheet 16

PG&E Generating

TERRA-MAP
Lebanon, New Hampshire
(603)442-9300

See Sheet 11

25. Hanover		68.9 Miles
	Sunny Day	PMF
Arrival Time:	6 Hrs.	5.5 Hrs.
Peak Flood Time:	23 Hrs.	14.3 Hrs.
Peak Elevation:	399.3 Ft.	399.3 Ft.

Connecticut River

Hanover

River Rd

West Wheelock Rd

So. Main St

Norwich

Boston and Maine Railroad

Hartford

Connecticut River

Lebanon

See Sheet 13

Comerford Development

- Dams
- Bridges
- Cross Section
- Roads
- Powerlines
- Railroads
- Streams
- Town Lines
- Water
- Structures
- Sunny Day
- PMF
- Towns

The inundated areas shown on this map reflect events of an extremely remote nature. These results are not in any way intended to reflect upon the integrity of the Connecticut River Projects.

N

0.25 0 0.25 Miles

Sheet 12 of 23

PG&E Generating

TERRA-MAP
Lebanon, New Hampshire
(603)442-9300

See Sheet 14

See Sheet 12

27. Wilder Dam — 71.7 Miles

	Sunny Day	PMF
Arrival Time:	7 Hrs.	5.6 Hrs.
Peak Flood Time:	27 Hrs.	14.4 Hrs.
Peak Elevation:	392.6 Ft.	392.6 Ft.

28. West Lebanon at Gaging Station — 73.3 Miles

	Sunny Day	PMF
Arrival Time:	0 Hrs.	10 Hrs.
Peak Flood Time:	0 Hrs.	28.4 Hrs.
Peak Elevation:	0 Ft.	371.2 Ft.

Sunny Day inundation for the Comeford Pool ends at the Wilder Dam.

White River

Hartford

Lebanon

Connecticut River

Central Vermont Railway

Old River Rd

Boston and Maine Railroad

Main St

Mill St

Plainfield Rd

Comerford Development

- Dams
- Bridges
- Cross Section
- Roads
- Powerlines
- Railroads
- Streams
- Town Lines
- Water
- Structures
- Sunny Day
- PMF
- Towns

The inundated areas shown on this map reflect events of an extremely remote nature. These results are not in any way intended to reflect upon the integrity of the Connecticut River Projects.

N

0.25 0 0.25 Miles

Sheet 13 of 23

See Sheet 15

PG&E Generating

TERRA-MAP
Lebanon, New Hampshire
(603)442-9300

See Sheet 13

29. Ottauquechee 77.8 Miles

	Sunny Day	PMF
Arrival Time:	0 Hrs.	12 Hrs.
Peak Flood Time:	0 Hrs.	29 Hrs.
Peak Elevation:	0 Ft.	361.1 Ft.

Hartford

Lebanon

Hartland

Plainfield

Connecticut River

Central Vermont Railway

Plainfield Rd

Black Hill Rd

River Rd

91 5 12 30

See Sheet 16

Comerford Development

- Dams
- Bridges
- Cross Section
- Roads
- Powerlines
- Railroads
- Streams
- Town Lines
- Water
- Structures
- Sunny Day
- PMF
- Towns

The inundated areas shown on this map reflect events of an extremely remote nature. These results are not in any way intended to reflect upon the integrity of the Connecticut River Projects.

N

0.25 0 0.25 Miles

Sheet 15 of 23

PG&E Generating

TERRA-MAP
Lebanon, New Hampshire
(603)442-9300

See Sheet 1

27. Wilder Dam 71.8 Miles

	Sunny Day	PMF
Arrival Time:	0 Hrs.	0 Hrs.
Peak Flood Time:	1.9 Hrs.	0 Hrs.
Peak Elevation:	354 Ft.	407.6 Ft.

Sunny Day inundation ends here on the White River for the Wilder Pool.

28. West Lebanon at Gaging Station 73.3 Miles

	Sunny Day	PMF
Arrival Time:	0.3 Hrs.	0.2 Hrs.
Peak Flood Time:	2.2 Hrs.	1.3 Hrs.
Peak Elevation:	348 Ft.	394.3 Ft.

Wilder Development

- Dams
- Bridges
- Cross Section
- Roads
- Powerlines
- Railroads
- Streams
- Town Lines
- Structures
- Water
- Sunny Day
- PMF
- Towns

The inundated areas shown on this map reflect events of an extremely remote nature. These results are not in any way intended to reflect upon the integrity of the Connecticut River Projects.

N

0.25 0 0.25 Miles

Sheet 2 of 8

See Sheet 3

PG&E Generating

TERRA-MAP
Lebanon, New Hampshire
(603)442-9300

See Sheet 2

Hartford

Lebanon

Plainfield

Hartland

Clay Hill Rd

Plainfield Rd

Clay Hill Rd

Connecticut River

River Rd

Central Vermont Railway

Pierce Rd

Black Hill Rd

Old County Rd

Gilson Rd

29. Ottauquechee 77.8 Miles

	Sunny Day	PMF
Arrival Time:	0.7 Hrs.	0.3 Hrs.
Peak Flood Time:	2.7 Hrs.	1.7 Hrs.
Peak Elevation:	335.4 Ft.	379.9 Ft.

See Sheet 4

Wilder Development

- Dams
- Bridges
- Cross Section
- Roads
- Powerlines
- Railroads
- Streams
- Town Lines
- Structures
- Water
- Sunny Day
- PMF
- Towns

The inundated areas shown on this map reflect events of an extremely remote nature. These results are not in any way intended to reflect upon the integrity of the Connecticut River Projects.

