Chapter Eight
Natural Hazards

Introduction

During the past decade, the United States has suffered a record number of natural disasters. The 2002 summer flooding in central Texas topped $1 billion in damage and hurricanes Ivan and Rita in 2004 and 2005, respectively, each took over 100 lives and caused billions of dollars in damage. Hurricane Katrina alone caused $81 billion in damages and claimed over 1,800 lives.

This photo depicts the aftermath of the July 2008 F2 tornado that touched down in Deerfield. It caused a swath of destruction approximately 40 miles long, damaged or destroyed over 200 homes and caused one fatality. While tornados are rare in the SNHPC Region, they do occur, highlighting the need for hazard mitigation planning. (SNHPC photo)

In New England, more than 100 natural disasters during the past quarter century have been sufficiently catastrophic to be declared "disaster areas" by the president, making them eligible for federal disaster relief. That's about four major disasters per year. Nine out of ten of these disasters were the result of flooding.

The October 2005 floods in southwestern New Hampshire caused catastrophic damage. There were at least five bridges washed out, up to 18 families left homeless, more than 1,000 people displaced by evacuations and seven deaths occurred. Rainfall amounts of approximately nine inches in southwestern New Hampshire from October 7-12 made for swollen rivers, streams and brooks. While events of this magnitude are not commonplace, damage could be averted or reduced with the implementation of foresighted hazard mitigation efforts.

North of the Village of Gilsum, Southwestern New Hampshire
October, 2005

Another recent severe flooding event in New Hampshire took place over Mother's Day weekend in 2006. Like the October 2005 floods, this flood was due to record breaking amounts of rainfall of 8.8 inches, as recorded in Concord, from May 13th to the 16th. Preliminary damage assessments estimate 25 homes in the State were destroyed, another 235 were severely damaged, and approximately 4,750 were damaged. Over 600 roads were closed statewide. Additionally, over 200 schools were closed for the Monday and Tuesday following the onset of flooding. Three dams were breached, another four required controlled breaches, and two other dams failed. Additional damages to businesses were estimated to be greater than $4 million and 115 businesses were damaged. Damages to state and local infrastructure are estimated to be beyond $14 million. Other major floods occurred in 2007, 2008 and most recently in March of 2010. These floods occurred during a particularly rainy month that caused widespread home flooding in the region.

Addison Road, Goffstown, NH
May, 2006

Although uncommon in the SNHPC region, tornadoes have been known to touch down here, including the occurrence of a fatal storm as recently as July 24, 2008. An F2 twister with winds reaching between 111-135 mph touched down in Deerfield and continued on for approximately

40 miles in a northeasterly trajectory. The unexpected nature of events such as these reinforces the need for hazard mitigation planning.

Floods, tornados, winter storms, hurricanes, earthquakes, and wildfires—natural disasters are part of the world around us. Their occurrence is inevitable and can wreak havoc on the natural environment. However, the natural environment is amazingly resilient, often recuperating in a matter of days or weeks. When these events strike the man-made environment, however, the result is often more devastating. Disasters occur when a natural hazard crosses paths with elements of the man-made environment, including buildings, roads, pipelines, or crops. The natural environment takes care of itself. The fabricated environment, in contrast, often needs some emergency assistance.

With this in mind, it is important to remember that natural disasters and hazards do not respect man-made municipal and state boundaries. Rarely is a natural disaster confined to a single community. While local plans and procedures pertaining to natural hazards are necessary, it is also important for communities to recognize their interdependence during times of natural disaster. Regional collaboration, communication and information sharing are all vital components in hazard preparation, mitigation and cleanup. Efforts such as the Southern New Hampshire Region Community Preparedness Program, discussed later in this chapter, are steps being taken in this region toward achieving this goal.

Public Survey Results

The Natural Hazards Survey was developed to measure public input regarding hazard preparedness in each SNHPC community and which threats are perceived as the greatest to the region. Over 100 respondents replied to the survey, which was made available to Town Planners, Town Managers, Public Works Directors, Board of Selectmen, Planning Boards, and Conservation Commissions within the region. The survey was posted on the SNHPC website between October 1, 2010 and December 1, 2010. Every SNHPC region community participated in the survey, with the exception of the Town of Chester.

- Seventy-six percent of respondents felt they were well informed about the potential threats and natural hazards that may exist in their communities.

- The greatest concern was for flooding, ice storms, earthquakes, wildfire, and dam breach or failure, in that order.

- A vast majority, eighty-seven percent, responded that they were aware of the locations of the emergency shelters in their community.

- Forty-six percent of respondents were aware of those shelters in their neighboring communities.

- Of those who responded, fifty-three percent were familiar with the evacuation routes in their community.

- Fifty-six percent of the respondents felt that their communities did have adequate medical services and resources for response to a natural disaster.

- Sixty-one percent of respondents felt that the emergency response personnel in their community was fully prepared to handle all types of natural hazard emergencies in that may occur in the SNHPC Region.

- Fifty-one percent of those who took the survey believed the Hazard Mitigation Plan for their community had been updated in the past five years.

- Sixty-eight percent of respondents were not aware of the regional emergency response Community Preparedness DRAFT plan prepared by the SNHPC.

- Of the forty-four people who answered this question, 32 percent thought the plan would make their community safer from natural disaster.

Needs and Concerns

Based on the public survey results, the most important issues facing the SNHPC region are:

- About one in three respondents cited flooding as a major concern for the SNHPC Region. With the incidence of several major flooding events in the past few years, this figure is not surprising.
- There was a feeling among many respondents (20+ for each) that disasters uncommon to the SNHPC Region (earthquakes, wild fire and dam breach or failure) were of major concern. These highly devastating events are oftentimes overlooked in places where they occur infrequently, exacerbating their devastation. It is important to have a mitigation plan in place for *all* potential threats to the region.
- Awareness of the SNHPC DRAFT Community Preparedness Plan is low (only 32 percent know it exists). There should be greater awareness of this tool.
- Only 56 percent of respondents felt that their community had adequate medical services and resources for natural disaster emergencies. This figure was even higher for many of the region's smaller towns. This figure needs to improve.
- There was a high (87 percent) level of awareness of the location of the emergency shelters located in the different communities.

Ideally, the answers for many of these responses should be at 100 percent – the greater the number of people in a community who know what to do in the case of different emergencies, the better. Access to this information should be readily available to all citizens of every community so that when a natural hazard or disaster does strike, people know how to react, where to go and what to do in order to minimize property damage, infrastructure damage, injury and potential loss of life.

Hazard Mitigation

Hazard mitigation is the practice of reducing risks to people and property from natural hazards. It includes both structural interventions, such as flood control devices, and nonstructural measures, such as avoiding construction in the most flood-prone areas. Mitigation includes not only avoiding the development of vulnerable sections of the community, but also making existing development in hazard-prone areas safer. For example, a community could identify areas that are susceptible to damage from natural disasters and take steps to make these areas less vulnerable. It could also steer growth to less risky areas. Keeping buildings and people out of harm's way is the essence of mitigation.

Regionally, communities must cooperate to identify and mitigate potential hazards. Nature knows no municipal boundaries and failure to mitigate natural hazards in one community can have severe impacts on neighboring communities. Mitigation should not be seen as an impediment to growth and development. On the contrary, incorporating mitigation into development decisions can result in a safer, more resilient region, one that is more attractive to new families and businesses.

Benefits of Hazard Mitigation

Hazard mitigation offers many benefits for a community. It can:

- Save lives and property;
- Reduce vulnerability to future hazards;
- Facilitate post-disaster funding; and
- Speed recovery.

Hazard mitigation measures also help to ensure a healthy and sustainable community. Places that employ good hazard mitigation planning are better able to cope with and recover from the costly effects of natural disasters physically, economically and socially. Hazard mitigation planning can also help to reduce the environmental impacts associated with a devastating natural disaster in a developed area. Sustainability and hazard mitigation are complementary to each other – both should attempt to preserve a location's environment and resources while reducing its proneness to disasters in the future.

Hazard Mitigation Planning

The full cost of the damage resulting from natural hazards—personal suffering, loss of lives, disruption of the economy, and loss of tax base—is difficult to measure. New Hampshire is subject to many types of natural disasters: floods, hurricanes, nor'easters, winter storms, earthquakes, tornados, and wildfires, all of which can have significant economic and social impacts. Some, such as hurricanes, are seasonal and often strike in predictable locations. Others, such as floods, can occur any time of the year and almost anywhere in the state.

