

Chapter IX

Natural Hazards



"Land use planning to reduce natural hazards is ultimately and fundamentally about promoting a more sustainable human settlement pattern and living more lightly and sensibly on the earth."

~ Timothy Bealley

Chapter 9

Natural Hazards

9.1 INTRODUCTION

This chapter examines the potential natural hazards to Tamworth and considers elements of the built environment which are at risk from natural hazards.

9.2 RISK ASSESSMENT

Hazard Vulnerability

It is important to know what risks Tamworth residents face from natural hazards. The **Town of Tamworth Hazards Mitigation Plan** of August 2004, compiled by Lakes Region Planning Commission, examines these risks.

The table below is adapted from the analysis of hazard vulnerability by county, which is compiled by the New Hampshire Bureau of Emergency Management (NH BEM).

Hazard Vulnerability for Tamworth

High	Medium +	Medium	Low	None
Flood	Earthquake	Drought	Extreme Heat	Tsunami
Wildfire		High winds	Subsidence	
Radon		Thunderstorm	Landslide	
Nor'easter		Hurricane	Avalanche	
Heavy Snow		Downburst		
Ice Storm		Lightning		
		Hail		

Table 9.1 Tamworth Hazard Vulnerability

It is also important to consider those elements of the built environment which are at risk from natural hazards. This list includes houses, buildings, roads, culverts, bridges and dams that are built in areas subject to flood, wildfires or other natural hazards. It also includes all locations where hazardous materials are transported or stored.

There is no way to prevent natural hazards from occurring. The frequency of these events in Tamworth is fortunately not great. But it is important to consider and prepare for these events as Tamworth plans for future growth. The goal is to minimize the potential for loss of life and property when a natural hazard occurs.

Hazard Mitigation Goals

In 1995, Tamworth' master plan listed the following hazard mitigation goals:

- To raise the standard of municipal facilities, services, and infrastructure to meet the needs of Tamworth's current and future population.
- To participate actively with regional and state highway planners to assure that major route construction or reconstruction will serve the interests of the town.
- To provide for safe and efficient traffic flow along all local roads and state highways in Tamworth.
- To provide safe ... housing for all residents.
- To guide quality commercial and environmentally sensitive and low impact industrial development to appropriate locations.

In 2004, the Tamworth Hazard Mitigation Plan outlined the following hazard mitigation goals (as adapted from the NH state goals; <http://www.nhoem.state.nh.us/mitigation/>):

1. To reduce the potential impact of natural and man-made disasters on the town's critical support services, facilities and infrastructure.
2. To improve emergency preparedness.
3. To reduce the potential impact of natural and man-made disasters on private property, the town's economy, and Tamworth's natural environment.
4. To reduce Tamworth's liability with respect to natural and man-made hazards generally.
5. To reduce the potential impact of natural and man-made disasters on the town'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 Tamworth.
6. To identify, introduce and implement cost effective hazard mitigation measures so as to accomplish the town's goals and objectives and to raise the awareness and acceptance of hazard mitigation generally.

This 2008 Master Plan makes the following recommendations concerning natural hazards (also included in Chapter 3, Implementation):

- A. The Emergency Management Director should publish and otherwise make Tamworth residents and business owners aware of the Tamworth Emergency Management Plan.
- B. The Planning Board should require that development meet the Hazard Mitigation Goals described in the Town of Tamworth Hazards Mitigation Plan.
- C. The Planning Board, Fire Chief and the Board of Selectmen should require that developments and general construction of buildings and infrastructure conform to all safety codes.
- D. The Planning Board should present to the voters for adoption a Building Code and Fire Safety Code (RSA 155-1, RSA 153-5).
- E. The Planning Board should prohibit development in areas subject to flooding or wildfire.
- F. The Board of Selectmen with the Emergency Management Director should provide for the frequent inspection of roads, dams, culverts and bridges to verify that they are safe and take the appropriate action if they are not.