N

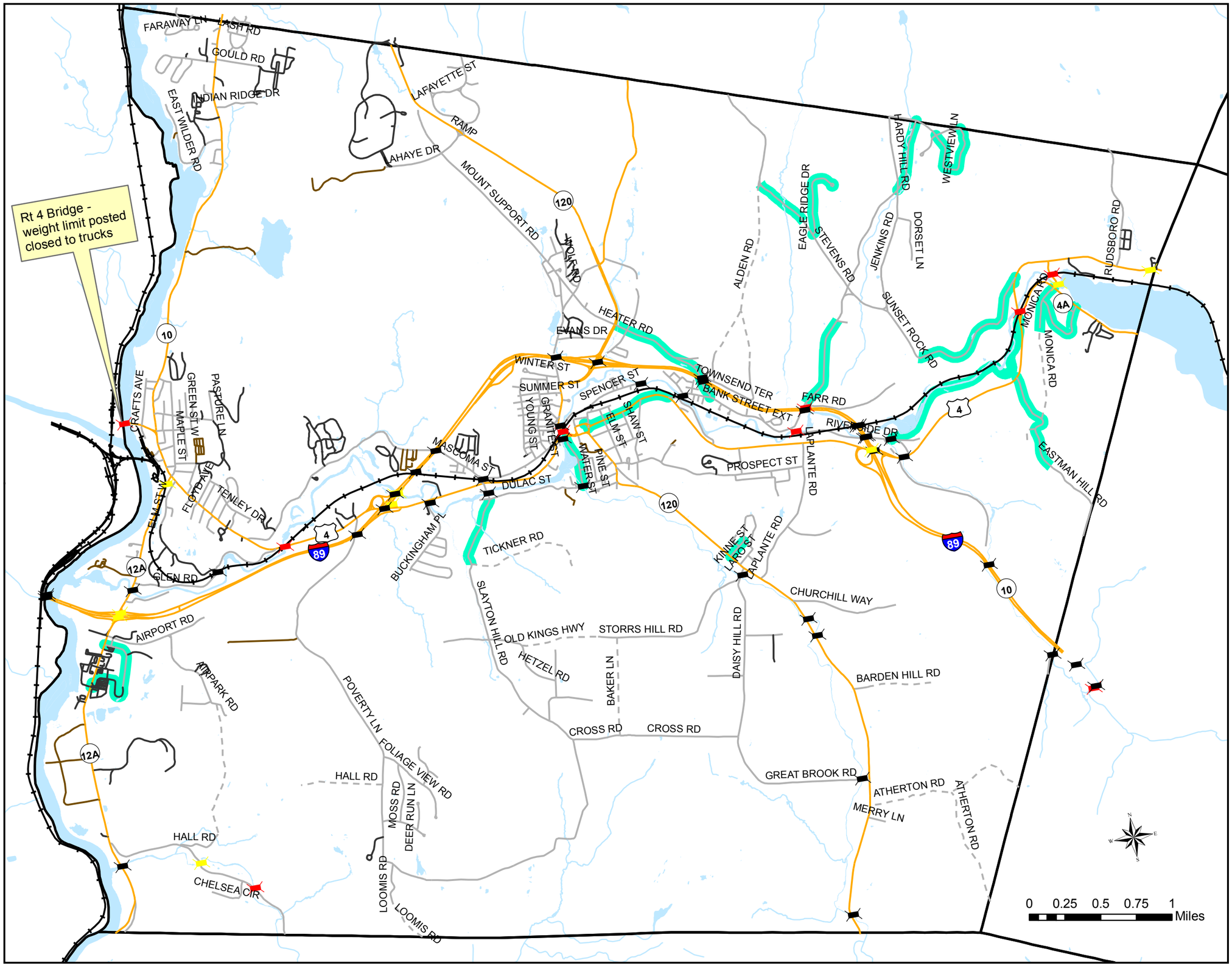
0.25 0 0.25 Miles

Sheet 3 of 8

PG&E Generating

TERRA-MAP
Lebanon, New Hampshire
(603)442-9300

Map 7.
Erosion Hazard Areas
Lebanon, NH



Legend

- Erosion Hazard Areas

Bridges by Condition
- Red List: More Frequent Inspection Required
- Structurally Deficient or Functionally Obsolete
- Other Bridges

Transportation
- Railroads

Roadways
- State and Interstate Highway
- City Roads (Class V)
- Class VI
- Public Works Access
- Private Roads/Driveways

Political Boundaries
- Town Lines

Waterbodies
- Lake or Pond; River or Stream
- Streams

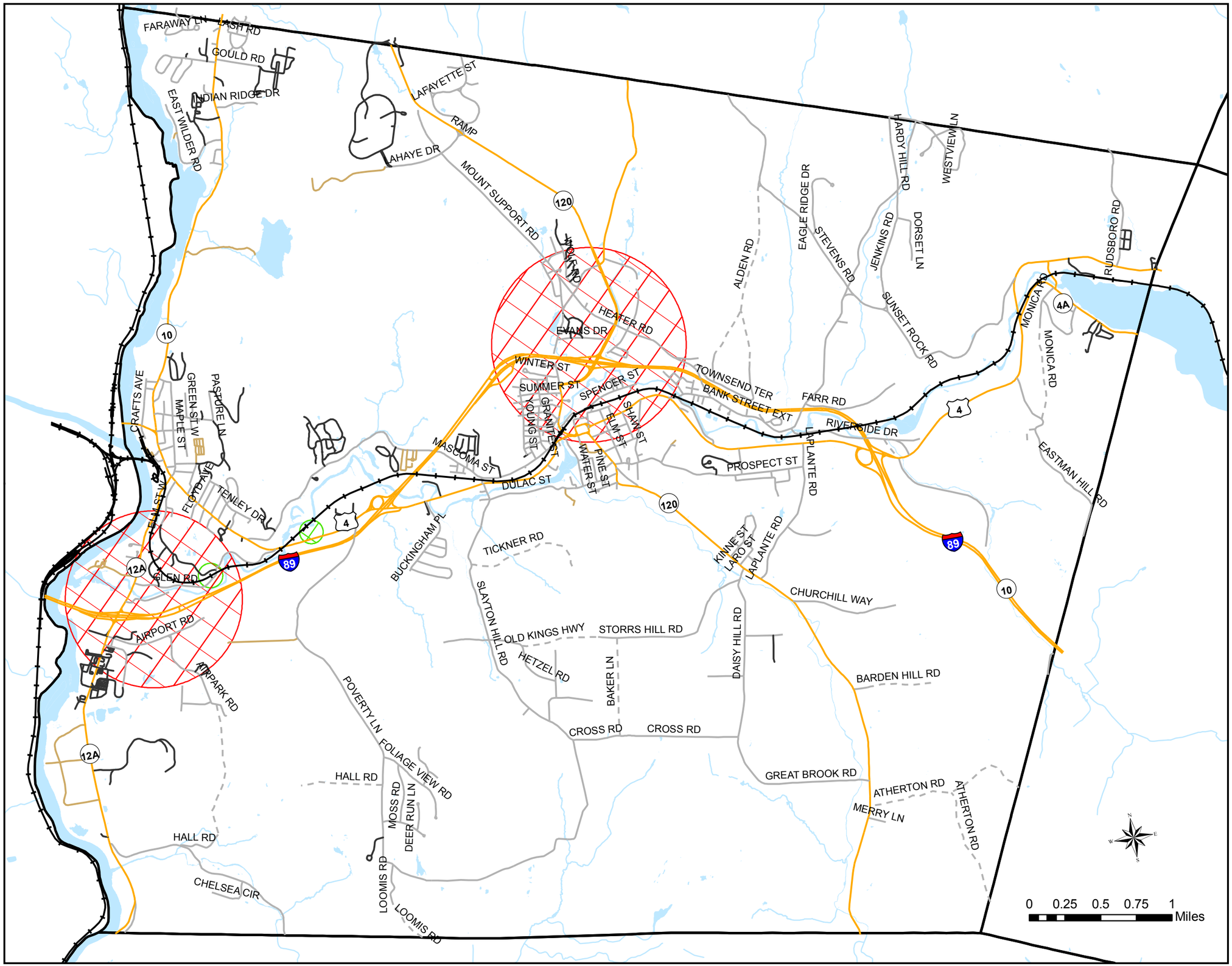
DATA SOURCES:
Roads and Waterbodies from City of Lebanon.
Town lines and railroads from NH GRANIT at the University of New Hampshire.
Erosion-prone locations identified by City of Lebanon Department of Public Works, 2009.
Bridge locations from NHDOT, condition last updated April 2008.