Individual communities must produce hazard mitigation plans per federal regulations every three to five years.[1] Mitigation funding is contingent upon an up-to-date hazard mitigation plan. ***This chapter does not substitute for individual community hazard mitigation plans.*** It does however, attempt to point out the feasibility and need for regional cooperation in hazard mitigation planning.

Once communities have developed and adopted a FEMA approved Hazard Mitigation Plan, it may constitute a new section of the communities' master plan, in accordance with RSA 674:2.

[1] FEMA Disaster Mitigation Act of 2000 44 CFR Part 201.6(d)(3) mandates "Plans must be reviewed, revised if appropriate, and resubmitted for approval within five years to continue to be eligible for HMGP project grant funding." (Federal Register Vol. 36, No. 38, Feb 26, 2002, Rules and Regulations, p8852)

The adopted plan can also be incorporated into other planning mechanisms, such as the Capital Improvement Program (CIP). Adoption of a Hazard Mitigation Plan demonstrates the municipality's commitment to hazard mitigation. It also qualifies the municipality for federal, state and local funding and prepares the public for what the community can be expected to do both before and after a natural hazard disaster occurs.

Hazard Identification

The SNHPC region is located in the south-central portion of the State of New Hampshire and encompasses parts of Hillsborough, Merrimack and Rockingham Counties. The climate of Manchester and its surrounding towns is typical of the Merrimack Valley, with warm summers and cool winters. Temperatures during the month of July range from an average high of 82.1 degrees Fahrenheit to an average low of 54.6 degrees. January temperatures range from an average high of 32.3 degrees to an average low of 5.2 degrees. Prolonged periods of severe cold are rare. Annual average precipitation is 39.82 inches.[2]

All towns in the region are now participating in the National Flood Insurance Program (NFIP). According to FEMA's Biennial Reports completed by participating towns, there were approximately 939 residential structures located in the FEMA designated special flood hazard areas (100 year floodplain) and 400 non-residential structures. [3]

The region currently has 1,034 NFIP policies, 748 one-to-four family residential policies, 222 other residential, and 64 non-residential structures. 448 claims have been filed with NFIP totaling $8,326,276. There are 54 repetitive loss properties insured under the NFIP within the region. Table (10.1) summarizes the National Flood Insurance Program by municipality.[4]

[2] Climate information from http://ggweather.com/normals/NH.htm accessed 7 January 2011.
[3] FEMA Community Information System, January 7, 2011.
[4] FEMA Community Information System, January 7, 2011.

Table 8.1
Summary of National Flood Insurance Program
For the SNHPC Region

Municipality	Year of Participation Entry	Number of residential structures within the SFHA	Number of non-residential structures within the SFHA	Number of National Flood Insurance Policies: 1-4 Family Residential	Number of National Flood Insurance Policies: Other Residential	Number of National Flood Insurance Policies: Non-Residential	Claim Dollar Amount (Number of Claims)	Repetitive Loss Dollar Amount (Number of Claims)	Total Repetitive Loss Buildings (Number Insured)
Auburn	1986	45	0	10	0	0	$32,600 (1)	$0 (0)	N/A
Bedford	1979	U	U	74	1	7	$344,540 (19)	$33,780 (2)	1 (0)
Candia	2006	85	3	12	0	0	$0 (0)	$0 (0)	N/A
Chester	2000	U	U	13	0	0	$11,331 (3)	$0 (0)	N/A
Deerfield	1989	75	0	31	0	0	$97,679 (12)	$11,187 (2)	1 (1)
Derry	1981	60	0	77	133	1	$192,967 (38)	$117,155 (14)	6 (5)
Goffstown	1979	U	U	135	2	8	$3,462,283 (150)	$1,266,906 (50)	24 (17)
Hooksett	1979	U	U	34	1	6	$963,537 (23)	$869,955 (9)	4 (2)
Londonderry	1980	85	32	44	1	9	$406,370 (37)	$243,176 (19)	5 (4)
Manchester	1981	254	343	150	34	23	$1,189,507 (53)	$480,151 (3)	1 (1)
New Boston	1981	32	7	27	0	3	$96,755 (9)	$0 (0)	N/A
Raymond	1982	303	15	106	49	7	$1,419,017 (95)	$569,851 (32)	11 (9)
Weare	1993	U	U	35	1	0	$109,690 (8)	$70,302 (2)	1 (0)
SNHPC Region	N/A	939	400	748	222	64	$8,326,276 (448)	$3,662,463 (133)	54 (39)

Source: FEMA Online Community Information System, 2011

Past hazard events in the SNHPC region include flooding, wind, wildfire, ice, snow, and seismic events. Other hazards include geomagnetism, drought, and extreme heat or cold. The Identified Hazard Zones Map on the following page reflects the impact areas for each hazard. For more specific information, including the probability for damage to occur from each hazard type, consult the hazard mitigation plan for the individual municipality.

Unless otherwise noted, the primary source for data and quotations presented in the Hazard Identification section is the State of New Hampshire Natural Hazard Mitigation Plan by the NH Bureau of Emergency Management.

Flooding

Riverine Flooding

"Typical riverine flooding involves the overflowing of the normal flood channels or rivers or streams, generally as a result of prolonged rainfall or rapid thawing of snow cover. The lateral spread of floodwater is largely a function of the terrain, becoming greater in wide, flat areas, and affecting narrower areas in steep terrain. In the latter cases, riparian hillsides in combination with seep declines in riverbed elevation often force waters downstream rapidly, sometimes resulting in flash floods." [5]

[5] James Schwab, Kenneth Topping, et al., Planning for Post-Disaster Recovery and Reconstruction, Planning Advisory Services, Report Number 483/484, (Chicago: American Planning Association, December, 1998), 208.

The Merrimack River flows through three communities in the region – Hooksett, Manchester, and Bedford. Tributaries of the Merrimack include the Piscataquog, which flows through Goffstown, New Boston, and Weare. The Lamprey River flows through Raymond, Candia and Deerfield. The Exeter Rivers flows through a small portion of Chester. There are numerous smaller streams and creeks within the region with a potential for riverine flooding. As in other New Hampshire communities, when "[r]esidents moved to the floodplains … [s]uch encroachment has led to problems… Flood safety is a great concern along these watercourses and can be greatly enhanced by flood hazard mitigation planning."

"The goal of flood hazard mitigation planning is to eliminate or reduce the long-term risks to human life and property from flooding by reducing the cause of the hazard or reducing the effects through preparedness, response and recovery measures. Hazard mitigation is the only phase of emergency management that can break the cycle of damage, reconstruction and repeated damage." Riverine flooding is the most common and significant hazard event in the State of New Hampshire as well as the SNHPC region.

Some of the more severe flooding in the region occurs during the spring, fall and winter seasons. The most severe riverine flooding event in the region, March 1936 along the Merrimack River, occurred due to heavy rainfall in combination with rapid snowmelt and debris impacted infrastructure.[6] Several major floods have occurred in the region in the past two decades resulting in millions of dollars of property damage.

From 1986 through 2010 there have been 12 flood-related declared disasters by FEMA (see Table 10.2).

Table 8.2
Federally Declared Flooding Disasters
In the SNHPC region, 1986-2010

Date	Year	Title	Affected Counties in the SNHPC region
May 12	2010	Severe Storms and Flooding	Hillsborough, and Rockingham Counties
October 3	2008	Severe Storms and Flooding	Hillsborough and Merrimack Counties
August 11	2008	Severe Storms, Flooding and Tornado	Merrimack and Rockingham Counties
April 27	2007	Severe Storms and Flooding	Hillsborough, Merrimack and Rockingham Counties
May 25	2006	Severe Storms and Flooding	Hillsborough, Merrimack and Rockingham Counties
October 26	2005	Severe Storms and Flooding	Hillsborough and Merrimack Counties
July 2	1998	Severe Storms and Flooding	Merrimack and Rockingham Counties
October 29	1996	Severe Storms and Flooding	Hillsborough, Merrimack, and Rockingham Counties
January 3	1996	Storms/Floods	Merrimack County
November 13	1991	Coastal Storm/Flooding	Rockingham County
April 16	1987	Severe Storms and Flooding	Hillsborough, Merrimack, and Rockingham Counties
August 27	1986	Severe Storms and Flooding	Hillsborough County

Source: FEMA "Federally Declared Disasters by Calendar Year"

[6] Manchester Flood Insurance Study, Federal Emergency Management Agency, 1981.

