Two Rivers-Ottauquechee Regional Commission

REGIONAL (MULTI-JURISDICTIONAL)

PRE-DISASTER MITIGATION (PDM) PLAN

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OVERVIEW OF PLAN

This plan is a regional, or multi-jurisdictional, pre-disaster mitigation (PDM) plan that covers all of the towns in the TRORC service area, and that, with the relevant local annex, constitutes each town's PDM plan as well. This regional approach is taken as the resources and time to complete local plans is very limited, there is essentially no paid local staff to work on this planning process, the hazards between the towns in the region do not vary widely, and there are economies of scale in dealing with much of the underlying data on a regional basis.

This plan is meant to be compliant with the Disaster Mitigation Act of 2000 (DMA2K) and subsequent rules and guidelines from the Federal Emergency Management Agency (FEMA). A crosswalk showing where this plan contains the necessary elements as specified in these guidelines is in Appendix III. The plan contains several sections that describe the planning process, delineate the hazards facing the region, rank the hazards and estimate potential damages, set mitigation goals, describe desired mitigation measures, and propose a method to keep the plan updated.

The overall goals of this plan are:

1) To reduce the loss of life and injury resulting from all hazards.
2) To lessen financial losses and property damage incurred by municipalities, businesses and private citizens due to disasters.

Area covered by this Plan

This plan covers all 30 towns in the Two Rivers-Ottauquechee Regional Commission's(TRORC) planning area. These are located in parts of four counties of Vermont. These towns are Granville and Hancock in Addison County; Bradford, Braintree, Brookfield, Chelsea, Corinth, Fairlee, Newbury, Randolph, Strafford, Thetford, Topsham, Tunbridge, Vershire and West Fairlee in Orange County; Pittsfield in Rutland County; and Barnard, Bethel, Bridgewater, Hartford, Hartland, Norwich, Plymouth, Pomfret, Rochester, Royalton, Sharon, Stockbridge and Woodstock in Windsor County. The towns of Norwich, Hartford, and Hartland were not covered by TRORC until 2004.

Relation of Plan to Overall Emergency Management Planning

The impact of expected, but unpredictable in terms of timing, natural and human-caused disaster events on the Region can be reduced through proper emergency management. Emergency management is generally broken down into four areas: preparedness, response, recovery and mitigation. This plan only covers mitigation, but it is important to understand how this plan fits into this larger picture.

Preparedness includes training personnel, acquiring sufficient equipment and conducting drills or exercises. Emergency responders should be trained and equipped to respond to anticipated disasters. Exercises should be conducted often to ensure that response plans are workable, and after action reports (AARs) should be written following exercises or actual emergencies that detail steps to improve response and recovery.

Response is the initial emergency response to save life and property during and immediately after the disaster, and is initiated by local emergency crews and then followed up by outside forces if necessary. Regional preparedness and response planning is covered under a separate document that is being developed for the region by the Local Emergency Planning Committee (LEPC#12). The LEPC is tasked by state and federal statute with planning for hazardous materials preparedness and response, but they have expanded this mission to an all-hazards approach. Municipalities may be able to use the LEPC plan to augment any local planning. Planning at the LEPC level will also help to coordinate municipal planning. Local response planning should at least include a Rapid Response Plan (RRP) that is up to date. Many towns have developed, or are developing, Emergency Operations Plans (EOPs) that include hazard-specific annexes.

Most local disasters will quickly overwhelm local forces and need state or federal assistance. The State of Vermont's Division of Emergency Management (VEM) has developed the State Emergency Operations Plan (SEOP) to coordinate this level of response. A critical connection between local and state response plans will be the timely communication of information. Local needs during an emergency should be accurately and quickly gathered by the state, and opportunities for state and federal help should be clearly communicated to towns.

Recovery is the more long-term process of putting life back to normal, and includes many state and federal agencies, especially the Federal Emergency Management Agency (FEMA) in large disasters. VEM has a recovery plan in place in terms of how it will assist local governments and individuals following a federally declared disaster. The actions to be taken by the state following disasters that are not federally declared is less clear. Most towns and major institutions do not have formal recovery plans, but one of the methods that towns can use to address this lack is through the development of a Continuity of Operations Plan (COOP). Such planning will ensure that local and regional emergency and governmental facilities can function during and after disasters.