Disclaimer: No claim is made as to the the validity of reliability or to any implied uses of these data.

UVLSRPC

Map created by Upper Valley Lake Sunapee Regional Planning Commission for the City of Lebanon, Hazard Mitigation Plan, 2009.

Map 8.
Hazardous Materials Spill Risk Areas
Lebanon, NH



Legend

Transportation
- Railroads

Roadways
- State and Interstate Highway
- City Roads (Class V)
- Class VI
- Public Works Access
- Private Roads/Driveways

Political Boundaries
- Town Lines

Hazard Areas
- Propane Storage
- High Risk Area for Hazardous Materials Spill

Waterbodies
- Lake, Pond, or River
- Streams

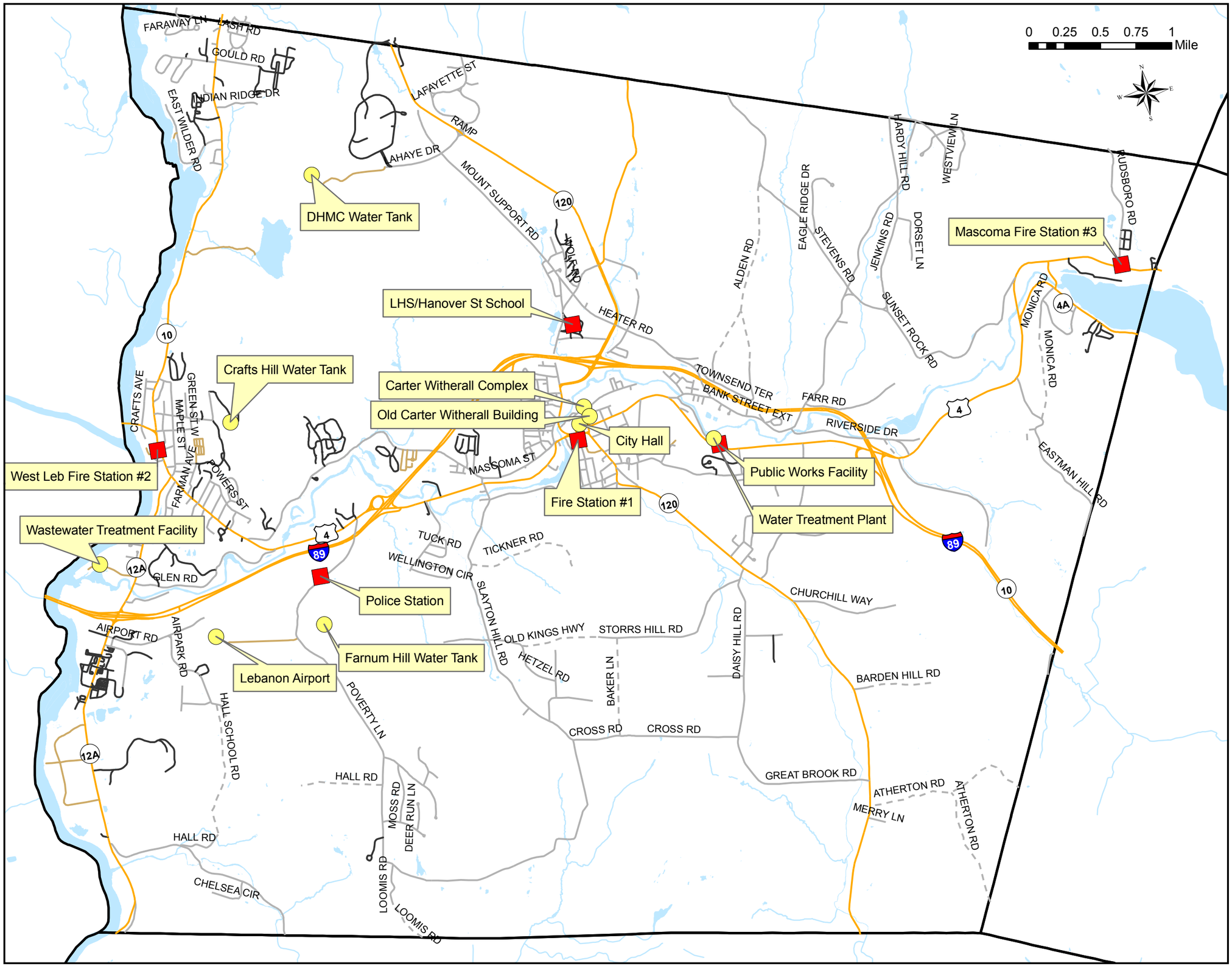
DATA SOURCES:
Roads and Waterbodies from City of Lebanon.
Town lines and railroads from NH GRANIT at the University of New Hampshire.
Hazard areas identified by Lebanon Hazard Mitigation Committee, 2002.

Disclaimer: No claim is made as to the the validity of reliability or to any implied uses of these data.

UVLSRPC

Map created by Upper Valley Lake Sunapee Regional Planning Commission for the City of Lebanon, Hazard Mitigation Plan, 2009.