All special flood hazard areas (SFHAs) in the SNHPC region are potentially at risk in the event of riverine flooding. The SFHAs are located on the Identified Hazard Zones Map.

Hurricanes

"A hurricane is a heat engine that derives is energy from ocean water. These storms develop from tropical depressions which form off the cost of Africa in the warm Atlantic waters. When water vapor evaporates, it absorbs energy in the form of heat. As the vapor rises, it cools within the tropical depression, and then condenses, releasing heat, which sustains the system." SNHPC region communities generally are impacted by hurricanes through rain induced flooding rather than high winds.

Since 1635, twelve hurricanes have reached New Hampshire: in the years 1635, 1778, 1804, 1815, 1869, 1938, 1954 (2), 1960, 1985, 1991 and 1999. The September 1938 hurricane was the most notable event to strike southern New Hampshire. Piscataquog river flood water discharges were measured, near the Town of Goffstown, at 21,900 cubic feet per second, exceeding a 100-year storm. Additionally, during the 1938 storm the Weare Reservoir failed. The 1938 flood is estimated to have been the greatest flood since 1733.[7] Hurricanes Carol and Edna caused some damage in August and September 1954.

Potential effects of a hurricane include flooding, runoff not handled adequately, and disrupted travel. The most recent hurricanes were: August 1991 – Bob; September 1999 – Floyd; and August 2005 - Katrina. During these events trees and power lines came down, and there was minimal structural damage. Only the 1991 storm was declared a federal emergency in New Hampshire.

All areas are potentially at risk if a hurricane reaches the SNHPC Region.

Debris-impacted infrastructure and river ice jams

"The potential effects of flooding are increased when infrastructure is obstructed either by debris or ice formations. These obstructions compromise the normal stormwater flow, creating an artificial dam or narrowing of the river channel causing a backup of water upstream and forcing water levels higher. Debris obstructions can be caused from vegetative debris, silt, soils, and other riparian structures that have been forced into the watercourse. Ice jams are caused by ice formations in riverbeds and against structures." Bridges, culverts, and related roadways are most vulnerable to ice jams and debris-impacted infrastructure.

Historically, floods in the region have been due to snow melt and heavy rains in conjunction with ice jams or debris-impacted infrastructure. The flood of 1936, previously mentioned, was severely exacerbated by the presence of 55,000 gallon oil tanks and other debris in the river that became lodged at the Granite Street Bridge.

All special flood hazard areas in the region are potentially at risk if there is an ice jam or debris-impacted infrastructure. Particular concern should be given to bridges along the Merrimack, Piscataquog, Lamprey and Exeter Rivers.

[7] Weare Flood Insurance Study, Federal Emergency Management Agency, 1993.

Erosion and mudslides

The New Hampshire Department of Environmental Services (NH DES) defines erosion as "The process in which a material is worn away by a stream of liquid (water) or air, often due to the presence of abrasive particles in the stream."[8] SNHPC defines erosion as the gradual or rapid wearing away of stream banks or shores, due to prevailing winds, natural water movement and more catastrophic events. Additional causes of erosion are removal of vegetation and soil disturbance. Riparian construction sites are one non-natural contributor (NH DES Shoreland Protection). Stream bank erosion may eventually result in mudslides.

Land in the region which has at least a 15 percent slope, a vertical rise of 15 feet over a horizontal run of 100 feet, is scattered throughout the region, usually occurring around the hills and stream banks. Areas of steep slopes in the region are shown on the Identified Hazard Zones map at the end of this section.

All areas of steep slopes, as mapped in the region, are potentially at risk in the case of potential erosion and mudslide events

Rapid snowpack melt

Rapid snowpack melt, much as its name suggests, is the rapid melting of the snowpack in conjunction with warming temperatures and moderate to severe rains, typically during the spring. "The lower lying areas of the State may experience either flash flooding or inundation events accelerated by the rapid melting of the snowpack."

Structures and improvements located on, along, or at the base of steep slopes are most vulnerable to rapid snowpack melt. These areas can be seen on the Identified Hazard Zones map's depiction of steep slopes.

All areas of steep slopes and erosion prone soils, as mapped, are potentially at risk in the event of rapid snowpack melt.

Dam breach or failure

The NH Department of Environmental Services indicates several failure modes for dams. The most typical of these modes include hydraulic failure or the uncontrolled overflowing of water, seepage or leaking at the dam's foundation or gate, structural failure or rupture, general deterioration, and gate inoperability. These modes vary between dams depending on their construction type.[9] Additionally, failure may be triggered because of significant seismic activity, particularly earthquakes.

The State of New Hampshire uses a hazard potential classification based on the impact of dam breach or failure. Dams are classified according to their potential to cause damage as Non Menace (NM), Low Hazard (L), Significant Hazard (S), and High Hazard (H). All dams classified as S and H have the potential to cause damage if they breach or fail. The SNHPC region has 129 class NM dams, 45 Class L dams, 12 Class S dams, and 6 Class S dams.[10] Class

[8] New Hampshire Department of Environmental Services Watershed Management Bureau.
[9] New Hampshire Department of Environmental Services Dam Bureau, Environmental Fact Sheets DB-4 through 7.
[10] New Hampshire Department of Environmental Services Dam Bureau, "Dams."

NH and S dams must be inspected every five years, class S dams every two years and class H dams once every year.

Under the New Hampshire Code of Administrative Rules ENV-WR 303.06, owners of all High Hazard and Significant dams whose failure could threaten public safety or result in major economic impact or property loss, are required to compile and maintain an Emergency Action Plan (EAP) which addresses the area of concern and identifies procedures to be initiated in the case of a dam failure. DES has developed a template and can provide technical assistance to dam owners in preparing their EAPs according to the state's rules.[11]

The Class H dams in the region are located in Auburn, Goffstown, Hooksett, Manchester and Weare. Class S dams are located in Derry, Goffstown, Hooksett, Manchester, and Weare. The class H and S dams are listed in Table 10.4. For potential damage assessments and inundation areas, consult the dam emergency action plans or hazard mitigation plan for the individual municipality.

Table 8.3
Class H and S Dams in the SNHPC Region

Hazard Class	Dam Name	River	Location
H	Tower Hill Pond	Maple Falls Brook	Auburn
H	Gregg Falls Dams	Piscataquog River	Goffstown
H	Hooksett Hydro	Merrimack River	Hooksett
H	Massabesic Lake Dam	Cohas Brook	Manchester
H	Amoskeag Dam	Merrimack River	Manchester
H	Everett Dam	Piscataquog River	Weare
S	Hoods Pond	Shields Brook	Derry
S	Sludge Treatment Lagoon	N/A	Derry
S	Waste Lagoon	N/A	Derry
S	Big Island Pond Outlet	Spickett River	Derry
S	Uncanoonuc Dam	Dan Little Brook	Goffstown
S	Hadley Falls	Piscataquog River	Goffstown
S	Dube Pond Dam	Maple Falls Brook	Hooksett
S	Dorrs Pond	Dorrs Pond	Manchester
S	Black Brook Pond	Black Brook	Manchester
S	Cohas Road Reservoir, Low Service	N/A	Manchester
S	Kelley Falls Dam	Piscataquog River	Manchester
S	Weare Reservoir - Horace Lake	Piscataquog River	Weare

Source: New Hampshire Department of Environmental Services

[11] NH DES Emergency Actions Plans Program, http://des.nh.gov/organization/divisions/water/dam/eap/index.htm

The SFHAs in proximity to the Region's Class H and S dams, as well as their designated floodways, would be impacted by a dam breach**.**

Wind

The most frequent problem and risk associated with all types of wind storms in the region is downed trees and the secondary impacts of their falling, including downed power lines. There have been two Presidentially Declared Disasters for severe wind storms in the region since 1990. The August 1990 windstorm caused approximately $2.3 million in damages across all counties in the state except Belknap. The 2010 storm left more than 330,000 without power statewide and shut down approximately 50 state highways.