Mitigation means any sustained action that reduces or eliminates long-term risk to people and property from natural or human-caused hazards and their effects. Though this plan is titled a pre-disaster mitigation plan, it will also be useful in post-disaster efforts to avoid a repeat of the effects of disasters. This plan, with annexes, is designed to cover this phase of emergency management at the regional and local level.

PLANNING AND INPUT PROCESS

This Regional PDM plan was developed in coordination with all of the towns in the TRORC region, neighboring regions through their regional planning commissions, and Vermont Emergency Management (VEM). The development of the plan was publicized in TRORC newsletters that are sent to over 750 citizens, organizations, and local officials in our region. Our website (www.trorc.org) also carried news of the plan's development. Input on this plan and local annexes was sought by placing an ad in the regional newspaper, sending letters to all town Selectboards (the local legislative bodies) and the posting of a notice that this plan was being drafted in each town office. The TRORC region is rural and there are few non-profit organizations and local businesses of size that would be concerned with mitigation efforts, however the public notice, web presence and newsletter articles serve to sufficiently notify anyone interested in this effort. Our Local Emergency Planning Committee (LEPC #12) also represents all of the towns and emergency disciplines in the region, and they are kept abreast of any planning (such as PDM) related to emergency management at their bimonthly meetings. As the LEPC members are largely emergency responders, they are directly affected by disasters and are used to make sure that hazard priorities are properly ranked.

This plan builds upon previous planning efforts, as much of the basic hazard inventory and risk assessment was adopted previously as part of the TRORC Regional Plan. The TRORC Regional Plan was adopted on May 30, 2007 by the TRORC Board of Directors following three publicly noticed hearings that were held throughout the region. The TRORC Board is made up of regional commissioners appointed by the legislative bodies of all member towns. Excepting small changes, this Regional PDM plan was also approved by the TRORC Board in December 2006, and will be formally adopted again once conditional approval from FEMA is granted.

The best available data for the regional and local levels were used in the plan development, and in many places it should be acknowledged that this data is not very detailed. Where more refined data would be helpful, this has been noted as a mitigation measure to be taken. During the plan's development, TRORC worked with other regional planning commissions and VEM to coordinate sources of data and to understand the requirements of this planning process. TRORC staff have attended FEMA Region I mitigation retreats, the national State Hazard Mitigation Officers conference, as well as a two-day FEMA instructional workshop on mitigation planning in order to be prepared to write this plan.

Work on the local annex for each town was done in direct consultation with their Selectboard, and generally also involved local emergency management officials, road foremen/commissioners, and the fire chief (see Appendix V). Mailings were sent to town officials before these meetings and follow-up meetings were held with many towns. These meetings are publicly noticed meetings. For readers unfamiliar with the area it should be noted that with few exceptions, there are no public works departments in our towns, and most disaster damage is road damage caused by flash flooding. Nearly all emergency services are volunteer-based within our region. Many towns have zoning and nearly all have flood hazard area regulations, but there are no building codes that are locally adopted and enforced in our region. Local annexes (found in Appendix II) were also developed through discussions about the process with municipal representatives at our regional LEPC, which has responders from EMS, fire, and police as well as local emergency directors/coordinators (see Appendix V for a complete roster), and through a review of municipal Comprehensive Plans that had been adopted by each town's legislative body following at least two publicly noticed hearings.

RISK ASSESSMENT

Identification of Hazards and Vulnerability Assessment

Mitigation efforts must be grounded in the rational evaluation of hazards to the area and the risks these hazards pose. This is done through a process, which in essence asks and answers three basic questions:

- What bad things can happen?
- How likely are they to occur?
- How bad could they be?

This process, which is laid out below, attempts to inventory the known hazards, establish the likelihood of them occurring and assess our vulnerability to the risks that they pose. Although information on some hazards is sketchy, performing such an analysis enables us to lay the groundwork to prioritize actions designed to mitigate the effects of each of these disaster types.