"No single approach to bringing hazards mitigation into existence shows more promise at this time than increased use of sound and equitable land-use management."

~Dennis Mileti

9.3 PROFILING HAZARD EVENTS

Flood

Flooding, whether from heavy rains or ice jams, carries great risk for the town of Tamworth. The Bearcamp, Chocorua, and Swift Rivers all flood seasonally. There are twelve active dams in Tamworth, eleven of which have an AA classification. The Chocorua River has one Class A dam. According to N.H. Bureau of Emergency Management, Class A dams have a low hazard potential, while failure of Class AA dams poses no threat to life or property.

State records indicate that some flooding events affect the entire state, while others have a more local impact. Since 1936, there have been five statewide flooding events and six others that have impacted the Saco watershed or Carroll County.

Seven ice jams were recorded in Tamworth from March 1, 1966, to February 28, 2000 by the U.S. Army Cold Region Research and Engineering Laboratory (CRREL). The jams occurred along the Bearcamp River and Cold Brook.

Wildfire

Since 1900 there have been five large fires in Carroll County, each burning more than 1,000 acres. The largest fire charred more than 10,000 acres in Conway. In 1907 there was a fire that burned 10,000 acres along the Swift River. Large fires such as this have been rare in New Hampshire. Although N.H. averages 500 fires per year, the average size of each fire is 0.5 acre or less due to the coordination between fire towers and local fire departments.

The Division of Forests and Lands of N.H. Department of Resources and Economic Development (DRED) express concern that the ice storm of 1998 left a significant amount of woody debris in our region's forests which may fuel future wildfires.

Note that there are two sections of Tamworth's forestlands that are considered Sensitive Zones due to the threat of fire. The pine barrens in the area of Chocorua Ski and Beach is a habitat type prone to fires. There is a large area in the western part of town that has limited firewatch coverage because of topological features.

Radon

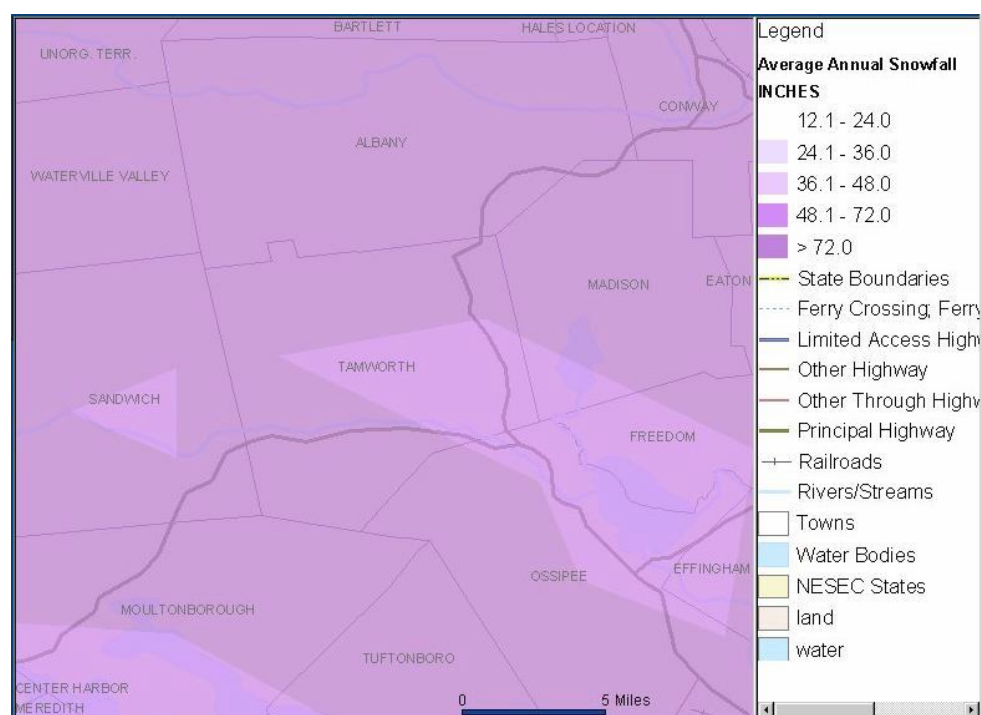
Radon is a naturally occurring, radioactive gas created from the decay of the element radium. Radon occurs in certain rock formations, especially those found in much of New Hampshire. Radon levels can build up in an enclosed underground structure, such as a basement. EPA has estimated that radon in indoor air is responsible for about 13,600 lung cancer deaths in this country each year (EPA document, EPA 811-R-94-001, 1994).