Between 1950 and 2010 New Hampshire recorded 67 strong wind events that resulted in 14 injuries and four fatalities. The total monetary damage caused by these storms is estimated at $201,000.[12]

Table 8.4
Federally Declared Severe Storms/Wind Disasters
In the SNHPC Region, 1986-2010

Date	Year	Title	Affected Counties in the SNHPC region
March 29	2010	Severe Winter Storm/Wind	Hillsborough, Merrimack, and Rockingham Counties
August 29	1990	Severe Storms/Wind	Hillsborough and Merrimack Counties

Source: FEMA, "Federally Declared Disasters by Calendar Year"

Hurricanes

Severe hurricanes reaching south-central New Hampshire in the late summer and early fall are the most dangerous of the coastal storms that pass through New England from the south. Tropical depressions are considered to be of hurricane force when winds reach 74 miles per hour, see table 8.5 below for hurricane categorization according to the Saffir-Simpson Scale. Substantial damage may result from winds of this force, especially considering the duration of the event, which may last for many hours. Potential effects of hurricane force winds include fallen trees, telephone poles and power lines.

Table 8.5
Saffir-Simpson Hurricane Scale

Category	Winds (mph)	Potential Damage
1	74-95	Minimal
2	96-110	Moderate
3	111-130	Extensive
4	131-155	Extreme
5	>155	Catastrophic

Source: http://www.unc.edu/~rowlett/units/scales/saffir.html

[12] National Oceanic & Atmospheric Administration, National Climatic Data Center, http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms

Winds from the Hurricane of 1938, previously mentioned, reached a high of 186 miles per hour, a category 5 on the Saffir-Simpson scale.

All areas in the SNHPC region are at risk if a hurricane reaches Southern New Hampshire.

Tornados

"A tornado is a violently rotating column of air extending from a thunderstorm to the ground. The most violent tornadoes are capable of tremendous destruction with wind speeds of 250 mph or more. Damage paths can be in excess of 1 mile wide and 50 miles long." Tornados originate from hurricanes and thunderstorms, and are created when cold air overrides warm air causing the warm air to rise rapidly.[13] Tornados are measured using the Fujita Tornado Damage Scale, as seen in Table 10.7.

Table 8.6
Fujita Tornado Damage Scale

Category	Winds (mph)	Potential Damage
F0	<73	Light
F1	73-112	Moderate
F2	113-157	Considerable
F3	158-206	Severe
F4	207-260	Devastating
F5	261-318	Incredible

Source: NOAA, http://www.spc.noaa.gov/faq/tornado/f-scale.html

Between 1951 and 2009 numerous tornadoes ranging from F0 to F2 on the Fujita Scale occurred in the SNHPC region. 20 of these tornadoes occurred in Hillsborough County, five occurred in Merrimack County and 11 occurred in Rockingham County.[14] . On July 24, 2008 an F2 twister with winds reaching between 111-135 mph touched down in Deerfield and continued on for about 40 miles northeasterly toward Lake Winnipesauke, leaving a path of destruction almost a third of a mile wide in some spots. Over 200 homes were damaged or destroyed due to the storm and it was responsible for one fatality.[15].

All areas of the SNHPC region are potentially at risk if a tornado forms in or passes through the region.

Table 8.7
Federally Declared Tornado Disasters
In the SNHPC Region, 1986-2010

Date	Year	Title	Affected Counties in the SNHPC region
August 11	2008	Severe Storms, Flooding and Tornado	Merrimack and Rockingham Counties

Source: FEMA, "Federally Declared Disasters by Calendar Year"

[13] Federal Emergency Management Agency, "Understanding Your Risks," 2-20.
[14] Tornado data from New Hampshire State Climatologist, http://www.unh.edu/stateclimatologist/
[15] WMUR News, http://www.wmur.com/r/16997809/detail.html accessed 4 January, 2011

Nor’easters

A Northeaster, or winter extra-tropical storm, is "[a] large weather system traveling from South to North passing along or near the seacoast. As the storm approaches New England and its intensity becomes increasingly apparent, the resulting counterclockwise cyclonic wind impacts the coast and inland areas from a northeasterly direction. The sustained winds may meet or exceed hurricane force, with larger bursts, and may exceed hurricane events by many hours in terms of duration."

"Unlike the relatively infrequent hurricane, New Hampshire generally experiences at least one or two "significant" events each year… with varying degrees of severity. These storms have the potential to inflict more damage than many hurricanes because … high winds can last from 12 hours to 3 days, while the duration of hurricanes ranges from 6 to 12 hours."

Nor’easters are measured on the Dolan-Davis scale, as is presented on the following page.

Table 8.8
Dolan-Davis Nor’easter Classification Scale

Storm Class	Percent of Nor’easters	Avg. Return Interval	Avg. Duration (hours)	Impact
1- WEAK	49.7	3 days	8	No property damage
2- MODERATE	25.2	1 month	18	Modest Property damage
3- SIGNIFICANT	22.1	9 months	34	Local-scale damage and structural loss
4- SEVERE	2.4	11 years	63	Community Scale damage and structural loss
5- EXTREME	0.1	100 years	95	Extensive regional-scale damage and structural loss

Source: State of NH Natural Hazards Mitigation Plan & NC Division of Emergency Management

All areas of the SNHPC region are potentially at risk for property damage and loss of life due to nor’easters.

Downburst

“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. Depending on the size and location of these events, the destruction to property may be devastating. Downbursts fall into two categories. Microbursts cover an area less than 2.5 miles in diameter, and macrobursts cover an area at least 2.5 miles in diameter.”

More recent downburst activity occurred on July 6, 1999 in the form of a microburst within central New Hampshire; throughout Merrimack, Grafton and Hillsborough Counties. There were two fatalities as well as two lost roofs, widespread power outages, and downed trees, utility poles and wires.

All locations in the SNHPC region are at risk for property damage and loss of life due to downbursts.

<u>Lightning</u>
"During the development of a thunderstorm, the rapidly rising air within the cloud, combined with the movement of the precipitation within the cloud, causes electrical charges to build up within the cloud. Generally, positive charges build up near the top of the cloud, while negative charges build up near the bottom. Normally, the earth's surface has a slight negative charge. However, as the negative charges build up near the base of the cloud, the ground beneath the cloud and the area surrounding the cloud become positively charged. As the cloud moves, these induced positive charges on the ground follow the cloud like a shadow. Lightning is a giant spark of electricity that occurs between the positive and negative charges within the atmosphere or between the atmosphere and the ground. In the initial stages of development, air acts as an insulator between the positive and negative charges. However, when the potential between the positive and negative charges becomes too great, there is a discharge of electricity that is known as lightning."

In the SNHPC region there have been 15 major lightning events that have resulted in three injuries and over $1 Million in damages between 1993 and 2009.[16] All areas in the SNHPC region are potentially at risk for property damage and loss of life due to lightning.

Fires

<u>Wild Land and Urban-Wild Land Interface Fires</u>
"Historically, large New Hampshire wild land fires run in roughly 50-year cycles. The increased incidence of large wild land fire activity in the late 1940s and early 1950s is thought to be associated, in part, with debris from the hurricane of 1938. Significant woody 'fuel' was deposited in the forests during that event. Present concerns of the New Hampshire Department of Resources and Economic Development, Division of Forests and Lands, are that the major ice storm of 2008 has left a significant amount of woody debris in the forests of the region and may fuel future wildfires similar to the debris caused by the Hurricane of 1938."

In addition to wild land fires the areas of urban and wild land interface are particularly at risk. These fires occur along the fringes of development creating another form of fire mixing the hazards of both urban and wild land fires.

Throughout the region, the following areas are susceptible to wild land fires:

- All new developments – when trees are cut the soil dries, leaving dead grass creating a new urban-wild land interface;
- Residential development adjacent to wooded areas – unattended fire pits and chimenias pose an additional risk;
- Trails and adjacent wooded areas used for hiking, biking, or snowmobiling; and
- Campgrounds – unattended fires pose an additional risk.

[16] National Oceanic & Atmospheric Administration, National Climatic Data Center, http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms

Isolated Homes

"New Hampshire is heavily forested and is therefore exposed to this hazard… The proximity of many populated areas to the State's forested lands exposes these areas and their populations to the potential impact of wildfire."

There are many dead end, single access roads in the region with residential development along them. Early subdivisions are of particular risk since typically they lack multiple road connections. Also the roads may be privately owned and maintained, making access by emergency vehicles difficult, especially with respect to turn arounds. Additionally, former vacation homes along the many water bodies in the region and the region's most remote areas have limited access for emergency and rescue vehicles.