Map 9.
Critical Facilities
Lebanon, NH



Legend

Critical Facilities
- Emergency Response
- Non-Emergency Response

Roadways
- State and Interstate Highway
- City Roads (Class V)
- Class VI
- Public Works Access
- Private Roads/Driveways

Political Boundaries
- Town Lines

Waterbodies
- Lake, Pond, or River
- Streams

DATA SOURCES:
Roads and Waterbodies from City of Lebanon.
Town lines and railroads from NH GRANIT at the University of New Hampshire.
Critical facilities identified by Lebanon Hazard Mitigation Committee, 2009.

Disclaimer: No claim is made as to the the validity of reliability or to any implied uses of these data.

UVLSRPC

Map created by Upper Valley Lake Sunapee Regional Planning Commission for the City of Lebanon, Hazard Mitigation Plan, 2009.

APPENDIX E

Plan Approval Documents

From:	Daly, Mark
To:	councilortuttleward1@myfairpoint.net;
cc:	vdavis@uvlsrpc.org; Hilliard, Marilyn; Johnson, Nan; Ndikum-Nyada, Brigitte; Verville, Richard (OGA); Lance D. Harbour;
Subject:	Lebanon, NH Hazard Mitigation Plan Conditional Approval
Date:	Monday, July 26, 2010 3:11:06 PM

Good afternoon The Honorable Mayor Tuttle,

FEMA Region I has completed the review for the Town of Lebanon's Hazard Mitigation Plan Update. The plan meets the local mitigation planning requirements under 44CFR 201 pending receipt of the adoption documentation and a final electronic copy of the plan. Acceptable electronic formats include a *.doc* or *.pdf* file and may be submitted to us on a CD. Upon receipt of these documents, a formal letter of approval will be issued, along with the final crosswalk.

The FEMA letter of approval will confirm the Town of Lebanon's eligibility to apply for Mitigation Grants administered by FEMA and identify related issues affecting eligibility, if any. If the plan is not adopted within one calendar year of FEMA's conditional approval, the jurisdiction must update the entire plan and resubmit it for FEMA review. If you have questions or wish to discuss this determination further, please contact Marilyn Hilliard at marilyn.hilliard@dhs.gov or 617-956-7536.

Thank you for submitting this plan update and congratulations on the successful community planning efforts by the Town of Lebanon.

Best Regards,

Mark Daly
FEMA Region I
99 High Street
Boston, MA 02110

617-956-7610
Mitigation Division

City of Lebanon

51 North Park Street
Lebanon, New Hampshire 03766

RESOLUTION

WHEREAS, the City of Lebanon received assistance from the Upper Valley Lake Sunapee Regional Planning Commission through funding from NH Homeland Security and Emergency Management to prepare a Hazard Mitigation Plan; and

WHEREAS, several planning meetings to develop the Hazard Mitigation Plan were held between August and October, 2009 and then presented to the City Council for review and discussion on August 18, 2010; and

WHEREAS, the LEBANON Hazard Mitigation Plan contains several potential future projects to mitigate the hazard damage in the City of Lebanon; and

WHEREAS, the City Council held a public meeting on August 18, 2010 to formally approve and adopt the LEBANON Hazard Mitigation Plan.

NOW, THEREFORE BE IT RESOLVED that the LEBANON City Council hereby approves and adopts the LEBANON Hazard Mitigation Plan as presented in the August 18, 2010 City Council Agenda Packet.

APPROVED and SIGNED this 18th day of August, 2010.

CITY OF LEBANON
City Council

Georgia A Tuttle, Mayor

(City Seal)

ATTEST:

LOCAL MITIGATION PLAN REVIEW CROSSWALK

INSTRUCTIONS FOR USING THE PLAN REVIEW CROSSWALK FOR REVIEW OF LOCAL MITIGATION PLANS

Attached is a Plan Review Crosswalk based on the ***Local Multi-Hazard Mitigation Planning Guidance***, published by FEMA in July, 2008. This Plan Review Crosswalk is consistent with the *Robert T. Stafford Disaster Relief and Emergency Assistance Act* (Stafford Act), as amended by Section 322 of the *Disaster Mitigation Act of 2000* (P.L. 106-390), the *National Flood Insurance Act of 1968,* as amended by the *National Flood Insurance Reform Act of 2004* (P.L. 108-264) and *44 Code of Federal Regulations (CFR) Part 201 – Mitigation Planning,* inclusive of all amendments through October 31, 2007.

SCORING SYSTEM
N – Needs Improvement: The plan does not meet the minimum for the requirement. Reviewer's comments must be provided.
S – Satisfactory: The plan meets the minimum for the requirement. Reviewer's comments are encouraged, but not required.

Each requirement includes separate elements. All elements of a requirement must be rated "Satisfactory" in order for the requirement to be fulfilled and receive a summary score of "Satisfactory." A "Needs Improvement" score on elements shaded in gray (recommended but not required) will not preclude the plan from passing.

When reviewing single jurisdiction plans, reviewers may want to put an N/A in the boxes for multi-jurisdictional plan requirements. When reviewing multi-jurisdictional plans, however, all elements apply. States that have additional requirements can add them in the appropriate sections of the *Local Multi-Hazard Mitigation Planning Guidance* or create a new section and modify this Plan Review Crosswalk to record the score for those requirements. Optional matrices for assisting in the review of sections on profiling hazards, assessing vulnerability, and identifying and analyzing mitigation actions are found at the end of the Plan Review Crosswalk.

The example below illustrates how to fill in the Plan Review Crosswalk.:

Assessing Vulnerability: Overview

Requirement §201.6(c)(2)(ii): *[The risk assessment **shall** include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description **shall** include an overall summary of each hazard and its impact on the community.*

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A. Does the **new or updated** plan include an **overall summary** description of the jurisdiction's **vulnerability** to each hazard?	Section II, pp. 4-10	The plan describes the types of assets that are located within geographically defined hazard areas as well as those that would be affected by winter storms.		□
B. Does the **new or updated** plan address the **impact** of each hazard on the jurisdiction?	Section II, pp. 10-20	The plan does not address the impact of two of the five hazards addressed in the plan. **Required Revisions:** • Include a description of the impact of floods and earthquakes on the assets. **Recommended Revisions:** This information can be presented in terms of dollar value or percentages of damage.	□	
		SUMMARY SCORE	□	

LOCAL MITIGATION PLAN REVIEW SUMMARY

The plan cannot be approved if the plan has not been formally adopted. Each requirement includes separate elements. All elements of the requirement must be rated "Satisfactory" in order for the requirement to be fulfilled and receive a score of "Satisfactory." Elements of each requirement are listed on the following pages of the Plan Review Crosswalk. A "Needs Improvement" score on elements shaded in gray (recommended but not required) will not preclude the plan from passing. Reviewer's comments must be provided for requirements receiving a **"Needs Improvement"** score.