It is important that we learn from the past in order to avoid the same disasters and their outcomes. Disasters that have occurred within the region itself give us very good information about what types of disasters we can expect and what they might cause. Looking at what disasters have occurred in the state, surrounding states, and even the nation can also give us a good idea of less common events that still might affect our region. Using hazard histories from the region, state, and nation and given our region's natural and manmade environment, hazards that could potentially affect the region and its towns are:

- Flood
- Structural Fire
- Winter Storms (Snow blizzards and ice storms)
- Technological Hazards (Hazardous materials spills, plane crashes, train derailments, motor vehicle pileups, dam failures, power outages)
- Severe Weather (Thunderstorm/Lightning/Hail/Tornado)
- Hurricane and Tropical Storm
- Epidemic and other Health Threats
- Terrorism and Civil Hazards
- Drought/Wildfire
- Climate Change
- Landslide
- Displaced Persons
- Earthquake
- Extreme Temperature
- Infestation/Invasive Species
- Shortage

Due to the location and physical properties of the region, there are no hazards associated with coastlines or volcanism.

Hazard Profiles

Overall, the region is relatively homogenous, and unless otherwise noted, the likelihood of a particular disasters occurring in any town is equal. Where a local jurisdiction would have a different likelihood than the region based on individual circumstances, this is noted in the local annex

Below, we have separated each of the potential hazards that could affect the region, and assigned them a regional frequency rating.. For this plan, hazard frequency was classed as follows:

Rare	May never have occurred in the state or has an annual probability .01 or less.
Unlikely	Has occurred in the state or has an annual probability of .01 - .04.
Unusual	Has occurred in the region or has an annual probability of .04 - .1.
Frequent	Occurs often in the region, although in varying degrees, annual probability of .1 - 1.

Each hazard was also assigned a general local level of severity. Again, this does not differ widely from town to town, but if there are exceptions, this is noted in the local annexes. The severity levels are designated as follows:

Minor	Minor injuries or illness, <10% of properties damaged, minimal disruption of quality of life, within local ability to handle.
Serious	Limited major injuries or illness that do not permanently disable, 10-25% of properties damaged, shutdown of critical facilities for more than a week, mutual aid systems activated and state resources needed, possible federal resources needed.
Extensive	Multiple severe injuries or illness, few fatalities, 25-50% of properties damaged, critical facilities shut down for >14 days, state resources activated, federal resources needed.
Catastrophic	Multiple fatalities, widespread injuries, >50% of properties damaged, critical facilities shut down for >30 days, state and federal resources needed.

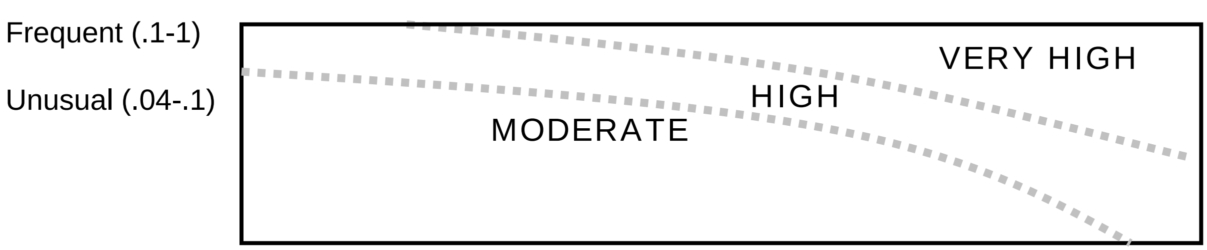
Vulnerability (Risk)

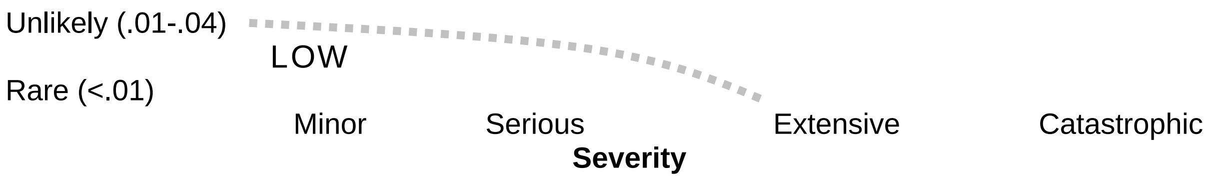
The combination of the probability or likelihood of a hazard occurring (frequency) and its potential effect (severity) creates a *vulnerability* to each type of hazard. The sense of vulnerability or risk is very important because it is what motivates people to take action to avoid the dangers from a hazard and prepare for what cannot be feasibly avoided. However, this sense should be an informed one, not driven by hysteria or popular misconceptions. As you will see from the Figure 1 below, in determining what level of vulnerability to assign, the likelihood of an event is rated slightly stronger than its severity. This is because frequent events are more well known, can be anticipated with greater accuracy, and can be mitigated against with less resources. Consequently, a frequent but minor event may be rated as a high risk, while a rare yet catastrophic event might only rated a moderate risk.