According to testing done by the State and compiled in 1999, Carroll County has the highest radon levels in the state. Tamworth was one of several Carroll County communities where 25% or more of the homes tested exceeded the state and federal threshold (greater than 4% pCi/l).

Heavy Snow

Snowstorms are a common occurrence throughout Carroll County. Blizzards, which may dump 12" – 36" or more in a one- to three-day period, are less frequent but can have a serious impact on structures, utilities, and services.

Between 1955 and 1985, the mean annual snowfall for this region of New Hampshire was between 6.5 and 8.0 feet. During this same time there were seven major snowstorms that impacted this region.



Map 9.2: Average Snowfall

from <http://www.nesec.org> (Northeast States Energy Consortium)

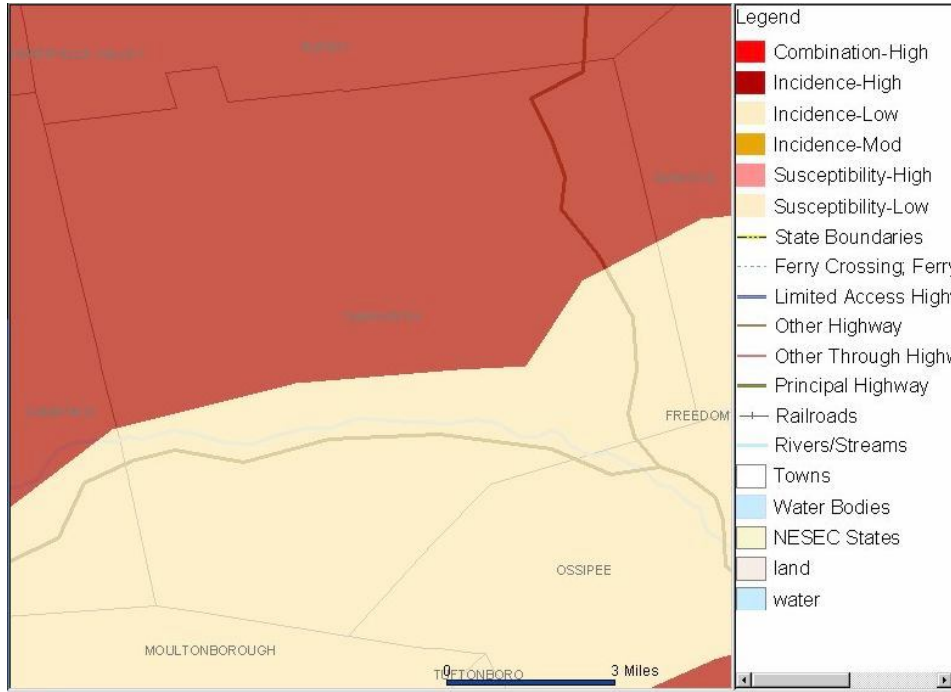
Ice Storm

A winter storm need not drop a great deal of snow to have a major impact on a community. During an ice storm, the major threats to a community come from hazardous road conditions, structural damage due to heavy loads on roofs, and interruptions to services such as electricity, fuel, water, and communications.