Prerequisite(s) (Check Applicable Box)	**NOT MET**	**MET**
1. Adoption by the Local Governing Body: §201.6(c)(5) OR		
2. Multi-Jurisdictional Plan Adoption: §201.6(c)(5) **AND**		
3. Multi-Jurisdictional Planning Participation: §201.6(a)(3)		

Planning Process	**N**	**S**
4. Documentation of the Planning Process: §201.6(b) and §201.6(c)(1)		

Risk Assessment	**N**	**S**
5. Identifying Hazards: §201.6(c)(2)(i)		
6. Profiling Hazards: §201.6(c)(2)(i)		
7. Assessing Vulnerability: Overview: §201.6(c)(2)(ii)		
8. Assessing Vulnerability: Addressing Repetitive Loss Properties. §201.6(c)(2)(ii)		
9. Assessing Vulnerability: Identifying Structures, Infrastructure, and Critical Facilities: §201.6(c)(2)(ii)(B)		
10. Assessing Vulnerability: Estimating Potential Losses: §201.6(c)(2)(ii)(B)		
11. Assessing Vulnerability: Analyzing Development Trends: §201.6(c)(2)(ii)(C)		
12. Multi-Jurisdictional Risk Assessment: §201.6(c)(2)(iii)		

*States that have additional requirements can add them in the appropriate sections of the *Local Multi-Hazard Mitigation Planning Guidance* or create a new section and modify this Plan Review Crosswalk to record the score for those requirements.

SCORING SYSTEM

Please check one of the following for each requirement.

N – Needs Improvement: The plan does not meet the minimum for the requirement. Reviewer's comments must be provided.

S – Satisfactory: The plan meets the minimum for the requirement. Reviewer's comments are encouraged, but not required.

Mitigation Strategy	**N**	**S**
13. Local Hazard Mitigation Goals: §201.6(c)(3)(i)		
14. Identification and Analysis of Mitigation Actions: §201.6(c)(3)(ii)		
15. Identification and Analysis of Mitigation Actions: NFIP Compliance. §201.6(c)(3)(ii)		
16. Implementation of Mitigation Actions: §201.6(c)(3)(iii)		
17. Multi-Jurisdictional Mitigation Actions: §201.6(c)(3)(iv)		

Plan Maintenance Process	**N**	**S**
18. Monitoring, Evaluating, and Updating the Plan: §201.6(c)(4)(ii)		
19. Incorporation into Existing Planning Mechanisms: §201.6(c)(4)(ii)		
20. Continued Public Involvement: §201.6(c)(4)(iii)		

Additional State Requirements*	**N**	**S**
Insert State Requirement		
Insert State Requirement		
Insert State Requirement		

LOCAL MITIGATION PLAN APPROVAL STATUS

PLAN NOT APPROVED	
See Reviewer's Comments	
PLAN APPROVED	

LOCAL MITIGATION PLAN REVIEW CROSSWALK

Local Mitigation Plan Review and Approval Status

Jurisdiction: City of Lebanon, New Hampshire	**Title of Plan:** Lebanon Hazard Mitigation Plan	**Date of Plan:** November 2009
Local Point of Contact: Victoria Davis	**Address:** 30 Bank Street Lebanon, NH 03766	
Title: Planner		
Agency: Upper Valley Lake Sunapee Regional Planning Commission		
Phone Number: 603-448-1680	**E-Mail:** vdavis@uvlsrpc.org	

State Reviewer:	**Title:**	**Date:**

FEMA Reviewer:	**Title:**	**Date:**
Date Received in FEMA Region [Insert #]		
Plan Not Approved		
Plan Approved		
Date Approved		

Jurisdiction:	**DFIRM**		**NFIP Status***			
	In Plan	**NOT in Plan**	**Y**	**N**	**N/A**	**CRS Class**
1. City of Lebanon, New Hampshire Current FIRM 2/20/09			x			
2.						
3.						
4.						
5. [ATTACH PAGE(S) WITH ADDITIONAL JURISDICTIONS]						

*** Notes:** **Y = Participating** **N = Not Participating** **N/A = Not Mapped**

LOCAL MITIGATION PLAN REVIEW CROSSWALK

PREREQUISITE(S)

1. Adoption by the Local Governing Body

***Requirement §201.6(c)(5)*:** *[The local hazard mitigation plan **shall** include] documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval of the plan (e.g., City Council, County Commissioner, Tribal Council).*

Element	**Location in the Plan** (section or annex and page #)	Reviewer's Comments	SCORE NOT MET	SCORE MET
A. Has the local governing body adopted **new or updated** plan?				
B. Is supporting documentation, such as a resolution, included?				
		SUMMARY SCORE		

2. Multi-Jurisdictional Plan Adoption

***Requirement §201.6(c)(5)*:** *For multi-jurisdictional plans, each jurisdiction requesting approval of the plan **must** document that it has been formally adopted.*

Element	**Location in the Plan** (section or annex and page #)	Reviewer's Comments	SCORE NOT MET	SCORE MET
A. Does the **new or updated** plan indicate the specific jurisdictions represented in the plan?				
B. For each jurisdiction, has the local governing body adopted the **new or updated** plan?				
C. Is supporting documentation, such as a resolution, included for each participating jurisdiction?				
		SUMMARY SCORE		

3. Multi-Jurisdictional Planning Participation

***Requirement §201.6(a)(3)*:** *Multi-jurisdictional plans (e.g., watershed plans) may be accepted, as appropriate, as long as each jurisdiction has participated in the process … Statewide plans will not be accepted as multi-jurisdictional plans.*

Element	**Location in the Plan** (section or annex and page #)	Reviewer's Comments	SCORE NOT MET	SCORE MET
A. Does the **new or updated** plan describe **how** each jurisdiction participated in the plan's development?				
B. Does the updated plan identify all participating jurisdictions, including new, continuing, and the jurisdictions that no longer participate in the plan?				
		SUMMARY SCORE		

PLANNING PROCESS: *§201.6(b): An open public involvement process is essential to the development of an effective plan.*

4. Documentation of the Planning Process

Requirement §201.6(b): *In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process **shall** include:*
(1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;
(2) An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process; and
(3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.