The vulnerability of the region to each type of hazard is discussed below and summarized in Figure 2. Luckily, we live in region that has no very high risks. Unless noted otherwise, this regional vulnerability for each hazard applies to all towns. Maps showing overall risk or varying levels of risk are found in Appendix I. Town scale maps, where appropriate, are shown in the local annexes in Appendix II.

Figure 1: Vulnerability as a Product of Severity and Frequency

Frequency (events/yr)





Discussion by Hazard Type

Flood

We know that flooding has hit the region in the past and that it will again in the future. The flooding has been of two types – rain and/or snowmelt events that are more widespread in nature and cause flooding in the major rivers' floodplains, and localized flash flooding caused by unusually large rainstorms over a small area. Both kinds of events can be worsened by ice or debris dams and the failure of infrastructure (especially culverts), private dams and beaver dams.

The worst flood disaster to hit the region and the state occurred on November 3, 1927. This event was caused by nearly 10 inches of heavy rain from the remnants of a tropical storm that fell on frozen ground. 84 Vermonters, including the Lieutenant Governor were killed. The flooding in the White River valley was particularly violent, with the river flowing at an estimated 900,000 gallons per second on the morning of the 4^{th} (Vermont Weatherbook). A prime example of the damage done was in Gaysville in Stockbridge. This village had a large mill, church, stores and many residences and was essentially scoured to bedrock during the 1927 flood.

The worst widespread spring flooding occurred on March 13-19, 1936, when slow-moving storms with warm air combined to drop around eight inches of rain on the late winter snowpack that had a water equivalent of ten inches. The most recent widespread flood occurred on June 28-30 in 1973, when up to six inches of rain fell. This was the worst flooding since 1927 in many places. A Presidential disaster was declared for the entire state and damage was estimated at $64 million (nearly a billion dollars in today's value).

Within the last several years there have been almost annual floods that have impacted smaller areas, usually the result of intense summer thunderstorms. An example of this was torrential rains in the summer of 1998 that the Bradford and Randolph areas received. The most recent flooding was in July 2007 that hit Stockbridge, Bethel, Randolph and Braintree.

Recent studies have shown that the majority of flooding in Vermont is occurring along upland streams, as well as along road drainage systems that fail to convey the amount of water they are receiving. These areas are often not recognized as being flood prone and property owners in these areas are not typically required to have flood insurance *(DHCA, 1998).* Furthermore, precipitation trend analysis suggests that intense, local storms are occurring more frequently. TRORC has worked with Vermont's River Management Program to educate the public and local officials about the dangers of lateral riverine (fluvial) erosion through mapping of some fluvial erosion hazard zones and trying to get these hazard areas addressed in local flood regulations. While there is the potential that flooding could be exacerbated by dam failures due to extreme high water, no failure of a small dam is known in the region, and none of the larger dams are considered as a risk outside of an extreme high water event.

Frequency: Frequent to Unusual
Severity: Minor to Extensive
Vulnerability: High

Structural Fire

Vermont has one of the highest per capita death rate from fire in the nation. This is in fact the deadliest form of disaster throughout the state. In 2000, there were 831 structural fires in the state (an average of more than 3 per town), 12 of which resulted in 22 civilian deaths, 20 of which occurred at residences. Although there have been requirements for smoke detectors in rental housing for over 20 years, and requirements for smoke detectors in single family dwellings since 1994, there was only one building involved in the fatal fires in 2000 that had evidence of working smoke alarms.