According to CRREL (U.S. Army Cold Region Research and Engineering Laboratory), New Hampshire has had five major ice storms. During the 1998 statewide storm, most of Tamworth escaped with only light damage, while surrounding communities experienced moderate to heavy damage. CRREL expects a 40-90 year return period for storms of this severity.

Landslide

The northern section of Tamworth is rugged and has many land parcels with slopes greater than 20%. Steep slopes, in combination with certain rock formations, lead to the high susceptibility to landslides in this section of town. No information was found that indicated that Tamworth has experienced landslides.



Map 9.3: Landslide Potential

from <http://www.nesec.org/> (Northeast States Energy Consortium)

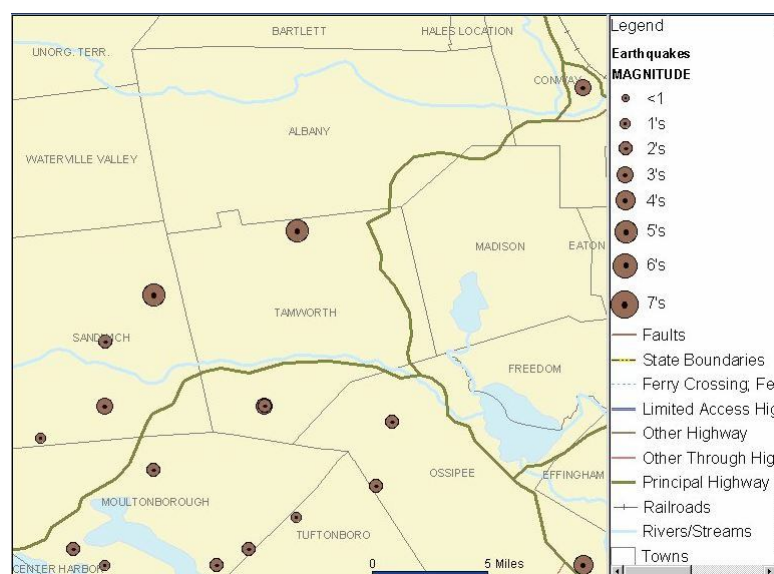
Avalanche

The New Hampshire Bureau of Emergency Management (NH BEM) lists Carroll County as a high risk area for avalanches. To date, no information has been found indicating that avalanches have occurred in Tamworth. The northern and western sections of town do receive heavy snowfalls and the steep slopes in the northern half of town would indicate the possibility of avalanche.

Earthquakes

The chance of a damaging earthquake of magnitude 5.0 or greater in any given year in New England is 1 in 20. The strongest earthquakes to date to strike New Hampshire in the twentieth century occurred December 20 and 24, 1940, near the town of Tamworth. Both earthquakes had a magnitude of 5.5 and were felt over an area of 400,000 square miles. An indication of the extent of this earthquake is that Christmas trees fell over in Albany,

New York. Most of the chimneys in the epicentral region of Tamworth suffered some damage, ranging from cosmetic cracks to total collapse. Sections of several foundations collapsed, and at least one house rotated on its foundation.



Map 9.4: Earthquakes

from <http://www.nesec.org/> (Northeast States Energy Consortium)

New England Earthquakes²

(with a magnitude 4.2 or more)

1924 - 1989

New England Location	Date	Magnitude
Ossipee, NH	December 20, 1940	5.5
Ossipee, NH	December 24, 1940	5.5
Dover-Foxcroft, ME	December 28, 1947	4.5
Kingston, RI	June 10, 1951	4.6
Portland, ME	April 26, 1957	4.7
Middlebury, VT	April 10, 1962	4.2
Near NH Quebec Border, NH	June 15, 1973	4.8
West of Laconia, NH	Jan. 19, 1982	4.5

Information in this table comes from a NESEC publication.