Requirement §201.6(c)(1): *[The plan **shall** document] the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.*

Element	**Location in the Plan** (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A. Does the plan provide a narrative description of the process followed to prepare the **new or updated** plan?	pp. 8-9			
B. Does the **new or updated** plan indicate who was involved in the **current** planning process? (For example, who led the development at the staff level and were there any external contributors such as contractors? Who participated on the plan committee, provided information, reviewed drafts, *etc*.?)	p. 11			
C. Does the **new or updated** plan indicate how the public was involved? (Was the public provided an opportunity to comment on the plan during the drafting stage and prior to the plan approval?)	p. 11			
D. **Does the new or updated plan discuss the** opportunity for neighboring communities, agencies, businesses, academia, nonprofits, and other interested parties to be involved in the planning process?	p. 11			
E. Does the planning process describe the review and incorporation, if appropriate, of existing plans, studies, reports, and technical information?	pp. 64-67			
F. Does the updated plan document how the planning team reviewed and analyzed each section of the plan and whether each section was revised as part of the update process?	p. 7-10			
		SUMMARY SCORE		

RISK ASSESSMENT: *§201.6(c)(2): The plan shall include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.*

5. Identifying Hazards

Requirement §201.6(c)(2)(i): *[The risk assessment **shall** include a] description of the type … of all natural hazards that can affect the jurisdiction.*

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A. Does the **new or updated** plan include **a description** of the types of **all natural hazards** that affect the jurisdiction?	pp. 18-45			
		SUMMARY SCORE		

6. Profiling Hazards

Requirement §201.6(c)(2)(i): *[The risk assessment **shall** include a] description of the … location and extent of all natural hazards that can affect the jurisdiction. The plan **shall** include information on previous occurrences of hazard events and on the probability of future hazard events.*

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A. Does the risk assessment identify the **location** (*i.e.*, geographic area affected) of each natural hazard addressed in the **new or updated** plan?	pp. 18-45; Appendix D			
B. Does the risk assessment identify the **extent** (*i.e.*, magnitude or severity) of each hazard addressed in the **new or updated** plan?	pp. 18-45			
C. Does the plan provide information on **previous occurrences** of each hazard addressed in the **new or updated** plan?	pp. 18-45			
D. Does the plan include the **probability of future events** (*i.e.*, chance of occurrence) for each hazard addressed in the **new or updated** plan?	pp. 18-48			
		SUMMARY SCORE		

7. Assessing Vulnerability: Overview

Requirement §201.6(c)(2)(ii): *[The risk assessment **shall** include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description **shall** include an overall summary of each hazard and its impact on the community.*

Element	Location in the **Plan** (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A. Does the **new or updated** plan include an **overall summary** description of the jurisdiction's **vulnerability** to each hazard?	p. 46			
B. Does the **new or updated** plan address the **impact** of each hazard on the jurisdiction?	pp. 18-45			
		SUMMARY SCORE		

8. Assessing Vulnerability: Addressing Repetitive Loss Properties

Requirement §201.6(c)(2)(ii): *[The risk assessment] **must** also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged floods.*

Element	Location in the **Plan** (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A. Does the new or updated plan describe vulnerability in terms of the types and numbers of *repetitive loss properties* located in the identified hazard areas?	p. 27	***Note: This requirement becomes effective for all local plans approved after October 1, 2008.***		
		SUMMARY SCORE		

9. Assessing Vulnerability: Identifying Structures

Requirement §201.6(c)(2)(ii)(A): *The plan **should** describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area … .*

Element	Location in the **Plan** (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A. Does the **new or updated** plan describe vulnerability in terms of the **types and numbers** of **existing** buildings, infrastructure, and critical facilities located in the identified hazard areas?	pp. 49 - 53	***Note: A "Needs Improvement" score on this requirement will not preclude the plan from passing.***		
B. Does the **new or updated** plan describe vulnerability in terms of the **types and numbers** of **future** buildings, infrastructure, and critical facilities located in the identified hazard areas?	p. 54	***Note: A "Needs Improvement" score on this requirement will not preclude the plan from passing.***		
		SUMMARY SCORE		

10. Assessing Vulnerability: Estimating Potential Losses

Requirement §201.6(c)(2)(ii)(B): *[The plan **should** describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate … .*

Element	**Location in the Plan** (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A. Does the **new or updated** plan estimate **potential dollar losses** to vulnerable structures?	p. 49-53; p. 59	***Note: A "Needs Improvement" score on this requirement will not preclude the plan from passing.***		
B. Does the **new or updated** plan describe the **methodology** used to prepare the estimate?	p. 49	***Note: A "Needs Improvement" score on this requirement will not preclude the plan from passing.***		
		SUMMARY SCORE		

11. Assessing Vulnerability: Analyzing Development Trends

Requirement §201.6(c)(2)(ii)(C): *[The plan **should** describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.*

Element	**Location in the Plan** (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A. Does the **new or updated** plan describe land uses and development trends?	pp. 13-14; p. 54; p. 60	***Note: A "Needs Improvement" score on this requirement will not preclude the plan from passing.***		
		SUMMARY SCORE		

12. Multi-Jurisdictional Risk Assessment

Requirement §201.6(c)(2)(iii): *For multi-jurisdictional plans, the risk assessment **must** assess each jurisdiction's risks where they vary from the risks facing the entire planning area.*

Element	**Location in the Plan** (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A. Does the **new or updated** plan include a risk assessment for each participating jurisdiction as needed to reflect unique or varied risks?				
		SUMMARY SCORE		

LOCAL MITIGATION PLAN REVIEW CROSSWALK

MITIGATION STRATEGY: *§201.6(c)(3): The plan shall include a mitigation strategy that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools.*

13. Local Hazard Mitigation Goals

Requirement §201.6(c)(3)(i): *[The hazard mitigation strategy **shall** include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.*

Element	**Location in the Plan** (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A Does the **new or updated** plan include a description of mitigation **goals** to reduce or avoid long-term vulnerabilities to the identified hazards?	p. 10 & p. 69			
		SUMMARY SCORE		

14. Identification and Analysis of Mitigation Actions

Requirement §201.6(c)(3)(ii): *[The mitigation strategy **shall** include a] section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.*