Subdivisions that do not feature multiple road connections, former vacation spots along the many water bodies in the region, and the most remote areas in the region are potentially at risk for property damage and loss of life due to isolated home fires.

Ice and Snow Events

Heavy Snowstorms

"A heavy snowstorm is generally considered to be one that deposits four or more inches of snow in a twelve-hour period. A blizzard is violent snowstorm with winds blowing at a minimum speed of 35 miles per hour and visibility of less than one-quarter mile for three hours." During a blizzard temperatures drop to below 20°F. Intense wintertime nor'easters are often referred to as blizzards. "White outs" occur when previously fallen dry snow is blown into the air and visibility is extremely reduced.

Heavy snowstorms include all storms with four or more inches of snow in a twelve-hour period, including all blizzards and nor'easters with large snow accumulation.

In the past 20 years the Federal Emergency Management Agency declared six snowstorm-related Emergency Declarations for the SNHPC region. The first was declared by FEMA in March of 1993 for statewide heavy snow. The second was for snowstorms during March of 2001 covering seven of the State's ten counties.[17]

The third declared emergency was for a snowstorm on February 17-18, 2003. This storm accumulated approximately 18 inches of snow in the Manchester area (National Weather Service, "Winter Weather Summaries"). This snow was added to an existing base of snow to create an approximate snow depth of 29 inches.[18]

The fourth declared emergency was on December 6-7, 2003. This emergency was declared for eight out of the ten counties. The storm accumulated approximately 20 inches of snow in the Manchester area and winds were measured at up to 39 miles per hour.[19]

[17] Federal Emergency Management Agency, "Federally Declared Disasters by Calendar Year."
[18] National Weather Service, "Climate Data."
[19] National Weather Service, "Winter Weather Summaries."

The fifth declared emergency was for January 22-23, 2005 and was declared for all New Hampshire counties, except Coos. Snowfall accumulations of 6 to 20 inches where recorded across much of southern and central New Hampshire. Winds gusting as high as 45 mph created near blizzard conditions at times, making travel impossible during the height of the storm.[20]

The most recent declared emergency was for March 11-12, 2005 and was declared for four of New Hampshire's nine counties. Snow accumulated 4 to 15 inches across most of the state before ending during the early morning hours of March 13. State police reported numerous vehicles off roads around the region, especially on Interstate 93. A number of flights at Manchester Airport were delayed or canceled as a result of the storm.[21]

Table 8.9
Federally Declared Snowstorm Disasters
In the SNHPC Region, 1986-2010

Date	Year	Title	Affected Counties in the SNHPC region
April 28	2005	Snow Emergency	Hillsborough and Rockingham Counties
March 30	2005	Snow Emergency	Hillsborough, Merrimack, and Rockingham Counties
January 15	2004	Snow Emergency	Hillsborough and Merrimack Counties
March 11	2003	Snow Emergency	Hillsborough, Merrimack, and Rockingham Counties
March 28	2001	Snow Emergency	Hillsborough, Merrimack, and Rockingham Counties
March 16	1993	Heavy Snow	Statewide

Source: FEMA, "Federally Declared Disasters by Calendar Year"

All areas of the SNHPC region are potentially at risk for property damage and loss of life due to heavy snows.

Ice Storms

"Ice Storms occur when a mass of warm moist air collides with a mass of cold arctic air. The less dense warm air will rise and the moisture may precipitate out in the form of rain. When this rain falls through the colder more dense air and comes in contact with cold surfaces, ice will form and may continue to form until the ice is as thick as several inches."

Despite the beauty of ice events, the extreme weight of ice build-up may strain tree branches, power lines and even transmission towers to the breaking point, resulting in a loss of power, telephone service, or other services. Fallen trees, limbs, or utility poles may obstruct roads and restrict emergency vehicle passage. Additionally, ice creates treacherous conditions for highway travel and aviation.

The ice storm of December 2008 caused statewide devastation and left thousands without power – some for a period of weeks. It was a Declared Disaster by FEMA for all 10 of the State's counties. The ice storm of 1998 was a Declared Disaster for nine counties, including Hillsborough and Merrimack County, and resulted in six related injuries, one fatality and 20 major road closures. Both the December 2010 and January 1998 ice storms were very similar in

[20] National Oceanic & Atmospheric Administration National Climatic Data Center and the National Weather Service, Gray, ME.
[21] Ibid.

both impact area and severity to a 1929 ice storm that caused unprecedented damage to the telephone, telegraph and power system. The 1998 and 2008 storms caused significant damage to the utility network.

Table 8.10
Federally Declared Ice Storm Disasters
In the SNHPC Region, 1986-2010

Date	Year	Title	Affected Counties in the SNHPC region
January 2	2009	Severe Winter Storm	Hillsborough, Merrimack, and Rockingham Counties
January 15	1998	Ice Storm	Hillsborough and Merrimack Counties

Source: FEMA "Federally Declared Disasters by Calendar Year"

All areas of the SNHPC region are potentially at risk for property damage and loss of life due to ice storms.

Hailstorms

"Hailstones are balls of ice that grow as they are held up by winds, known as updrafts, that blow upwards in thunderstorms. The updrafts carry droplets of super cooled water (at a below freezing temperature) but not yet ice. The super cooled water droplets hit the balls of ice and freeze instantly, making the hailstones grow. The faster the updraft, the bigger the stone can grow."

"Most hailstones are smaller in diameter than a dime, but stones weighing more than a pound have been recorded. Details of how hailstones grow are complicated but the results are irregular balls of ice that can be as large as baseballs, sometimes even bigger. While crops are the major victims, hail is also a hazard to vehicles and windows. Hail damage events can be severe to persons, property, livestock and agriculture."

All areas of the SNHPC region are potentially at risk from this hazard.

Seismic Events

Earthquakes

An earthquake is "a series of vibrations induced in the earth's crust by the abrupt rupture and rebound of rocks in which elastic strain has been slowly accumulating."

In the State of New Hampshire, earthquakes are due to intraplate seismic activity, opposed to interplate activity or shifting between tectonic plates as occurs in California. The causes of intraplate earthquakes have yet to be scientifically proven. One accepted explanation for the cause of intraplate "earthquakes in the Northeast is that ancient zones of weakness are being reactivated in the present-day stress field. In this model, pre-existing faults and/or other geological features formed during ancient geological episodes persist in the intraplate crust, and, by way of analogy with plate boundary seismicity, earthquakes occur when the present-day stress is released along these zones of weakness."[22]

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[22] Alan L. Kafka, Ph.D., "Why Does the Earth Quake in New England? The Science of Unexpected Earthquakes, Revised: January 3, 2004," Weston Observatory, Department of Geology and Geophysics, Boston College. 26 January 2004. http://irc.nrc-cnrc.gc.ca/fulltext/nrcc43363.pdf

There are two scales that measure earthquakes, the Modified Mercalli (MM) and the Richter scales. The Richter scale is a measurement of magnitude of the quake as calculated by a seismograph and does not measure damage. The Modified Mercalli scale denotes the intensity of an earthquake as it is perceived by humans, their reactions and damage created. It is not a mathematically based scale but a ranking of perception.[23]

One of New England's more notable seismic zones runs from the Ossipee Mountain area of New Hampshire, through the Manchester area, and continues south toward Boston, Massachusetts. This particular area has a mean return time of 408 years for a 6.0 Richter scale earthquake or a 39 percent probability of occurrence in 200 years. Additionally for a 6.5 Richter scale quake there is a mean return time of 1,060 years or a 17 percent probability of occurrence in 200 years.[24] When New England is generalized as a whole for earthquake probability estimation, the risk increases from the specific hazard zone noted above. For New England there is an estimated return time of every 10 years for an earthquake with a 4.6 Richter scale magnitude and 1000 years for 7.0 magnitude.

There have been 360 earthquakes reported in New Hampshire since the mid 1600's, averaging approximately one quake per year.[25] There have been 10 quakes over 4.0 on the Richter scale during the Twentieth Century and none yet in the Twenty First.[26] The most recent quake in New Hampshire occurred on January 3, 2011, approximately 50 miles north of Manchester, with a magnitude of 2.6 on the Richter scale.[27] Figure 1 shows earthquake activity in the northeast United States and eastern Canada between 1975 and 2010.

All areas of the SNHCP region are potentially at risk for property damage and loss of life due to earthquakes.