Table 9.5: New England Earthquakes

Drought

Since 1947, N.H. has experienced seven droughts lasting two or more months, according to the Northeast Regional Climate Center in Ithaca, NY. The anticipated recurrence interval for such droughts ranges from ten to more than 25 years. The New Hampshire Drought Management Plan was developed by the N.H. Department of Environmental Services, and published in 1990.

Severe Wind Events

Tamworth is at risk from several types of natural events associated with high winds. These include hurricanes, microbursts, macrobursts, tornadoes, and nor'easters.

Nor'easters

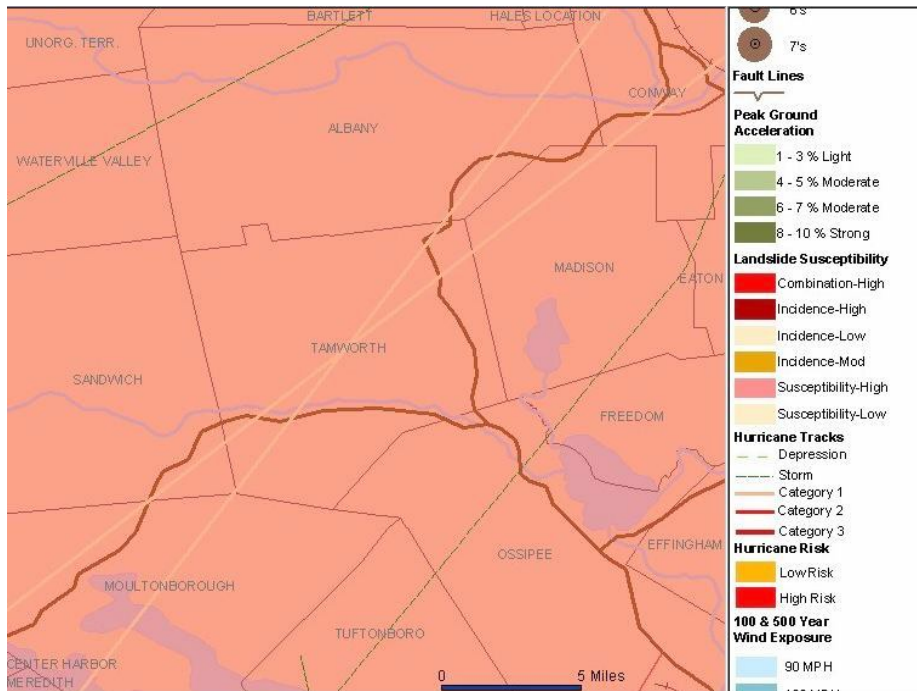
Unlike the relatively infrequent hurricane, New Hampshire generally experiences at least one or two nor'easters each year with varying degrees of severity. These storms have the potential to inflict more damage than many hurricanes because high winds can last from 12 hours to three days, while the duration of hurricanes ranges from six to 12 hours. Infrastructure, including critical facilities, may be impacted by these events, including power outages and transportation disruptions due to snow and/or debris impacted roads.

In the winter months, the state may experience the additional coincidence of these events with blizzard conditions. The added impact of masses of snow and/or ice upon

infrastructure often affects transportation and the delivery of goods and services for extended periods.

Hurricane

According to N.H. Bureau of Emergency Management, there were two hurricanes in the 1960s and two in the 1970s that impacted central New Hampshire. Hurricane Gloria in 1985 tracked through the center of Tamworth with winds of 75 miles an hour, as did an unnamed hurricane in 1893. Hurricane Floyd also caused damage in 1999.



Map 9.6: Hurricane Tracks

from <http://www.nesec.org/> (Northeast States Energy Consortium)

Tornadoes

According to the Northeast States Energy Consortium (NSEC), Tamworth is in a zone that is susceptible to three to four tornadoes per year. However, only one has actually been reported in Tamworth.