Element	**Location in the Plan** (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A. Does the **new or updated** plan identify and analyze a **comprehensive range** of specific mitigation actions and projects for each hazard?	pp. 64 – 67; pp. 70-71			
B Do the identified actions and projects address reducing the effects of hazards on **new** buildings and infrastructure?	pp. 64 – 67; pp. 70-71			
C. Do the identified actions and projects address reducing the effects of hazards on **existing** buildings and infrastructure?	pp. 64 – 68; pp. 70-72			
		SUMMARY SCORE		

15. Identification and Analysis of Mitigation Actions: National Flood Insurance Program (NFIP) Compliance

Requirement: §201.6(c)(3)(ii): *[The mitigation strategy] must also address the jurisdiction's participation in the National Flood Insurance Program (NFIP), and continued compliance with NFIP requirements, as appropriate.*

Element	**Location in the Plan** (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A. Does the new or updated plan describe the jurisdiction (s) participation in the NFIP?	p. 27	***Note: This requirement becomes effective for all local mitigation plans approved after October 1, 2008.***		
B. Does the mitigation strategy identify, analyze and prioritize actions related to continued compliance with the NFIP?	pp. 64-67: p. 70	***Note: This requirement becomes effective for all local mitigation plans approved after October 1, 2008.***		
		SUMMARY SCORE		

16. Implementation of Mitigation Actions

Requirement: §201.6(c)(3)(iii): *[The mitigation strategy section **shall** include] an action plan describing how the actions identified in section (c)(3)(ii) will be prioritized, implemented, and administered by the local jurisdiction. Prioritization **shall** include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.*

Element	**Location in the Plan** (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A. Does the **new or updated** mitigation strategy include how the actions are **prioritized**? (For example, is there a discussion of the process and criteria used?)	p. 68 & pp. 71-72			
B. Does the **new or updated** mitigation strategy address how the actions will be implemented and administered, including the responsible department, existing and potential resources and the timeframe to complete each action?	pp. 73-74			
C. Does the **new or updated** prioritization process include an emphasis on the use of a **cost-benefit review** to maximize benefits?	p. 68 & p. 72			
D. Does the **updated** plan identify the completed, deleted or deferred mitigation actions as a benchmark for progress, and if activities are unchanged (*i.e.*, deferred), does the updated plan describe why no changes occurred?	pp. 64-67; pp. 70-71			
		SUMMARY SCORE		

17. Multi-Jurisdictional Mitigation Actions

Requirement §201.6(c)(3)(iv): *For multi-jurisdictional plans, there **must** be identifiable action items specific to the jurisdiction requesting FEMA approval or credit of the plan.*

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A Does the **new or updated** plan include identifiable **action items** for each jurisdiction requesting FEMA approval of the plan?				
B. Does the **updated** plan identify the completed, deleted or deferred mitigation actions as a benchmark for progress, and if activities are unchanged (*i.e.*, deferred), does the updated plan describe why no changes occurred?				
		SUMMARY SCORE		

PLAN MAINTENANCE PROCESS

18. Monitoring, Evaluating, and Updating the Plan

Requirement §201.6(c)(4)(i): *[The plan maintenance process **shall** include a] section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.*

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A. Does the **new or updated** plan describe the method and schedule for **monitoring** the plan, including the responsible department?	p. 75			
B. Does the **new or updated** plan describe the method and schedule for **evaluating** the plan, including how, when and by whom (*i.e.* the responsible department)?	p. 75			
C. Does the **new or updated** plan describe the method and schedule for **updating** the plan within the five-year cycle?	p. 75			
		SUMMARY SCORE		

19. Incorporation into Existing Planning Mechanisms

Requirement §201.6(c)(4)(ii): *[The plan **shall** include a] process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate.*

Element	**Location in the Plan** (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A. Does the **new or updated** plan identify other local planning mechanisms available for incorporating the mitigation requirements of the mitigation plan?	pp. 64-67; pp. 70-71			
B. Does the **new or updated** plan include a process by which the local government will incorporate the mitigation strategy and other information contained in the plan (*e.g.*, risk assessment) into other planning mechanisms, when appropriate?	pp. 64-67; pp. 70-71			
C. Does the **updated** plan explain how the local government incorporated the mitigation strategy and other information contained in the plan (*e.g.*, risk assessment) into other planning mechanisms, when appropriate?	pp. 64-67; pp. 70-71			
		SUMMARY SCORE		

Continued Public Involvement

Requirement §201.6(c)(4)(iii): *[The plan maintenance process **shall** include a] discussion on how the community will continue public participation in the plan maintenance process.*

Element	**Location in the Plan** (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A. Does the **new or updated** plan explain how **continued public participation** will be obtained? (For example, will there be public notices, an on-going mitigation plan committee, or annual review meetings with stakeholders?)	p. 75			
		SUMMARY SCORE		

MATRIX A: PROFILING HAZARDS

This matrix can assist FEMA and the State in scoring each hazard. Local jurisdictions may find the matrix useful to ensure that their plan addresses each natural hazard that can affect the jurisdiction. **Completing the matrix is not required**.

Note: First, check which hazards are identified in requirement §201.6(c)(2)(i). Then, place a checkmark in either the N or S box for each** applicable **hazard. An "N" for any element of any identified hazard will result in a "Needs Improvement" score for this requirement. List the hazard and its related shortcoming in the comments section of the Plan Review Crosswalk.

Hazard Type	Hazards Identified Per Requirement §201.6(c)(2)(i)	A. Location		B. Extent		C. Previous Occurrences		D. Probability of Future Events	
	Yes	N	S	N	S	N	S	N	S
Avalanche	☐	☐	☐	☐	☐	☐	☐	☐	☐
Coastal Erosion	☐	☐	☐	☐	☐	☐	☐	☐	☐
Coastal Storm	☐	☐	☐	☐	☐	☐	☐	☐	☐
Dam Failure	☐	☐	☐	☐	☐	☐	☐	☐	☐
Drought	☐	☐	☐	☐	☐	☐	☐	☐	☐
Earthquake	☐	☐	☐	☐	☐	☐	☐	☐	☐
Expansive Soils	☐	☐	☐	☐	☐	☐	☐	☐	☐
Levee Failure	☐	☐	☐	☐	☐	☐	☐	☐	☐
Flood	☐	☐	☐	☐	☐	☐	☐	☐	☐
Hailstorm	☐	☐	☐	☐	☐	☐	☐	☐	☐
Hurricane	☐	☐	☐	☐	☐	☐	☐	☐	☐
Land Subsidence	☐	☐	☐	☐	☐	☐	☐	☐	☐
Landslide	☐	☐	☐	☐	☐	☐	☐	☐	☐
Severe Winter Storm	☐	☐	☐	☐	☐	☐	☐	☐	☐
Tornado	☐	☐	☐	☐	☐	☐	☐	☐	☐
Tsunami	☐	☐	☐	☐	☐	☐	☐	☐	☐
Volcano	☐	☐	☐	☐	☐	☐	☐	☐	☐
Wildfire	☐	☐	☐	☐	☐	☐	☐	☐	☐
Windstorm	☐	☐	☐	☐	☐	☐	☐	☐	☐
Other _____	☐	☐	☐	☐	☐	☐	☐	☐	☐
Other _____	☐	☐	☐	☐	☐	☐	☐	☐	☐
Other _____	☐	☐	☐	☐	☐	☐	☐	☐	☐

To check boxes, double click on the box and change the default value to "checked."