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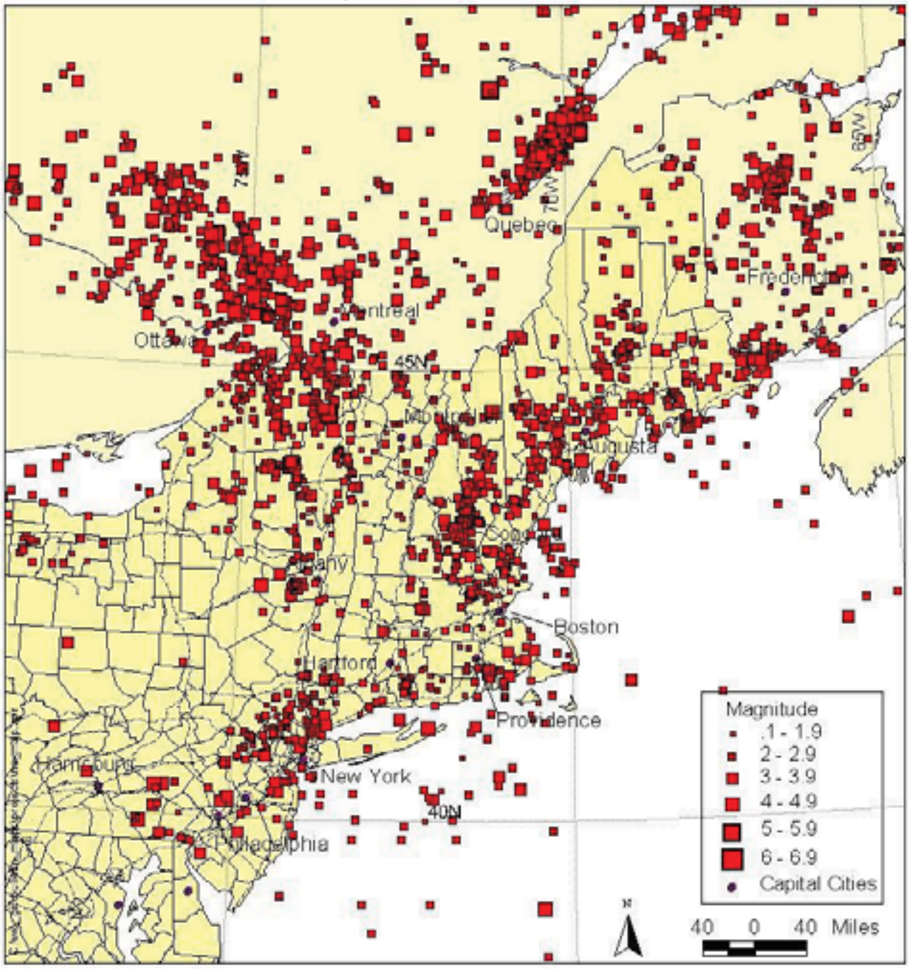
[23] USGS Magnitude / Intensity Comparison http://earthquake.usgs.gov/learning/topics/mag_vs_int.php accessed 2 May 2006.
[24] Jay J. Pulli, "Seismiscity, Earthquakes Mechanisms, and Seismic Wave Attenuation in the Northeastern United States," PhD Dissertation Abstract. MIT, June 10, 1983. 26 January 2004. http://www-eaps.mit.edu/erl/research/theses/abstracts/Pulli.html
[25] The Northeast States Emergency Consortium http://www.nesec.org/hazards/earthquakes.cfm.
[26] Pulli.
[27] USGS Earthquake Hazards Program, http://earthquake.usgs.gov/earthquakes/eqarchives/last_event/states/states_new_hampshire.php accessed 15 February, 2011.

Figure 8.1
Northeast Seismicity from October, 1975 - March, 2010



Source: Weston Observatory

Landslides
"A Landslide is the downward or outward movement of slope forming materials reacting under the force of gravity including: mudflows, mudslides, debris flows, rockslides, debris avalanches, debris slides and earth flows. Landslides may be formed when a layer of soil atop a slope becomes saturated by significant precipitation and slides along a more cohesive layer of soil or rock. Seismicity may play a role in the mass movement of landforms."

All areas of steep slopes in the SNHPC region, as shown on the Identified Hazard Zones Map, are at risk for landslides.

Other Hazards

Geomagnetism
The State of New Hampshire Natural Hazards Mitigation Plan defines geomagnetism as "…of, or pertaining to, the earth's magnetic field and related phenomena. Large geomagnetic disturbances commonly known as magnetic storms, if global in scale, or as magnetic substorms, if localized in scale and limited to night time high altitude auroral regions, are of particular

significance for electric power utilities, pipeline operations, radio communications, navigation, satellite operations, geophysical exploration and GPS (global positional system) use."

Geomagnetism includes both solar wind coupling and magnetic storms. Solar wind coupling is the relationship between solar events and winds with geomagnetic activity within the earth's magnetosphere. "Magnetic storms occur when the radiation belts become filled with energetic ions and electrons. The drift of these particles produces a doughnut shaped ring of electrical current around the earth. Magnetic storms are often initiated by the sudden arrival of a high-speed stream of solar wind, carrying high particle density and high magnetic field."

High-tension lines and communications towers are at risk in the SNHPC region.

Drought

A drought is a natural hazard that evolves over months or even years, lasting as long as several years to as short as a few months. Fortunately, droughts are rare in New Hampshire. The central theme in the definition of a drought is the concept of water deficit. The severity of the drought is gauged by the degree of moisture deficiency, its duration and the size of the area affected. The effect of droughts, or decreased precipitation, is indicated through measurements of soil moisture, groundwater levels, and streamflow. Not all of these indicators will be minimal during a particular drought. For example, frequent minor rainstorms can replenish the soil moisture without raising ground water levels or increasing streamflow.

While droughts are not as devastating as other hazards, low water levels can have negative effects on existing and future developed areas that depend on groundwater for water supply. Additionally, the dry conditions of a drought may lead to an increase wild fire risk.

All areas of the SNHPC region would be affected by a drought.

Extreme Heat

A heat wave is defined as a period of three consecutive days during which the air temperature reaches 90 degrees Fahrenheit or higher on each day. Extreme heat is an occasional and short-lived event in southern New Hampshire. While there have been no extended periods of extreme heat in Southern New Hampshire, 2010 was tied for the third hottest year on record in Concord with an average monthly mean of 48.8 degrees, 2.9 degrees above normal. The average summer temperatures in Concord in 2010 were 78.1 degrees in June, 87.4 in July, 82.9 and 75.3 in September compared to the 1971-2000 averages of 77.7 degrees for June, 82.5 for July, 80.3 for August and 71.6 for September.[28] There were 26 days where the thermometer topped 90 degrees, compared to an average of 11.4 and three heat waves in 2010. The highest temperature was 99 degrees, recorded on July 8, 2010[29].

All areas of the SNHPC region would be affected by extreme heat, in its event. Particular areas and populations at a greater risk are:

- Elderly populations and day care centers;
- Power system that may become overburdened; and

[28] NOAA Weather Data, http://www.srh.noaa.gov/data/GYX/CLACON
[29] Ibid.

- Communications negatively affected by power burden.

Extreme Cold

While most New Hampshire residents are rather habituated to the extreme cold situations in the State, and this is not a section identified by the State of New Hampshire Natural Hazards Mitigation Plan, it was decided to include a statement in this *Plan*. For the purposes of this *Plan* we will refer to extreme cold in a general manner, without a scientific definition. Periods of extreme cold pose a life-threatening situation for the SNHPC region's homeless and low-income populations. With the rising costs of heating fuel and electric heat, many low-income citizens are not able to adequately heat their homes, exposing themselves to cold related medical emergencies or death. This is an even greater concern for homeless persons who maybe unable to escape the extreme temperatures.

In Concord, New Hampshire, the average January daily mean temperature is 20.1 degrees. There are on average 21 days below 32 degrees Fahrenheit in November; 29 days in December; 30 days in January; 27 days in February; and 26 days in March. The coldest temperatures recorded for each month were –5 degrees Fahrenheit in November;
-22° in December; -33° in January; -37° in February; and -16° in March.[30]

All areas of the SNHPC region would be affected by extreme cold, in its event. Particular areas and populations at a greater risk are:

- Elderly populations and day care centers;
- Power system that may become overburdened; and
- Homeless and low income populations.