Less frequent, but locally catastrophic, are the major downtown fires that can destroy town centers. The villages of Woodstock, Randolph, Bethel, South Royalton and Bradford are vulnerable to this hazard due to large numbers of closely packed older structures that commonly lack sprinkler systems. Most of these have had such horrendous fires in the earlier 20th century. A fire in an unprotected downtown can be devastating. For example, in a 15-month period between December of 1991 and July of 1992, 55,000 square feet of the Randolph Village business district was lost to fire. The Colby Block in Fairlee was the latest victim of a downtown fire destroying a core part of one of our villages.

Frequency: Frequent to Unusual
Severity: Locally Extensive
Vulnerability: High

Technological Hazards

Technological hazards are hazards created by man-made substances, facilities or actions that threaten people or property. This includes train derailments, airplane crashes, vehicle crashes, hazardous materials spills or leaks, explosions, radiation hazards, noxious or poisonous fumes, dam failure and structure collapse. Far and away, the greatest occurrence of this type of hazard is transportation-related spills of petroleum-based liquids or gases, and therefore that is the only hazard subset looked at under this hazard type. Since the region has busy highways and Interstates 91 and 89, active rail lines, fuel storage facilities and hazardous materials there is certainly the potential for these types of events, and in fact, though these types of events are uncommon, a few occur in the region each year, with the most notable event being a propane rail car explosion in Fairlee in 1974. Data on what is transported over roads and rails is very limited, but by volume and accident data, the most probable events are petroleum related. This hazard is present in all towns, as they all have major roads. However, towns with facilities with large amounts of chemicals or fuel, and towns with an interstate highway or an active rail line are more at risk. Spatial information on facilities is still not readily available, so a standard distance of effect of 1,000 feet was used to buffer major roads and rail lines to arrive at a potential area of effect. See maps in Appendix I.

Frequency: Unusual
Severity: Minor to locally Extensive
Vulnerability: Moderate to High based on presence of materials or transportation routes

Winter Storm

Winter storms are a regular occurrence in Vermont. However, severe winter storms can cause serious damage, including collapse of buildings due to overloading with snow or ice, brutal wind chills, downed trees and power lines and stranded vehicles. People can be at risk of freezing in extended power outages if they lack wood heat or backup power, and individuals shoveling large accumulations of snow can also be at risk from frostbite, hypothermia and heart attacks due to cold and overexertion. While snow removal from the transportation system is standard fare in Vermont winters, extreme snow or ice can close rail and road systems, further jeopardizing any stranded persons that are in danger of freezing or needing medical assistance.

Severe winter storms include a blizzard on February 15-17 in 1958 that dumped over 30 inches and resulted in 26 deaths in New England. On December 26-27 in 1969, another blizzard left 18-36 inches of snow in northwestern Vermont and a whopping 45 inches in Waitsfield. Then-Governor Dean Davis declared a state disaster. Drifts of snow from that storm piled up to 30 feet in places. Very recently, a string of storms in March 2001 hit the state, beginning with 15-30 inches on March 5-6 (later declared a federal disaster), 10-30 inches on the 22nd and 10-20 inches on the 30th. Brookfield received nearly 50 inches of snow from these storms. Recent years have seen wet sow storms that have leveled trees and caused widespread power outages.

The worst winter storm in terms of damage to hit the state recently was not a snow storm, but an ice storm. In January of 1998, just the right combination of precipitation and temperature led to more then three inches of ice in spots, closing roads, downing power lines, and snapping thousands of trees. This storm was estimated as a 200-500 year event. Power was out up to 10 days in some areas and 700,000 acres in of forest were damaged in Vermont. Amazingly, we had no fatalities, unlike Quebec where 3 million people lost power and 28 were killed. Thankfully, the temperature rose after the storm, melting the ice and permitting crews to reopen roads and keeping many residents from freezing in their unheated homes. Mapping of this hazard is still being developed, but may indicate a gradient of higher snow load risk the further northward one goes. A map showing vulnerability to this hazard will be added when available.