Downburst

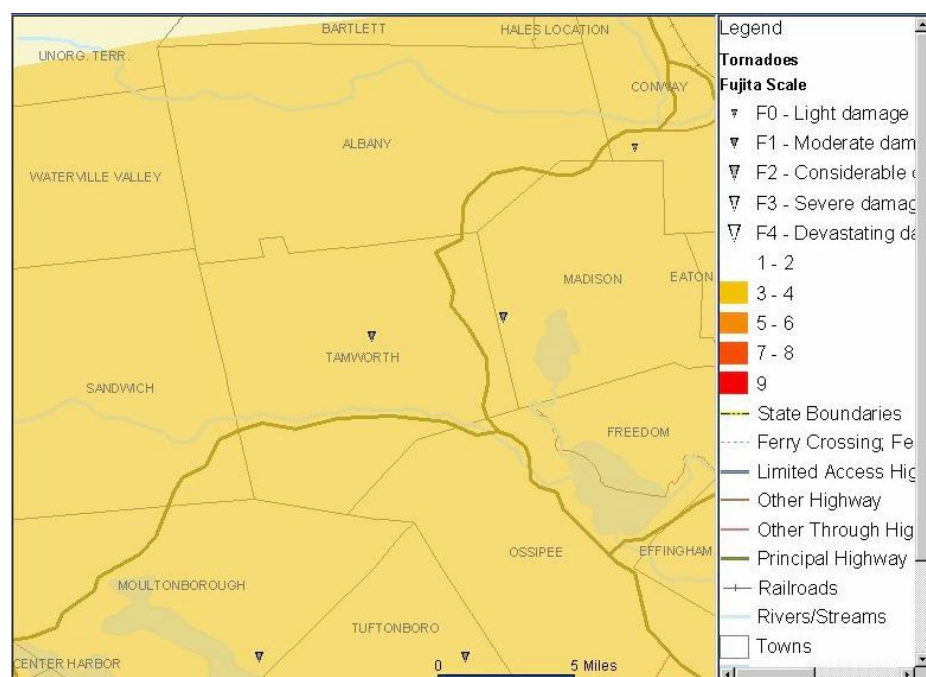
According to the National Oceanic and Atmospheric Administration (NOAA), a downburst is a strong downdraft, which causes damaging winds on or near the ground. Winds can exceed 130 mph. Downbursts are 10 times more likely to occur than tornadoes. Downbursts fall into two categories based on their size: *microbursts*, which cover an area less than 2.5 miles in diameter, and *macrobursts*, which cover an area at least 2.5 miles in diameter.

In 1994 a macroburst in the neighboring town of Moultonborough affected approximately 2.5 square miles and left 1,800 people without power.

Thunderstorm

Hail associated with thunderstorms can cause damage to crops and some cosmetic damage to vehicles. No record of hail events in Tamworth has been found.

The annual average of lightening strikes in this region is two to four lightening strikes per square kilometer.



Map 9.7: Tornadoes

from <http://www.nsec.org/> (Northeast States Energy Consortium)

Human Hazards

Vehicular Accidents

According to the University of New Hampshire's Technology Transfer Center data, between 1996 and 2000, there were 173 crashes on the roads in Tamworth. The majority of these accidents occurred in 1996 and 1997, and most were along Routes 16, 25, and 113.

Only the data for 1998-2000 indicates whether an accident involved overturned vehicles, jackknives, hazardous materials, fires, or explosions. There were 72 accidents during this

three-year period. Only one is reported to have involved an overturned vehicle. None of the other potentially dangerous accident types occurred during this timeframe.

Dams, Culverts, and Bridges

During flood events, dams, culverts, and bridges become vulnerable to blockage. The Tamworth Hazard Committee was concerned with how such a blockage might impact access to and evacuation of people.

There was also concern about the weight limits on some of the bridges, especially in the northern section of Tamworth. This limits the ability of fire trucks from other communities to provide mutual aid.



"It's New England. Anything can happen."
~Lawrence S. Little