Typical Existing Mitigation Strategies

There are several programs and ordinances that are commonly used in New Hampshire either as primary or secondary hazard mitigation benefits. Below are brief descriptions of these programs and how they aid in hazard mitigation. It is important to note that each individual community is different, as are the hazards it will face. This list is intended to be a resource for possible strategies a community can employ and is not a list of the strategies any one community does employ.

Emergency Operations Plan

An Emergency Operations Plan coordinates actions and responses before, during and after emergency operations. Events planned for range from flooding and snowstorms to downed aircrafts and nuclear attack. Plans conform to guidelines by the Federal Emergency Management Agency; U.S. Nuclear Regulatory Commission; Federal Energy Regulatory Commission; the New Hampshire Emergency Management Agency; and the NH Emergency Operations Plan. The Emergency Operations Plan addresses evacuation procedures for emergency notification and routes to be taken. Additionally, it includes a Terrorism Assessment.

[30] Northeast Regional Climate Center, "Comparative Climatic Data for the United States," 26 January 2004. http://www.nrcc.cornell.edu/ccd.html

Floodplain District (Zoning Ordinance & Subdivision and Site Plan Regulations)
Floodplain District regulations apply to all lands designated as special flood hazard areas by FEMA. Encroachments, including fill, new construction, substantial improvements to existing structures, and other development are prohibited unless certification by a registered professional engineer is provided by the applicant demonstrating that such encroachment will not result in any increase in flood levels during the occurrence of the 100-year base flood. All building permit applications for new construction or substantial improvements are reviewed to determine whether proposed building sites will be reasonably safe from flooding.

Elevation Certificates
An Elevation Certificate is usually required when (1) a structure is built or substantially improved within a known flood zone, or (2) if the flood map shows a part of the lot within the flood zone and the certified foundation plan shows the house is located within the flood zone. Typically the land surveyor must supply the footing elevation.

Wetlands Regulations (Zoning Ordinance)
Wetlands regulations, contained within the zoning ordinance, can require a buffer, typically ranging from 25 to 150 feet, between all wetlands falling under the State Statutory jurisdiction of the NH Department of Environmental Services, and any building, structure or parking lot. A setback, typically between 30 and 75 feet from the high water mark, may be established between all wetlands and on-site subsurface disposal systems.

Aquifer Protection Ordinance (Zoning Ordinance)
Regulations may be established to protect, preserve and maintain the existing and potential groundwater supplies from adverse development or unwise land use practices. These ordinances are designed to encourage uses that can appropriately and safely be located within the direct and indirect recharge areas of aquifers. The Aquifer Protection Ordinance minimizes potential hazards related to the disposal of solid and hazardous waste, underground storage tanks, storage and dumping of road salt or other de-icing chemicals, including snow containing such chemicals, discharge of industrial processed waters and junk and salvage yards by prohibiting such activities in the aquifer protection zone. Further provisions can provide standards for safeguards, location of potential pollution sources, drainage and inspection for all built structures with the exception of single and two-family dwellings within the zone.

Manufactured Housing (Zoning Ordinance)
Regulations are established to provide suitable and affordable living environments in manufactured home parks and subdivisions. Minimum standards are set regulating required utilities, construction and installation methods, and foundations in order to protect the occupants and reduce the homes' vulnerability to natural disasters.

Excavation Regulations (Zoning Ordinance & Subdivision and Site Plan Regulations)
Excavation Regulations minimize safety hazards created by open excavations; safeguard the public health and welfare; preserve the natural assets of soil, water, forests, and wildlife; maintain aesthetic features of the environment; prevent land and water pollution; and promote soil stabilization.

Erosion and Sediment Control Regulations (Subdivision and Site Plan Regulations)

Erosion and sediment control regulations can be put into place to address runoff, soil erosion, and sedimentation from development sites. Efforts must be taken to minimize any impacts from stormwater runoff and erosion. Typically, the post-development peak runoff rate must not exceed pre-development rates for the two-year 24-hour storm event.

Drainage Requirements (Subdivision and Site Plan Regulations)
Engineering design standards can be set to minimize any adverse impacts from stormwater drainage.

Steep Slopes (Zoning Ordinance, Subdivision or Site Plan Regulations)
These ordinances typically remove all steep slopes of 25 percent or greater from the calculation of buildable or open space area. Generally, steep slopes in excess of 25 percent are unsuitable for building, limit the usefulness of the land, and limit safe access to the street.

Road Design Standards (Subdivision and Site Plan Regulations)
Road design regulations are usually part of the Subdivision and Site Plan Regulations. These regulations assure "safe and convenient access" to all associated lots and set engineering standards to maintain adequate visibility and safety.

Fire Protection Cistern Specifications (Subdivision and Site Plan Regulations)
Regulations governing the use, construction, and maintenance of all cisterns can be enacted. These regulations are critical for safety and the mitigation of fire hazards.

Snow Emergency Ordinance
A Snow Emergency Ordinance allows for a declaration of snow emergencies, which trigger parking bans on all listed snow emergency routes to expedite the flow of traffic and snow removal. Additionally, these ordinances can set winter parking restrictions limiting parking to one side of the street to maintain necessary road widths, traffic flow and ease of snow removal and maintenance.

Building Codes
Building codes set minimum safety standards for occupants utilizing structural, fire and life safety provisions, wind loads and design, seismic design, flood proofing, and egress design. The State building code is the 2000 International Building Code.

Housing Code
A Housing Code Ordinance ensures that all residential rental properties meet or exceed minimum standards. One item of particular importance is the need for hard-wired smoke detectors. Additionally, the housing code delineates standards ensuring proper ventilation, fire prevention, fuel tank storage, safety and sanitation, and the provision of utilities including water, sewer, heat and electricity. The State building codes for housing is the 2000 International Building Code.

Fire Codes
Generally, a Fire Code Ordinance adopts the International Fire Code and its provisions to protect residents from fire hazards in residential and non-residential facilities. Single family residences may be required to have all gas and oil fired systems inspected by the Fire Department prior to

receiving a certificate of occupancy. Commercial and industrial structures typically must have inspections reviewing sprinkler, mechanical, and fire alarm systems, structural components including firewalls. Additionally, site plans can be reviewed by the fire inspector to ensure proper hydrant placement and adequate access is provided for fire and emergency vehicles.

Hazmat/Terrorism Response
The response program covers chemical, biological, and nuclear agents and their properties, effects and identification methodology. It is typically administered through the Fire Department.

Municipal Radio Systems
Typically the Fire, Police, and Public Works Departments maintain separate, but interoperable, radio networks for day-to-day operations. The systems can also interface with regional mutual aid and State agencies.

Police
The Chief of Police is charged with preserving public peace, preventing riots and disorder. During fires the police are to prevent theft and further unwarranted destruction of property.

Water Ordinances
Regulations are established for water usage and the responsibility for maintenance of water related infrastructure designated to the property owner. These regulations aim to prevent damage to or tampering with public pipes, reservoirs or other property.

Sewer Ordinances
The purpose of a sewer ordinance is to ensure proper removal and disposal of sewage and waste water as well as the operation and maintenance of the necessary systems to do so, including sewers, drains, and treatment plant. The appropriate uses of the sanitary sewer and storm drains are established. Additional regulations are outlined for industrial pretreatment, septage disposal, and sewer construction and connection standards.

On-Site Sewage Disposal Systems
The purpose of on-site sewage disposal system regulations are to protect the public heath and well being of residents and ensure that systems are designed and constructed so they are not a public nuisance or environmentally harmful. A review of proposed plans by the Health Authority may be mandated for all new subdivisions. The ordinance usually calls for permits to be issued and sets design requirements and remediation in the event of failure.

Stormwater Management Program
The Storm Water Management Program (SWMP) is designed in conformance with the Environmental Protection Agency's mandate. Program controls include public education and outreach, public participation, illicit discharge detection and elimination, construction of site runoff controls, post-construction stormwater management in new developments, and pollution prevention for municipal operations.

Health and Sanitation
The primary purpose of the Health and Sanitation ordinance is to protect the health of residents. Several activities are typically regulated, including childcare facilities, paint removal, swimming and bathing facilities, mosquito control, solid waste and littering.

Comprehensive Emergency Management Planning for Schools (CEMPS)
Comprehensive Emergency Management Planning for Schools is available from the NH Bureau of Emergency Management. CEMPS outlines training for school teachers, administrators, and students on actions to be taken during an emergency at school.