Legend:

§201.6(c)(2)(i) Profiling Hazards
A. Does the risk assessment identify the location (*i.e.*, geographic area affected) of each hazard addressed in the **new or updated** plan?
B. Does the risk assessment identify the extent (*i.e.*, magnitude or severity) of each hazard addressed in the **new or updated** plan?
C. Does the plan provide information on previous occurrences of each natural hazard addressed in the **new or updated** plan?
D. Does the plan include the probability of future events (*i.e.*, chance of occurrence) for each hazard addressed in the plan?

MATRIX B: ASSESSING VULNERABILITY

This matrix can assist FEMA and the State in scoring each hazard. Local jurisdictions may find the matrix useful to ensure that the new or updated plan addresses each requirement. **Completing the matrix is not required**.

*Note: First, check which hazards are identified in requirement §201.6(c)(2)(i). Then, place a checkmark in either the N or S box for each **applicable** hazard. An "N" for any element of any identified hazard will result in a "Needs Improvement" score for this requirement. List the hazard and its related shortcoming in the comments section of the Plan Review Crosswalk. Note: Receiving an N in the shaded columns will not preclude the plan from passing.*

To check boxes, double click on the box and change the default value to "checked."

Hazard Type	Hazards Identified Per Requirement §201.6(c)(2)(i)	§201.6(c)(2)(ii) Assessing Vulnerability: Overview					§201.6(c)(2)(ii) Assessing Vulnerability: Identifying Structures				§201.6(c)(2)(ii) Assessing Vulnerability: Estimating Potential Losses							
		A. Overall Summary Description of Vulnerability		B. Hazard Impact			A. Types and Number of Existing Structures in Hazard Area (Estimate)		B. Types and Number of Future Structures in Hazard Area (Estimate)		A. Loss Estimate		B. Methodology					
	Yes	N	S	N	S		N	S	N	S	N	S	N	S				
Avalanche	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐	☐	☐				
Coastal Erosion	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐	☐	☐				
Coastal Storm	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐	☐	☐				
Dam Failure	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐	☐	☐				
Drought	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐	☐	☐				
Earthquake	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐	☐	☐				
Expansive Soils	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐	☐	☐				
Levee Failure	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐	☐	☐				
Flood	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐	☐	☐				
Hailstorm	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐	☐	☐				
Hurricane	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐	☐	☐				
Land Subsidence	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐	☐	☐				
Landslide	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐	☐	☐				
Severe Winter Storm	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐	☐	☐				
Tornado	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐	☐	☐				
Tsunami	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐	☐	☐				
Volcano	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐	☐	☐				
Wildfire	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐	☐	☐				
Windstorm	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐	☐	☐				
Other _____	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐	☐	☐				
Other _____	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐	☐	☐				
Other _____	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐	☐	☐				

Legend:

§201.6(c)(2)(ii) Assessing Vulnerability: Overview

A. Does the **new or updated** plan include an overall summary description of the jurisdiction's vulnerability to each hazard?

B. Does the **new or updated** plan address the impact of each hazard on the jurisdiction?

§201.6(c)(2)(ii)(A) Assessing Vulnerability: Identifying Structures

A. Does the **new or updated** plan describe vulnerability in terms of the types and numbers of existing buildings, infrastructure, and critical facilities located in the identified hazard areas?

B. Does the **new or updated** plan describe vulnerability in terms of the types and numbers of future buildings, infrastructure, and critical facilities located in the identified hazard areas?

§201.6(c)(2)(ii)(B) Assessing Vulnerability: Estimating Potential Losses

A. Does the **new or updated** plan estimate potential dollar losses to vulnerable structures?

B. Does the **new or updated** plan describe the methodology used to prepare the estimate?

MATRIX C: IDENTIFICATION AND ANALYSIS OF MITIGATION ACTIONS

This matrix can assist FEMA and the State in scoring each hazard. Local jurisdictions may find the matrix useful to ensure consideration of a range of actions for each hazard. **Completing the matrix is not required.**

*Note: First, check which hazards are identified in requirement §201.6(c)(2)(i). Then, place a checkmark in either the N or S box for each **applicable** hazard. An "N" for any identified hazard will result in a "Needs Improvement" score for this requirement. List the hazard and its related shortcoming in the comments section of the Plan Review Crosswalk.*

Hazard Type	Hazards Identified Per Requirement §201.6(c)(2)(i)	A. Comprehensive Range of Actions and Projects	
	Yes	N	S
Avalanche	☐	☐	☐
Coastal Erosion	☐	☐	☐
Coastal Storm	☐	☐	☐
Dam Failure	☐	☐	☐
Drought	☐	☐	☐
Earthquake	☐	☐	☐
Expansive Soils	☐	☐	☐
Levee Failure	☐	☐	☐
Flood	☐	☐	☐
Hailstorm	☐	☐	☐
Hurricane	☐	☐	☐
Land Subsidence	☐	☐	☐
Landslide	☐	☐	☐
Severe Winter Storm	☐	☐	☐
Tornado	☐	☐	☐
Tsunami	☐	☐	☐
Volcano	☐	☐	☐
Wildfire	☐	☐	☐
Windstorm	☐	☐	☐
Other _____	☐	☐	☐
Other _____	☐	☐	☐
Other _____	☐	☐	☐

To check boxes, double click on the box and change the default value to "checked."

Legend:
§201.6(c)(3)(ii) Identification and Analysis of Mitigation Actions
A. Does the **new or updated** plan identify and analyze a comprehensive range of specific mitigation actions and projects for each hazard?