State Dam Program
The region maintains 192 Class AA, A, B and C dams in coordination with the State Dam Program, regulated by the Department of Environmental Services, Water Division. All class B and C plans have Emergency Action Plans that include emergency notification procedures, staff assignments, warning procedures, inundation area evacuation procedures, and a formal list of plan holders.

New Hampshire Shoreland Protection Act
The Shoreland Protection Act, adopted during 1994, establishes minimum standards for the future subdivision, use, and development of all shore lands within 250 feet of the ordinary high water mark. When repairs, improvements or expansions are proposed to existing development, the law requires these alterations to be consistent with the intent of the Act. The N.H. Department of Environmental Services is responsible for enforcing the standards within the protected shoreland, unless a community adopts an ordinance or shoreland provisions that are equal to or more stringent than the Act.

Best Management Practices
The State has established Best Management Practices (BMPs) for erosion and sediment control. These BMPs are methods, measures or practices to prevent or reduce water pollution, including, but not limited to, structural and nonstructural controls, operation and maintenance procedures, and other requirements and scheduling and distribution of activities. Usually, BMPs are applied as a system of practices rather than a single practice. BMPs are selected because of site-specific conditions that reflect natural background conditions.

Additional Mitigation Strategies to Reduce Risk
The following actions are examples of mitigation strategies that serve to enhance existing hazard reduction efforts. These projects have been identified by many communities in the SNHPC region during their Hazard Mitigation planning process. These actions are generally over and above the normal scope of hazard mitigation and provide communities with a set of specific, targeted goals to reduce risk. Communities may choose to implement any number of these actions to provide further protection of life and property.

Table 8.11
Additional Mitigation Strategies to Reduce Risk

Preventative	
Action	**Hazard**
Adopt new FAA/Airport Authority noise overlay zoning codes	Aircraft
Tree maintenance program	All Hazards
Complete Comprehensive Emergency Management Protection for Schools (CEMPS)	All Hazards
Address the West Nile virus	All Hazards
Coordinate pre-construction meetings with developers and town representatives	All Hazards
Continued training for the building inspector	All Hazards
Develop and Implement a Community Warning System	All Hazards
Revise ordinances related to steep slopes to be consistent	Erosion/Landslides
Adopt the new state-wide National Electric Code 2005 edition	Fire
Limit development on unmaintained private roads	Fire/Isolated Homes
Create or update a Watershed Protection Ordinance	Flooding
Adopt and implement the new EPA stormwater management regulations	Flooding
Map dam inundation area using GIS	Flooding
Stormwater drainage maps for GIS applications	Flooding
Update flood maps (FIRMS)	Flooding
Adopt new Digital FIRMs provided by FEMA as they become available	Flooding
Discourage construction in the floodplain	Flooding
Elevate structures in the floodplain	Flooding
Create or update wetlands regulations	Flooding
Improve Hazard Zones mapping	Flooding
Post high water level warnings along susceptible ponds	Flooding
Develop a river stewardship program	Flooding
Create maintenance program for detention/retention ponds	Flooding
Develop early warning system for floodplain residents	Flooding
Purchase river gauges for major water courses	Flooding
Purchase flood-prone properties or development rights	Flooding
Coordinate with surrounding towns on the effects of Dams	Flooding
Create secondary water treatment facilities utilizing the Merrimack River	Flooding/Terrorism
Establish a transportation hazard identification system	Hazardous Materials
Establish mobile truck safety inspections near highway	Hazardous Materials
Increase the frequency and enforcement of truck safety inspections	Hazardous Materials
Replace aging Highway Department equipment	Heavy Snow
Maintain the most current wind load design building codes	Wind

Structural Projects	
Action	**Hazard**
Relocate existing utilities underground where appropriate	All Hazards
Upgrade bridges to meet seismic design	Earthquake
Build new cisterns or improve old cisterns	Fire
Improve culverts and bridges	Flooding
Pave roads and install drainage systems	Flooding
Install bridges to raise roads above flood levels	Flooding
Elevate roads susceptible to flooding	Flooding
Continue the separation of Combined Sewer Overflows	Flooding

Emergency Services	
Action	**Hazard**
Establish a source of back-up power for schools	All Hazards
Upgrade radio system	All Hazards
Update the Emergency Operations Plan to most current federal standards	All Hazards
Create inter-departmental Public Safety Training Facility	All Hazards
Create auxiliary Emergency Operations Center	All Hazards
Update the Police Department's operating policies	All Hazards
Implement the reverse 911 system	All Hazards
Create emergency vehicle turnarounds	All Hazards
Provide water for residents at the fire house during droughts	Drought
Form a community network to check on elderly populations	Extreme Heat / Cold
Revise and update Hazmat/Terrorism response	Hazmat/Terrorism

Environmental Protection	
Action	**Hazard**
Consolidate the Excavation Regulations with excavation provisions in the Zoning Ordinance	Erosion
Coordinate forest maintenance with Manchester Water Works to reduce fuel buildup	Fire
Expand watershed security - patrol and surveillance	Hazmat/Terrorism
Extend sewer to areas with onsite treatment	Hazmat/Terrorism

Source: SNHPC

Public Information	
Action	**Hazard**
Develop a public awareness program for emergency management	All Hazards
Include a report from the Hazard Mitigation Committee in the Annual Town Report	All Hazards
Create a hazard mitigation and emergency preparedness page on the town website	All Hazards
Educate the public about the Community Warning System	All Hazards
Create a disaster preparedness and response web page	All Hazards
Publish a disaster preparedness and response newspaper cutout ad	All Hazards
Present disaster preparedness and response on local cable access channels	All Hazards
Present disaster preparedness and response education at schools, senior centers, and the Town meeting	All Hazards
Create and distribute a disaster preparedness and response pamphlet for residents	All Hazards
Create and distribute educational materials for residents of isolated areas	All Hazards
Establish remote broadcasting locations linked to local cable access channels	All Hazards
Educate residents about flood mitigation	Flooding
Develop a web site for floodplain information	Flooding
Advertise the availability of the FIRMs and FIS at the Town Hall	Flooding
Create and distribute educational materials for residents of flood prone areas	Flooding
Include snow load design standards in the Construction Guideline Packet prepared by the building inspector	Snow
Post snow ordinance reminder notice in local publications	Snow
Post a notice in local publications alerting residents of the dangers of snow accumulation on roofs	Snow

Source: Auburn, Bedford, Chester, Derry, Goffstown, Hooksett, Londonderry, Manchester, New Boston, and Weare Natural Hazard Mitigation Plans

Southern New Hampshire Region Community Preparedness Program

The SNHPC is currently working with emergency management officials from all communities within the region to create an Emergency Preparedness Program. Currently in its final stages, the plan seeks to raise natural hazard and disaster awareness of all residents in the region. It also serves as a central information bank for all emergency services available within the region. Its three stated goals are:

1. Improve the percentage of the population who is prepared to be self-reliant for a minimum of 72 hours following an emergency or disaster.
2. Increase awareness in each town in the region so that a majority of the population knows the sources of information in times of emergency and disaster.
3. Improve the percentage of the population that implements preparedness activities for all types of hazards, emergencies and disaster situations.

A new preparedness website has also been created with useful information and links pertaining natural hazard and disaster events that may strike the region, as well as links to each community's emergency management website. It can be found online at www.snhrcpp.org/.

Conclusion

The Southern New Hampshire Planning Commission region is susceptible to all forms of natural disasters with the exception of volcanic eruptions. Additionally, man-made hazards pose perhaps an even greater risk since the damage resulting from natural events is compounded by structures in the man-made environment.

Communities in the region are aware of these risks and nearly all have completed individual hazard mitigation plans. However, disasters are not constrained by municipal boundaries, and regional cooperation in terms of mitigation, planning and response is beneficial in the SNHPC region. Additionally, it is becoming increasingly important to focus on sustainability in all areas of planning.

As such, it is crucial for the SNHPC Region to maintain a strong commitment to natural hazard mitigation planning in order to remain a safe, attractive and sustainable place to live and work. Hazard mitigation planning and sustainability are mutually dependent – hazard mitigation planning leads to more sustainable communities and vice versa. By employing the mitigation techniques and strategies listed here, communities can make themselves safer, more livable and more sustainable.