> Frequency: Unusual to Rare
> Severity: Serious to Extensive
> Vulnerability: Moderate (for the more frequent events) to High (for rarer, but more destructive events)

<u>Hurricane/Tropical Storm</u>

Hurricanes (storms with sustained winds greater than 74 mph) rarely reach as far inland as Vermont; more often they have weakened to tropical storms. In either case, the high winds, heavy rains, and large affected areas from hurricane or tropical storms can make these rare events major disasters. The most infamous example of this was the disastrous hurricane of 1938. On September 21, 1938 a very fast moving hurricane hit Vermont in the early evening, but was moving so fast that wind damage was more severe than damage due to rain in places. However, there was severe flooding as over 4 inches of rain accompanied the storm and followed upon the heels of preceding storms that had saturated the ground and raised river levels. Buildings were lost, power lines downed, and many trees were felled. Much more recently, Tropical Storm Floyd in September 1999 caused flooding and wind damage in parts of Vermont, as well as one fatality, and resulted in a federal disaster declaration. The vulnerability to this hazard is homogenous across the region. See the historic storm tracks in Appendix I.

> Frequency: Unlikely
> Severity: Minor to Catastrophic (if widespread)
> Vulnerability: Moderate

<u>Severe Weather (Thunderstorm, Lightning, High Winds, Hail, and Tornado)</u>

More common than hurricanes or tropical storms are severe thunderstorms (usually in the summer), which can cause flooding as noted above, and be associated with lightning, high winds, hail and tornadoes. Hailstorms have occurred in Vermont, usually during the summer months. While local in nature, these storms are especially significant to area farmers, who can lose entire fields of crops in a single hailstorm. Large hail is also capable of property damage. 107 hail events were recorded between 1959 and 1992 in the state, making hail an annual occurrence in some part of the state. Most of these events had hail measuring .75 inches, but many had hail at least 1.5 inches in size. The largest hail during the period was 3-inch hail that fell in Chittenden County in 1968 (NCDC). Tennis ball-sized hail was reported in the town of Chittenden during a storm in the summer of 2001.

Thunderstorms can generate high winds, such as hit the region on July 6, 1999, downing hundreds of large trees in a few minutes. The region can also experience tornadoes, which are capable of damaging or destroying structures, downing trees and power lines and creating injuries and death from collapsing buildings and flying objects. Tornadoes are less common than hail storms and high winds, but have occurred throughout Vermont. In fact, 34 tornadoes were recorded between 1950 and 1999, injuring 10 people and causing over $8.4 million dollars in estimated property damage. Nearly all of these occurred from May through August and most of these occurred in the afternoon when thunderstorm activity is highest due to heating of the atmosphere. Tornadoes are classed by wind speeds from 40 –318 miles per hour (mph) and placed into five categories (F0-F5). All recorded tornadoes in Vermont have either been FO (40-72 mph winds), F1 (73-112 mph winds) or F2 (113-157 mph winds). Interestingly, F2 tornadoes are the most common of the three classes recorded in the state. The occurrence of these hazard events is widespread, so there is no individual town ranking. See the map in Appendix I.

Frequency: Unusual to Unlikely
Severity: Minor to Extensive (if widespread)
Vulnerability: Moderate

Epidemic and other Health Threats

Contagious diseases that are fatal or cause serious illness are generally not thought of a hazard, but even the annual flu season causes thousands of deaths nationwide. The great influenza epidemic of 1918 killed millions worldwide and would likely cause hundreds to thousands of deaths in Vermont should a similar outbreak occur again. In fact, it is anticipated that a more serious strain of the usual flu will occur some year and that vaccines would not be ready before it arrived in Vermont. Discussions with Susan Schoenfeld, VT State Epidemiologist, indicate that a fatal outbreak of the influenza virus is not a matter of “if”, but “when”. Significant planning has gone into monitoring avian flu and preparing for a pandemic over the last several years and CDC is taking this threat seriously. Relative to this, additional concerns revolve around the lack of surge capacity in the medical system to handle a huge increase in patients. Sufficient stockpiles of medicine are less of a concern after the development of the Strategic National Stockpile.

Other diseases such as HIV/AIDS, cholera, malaria or resistant tuberculosis are major disasters in some parts of the world, but not very prevalent here. A major disaster that caused water supplies to become contaminated or resulted in people eating spoiled food could have health implications. Rabid animals could be a local threat. A health threat might also be as a result of a bioterrorist act covered above. This threat is homogenous across the region, and is not mapped in Appendix I.

Frequency: Rare
Severity: Serious to Catastrophic
Vulnerability: Moderate

Terrorism and Civil Hazards

Terrorism and civil hazards include actions that people *intentionally* do to threaten lives and property. They may range from a single person on a shooting rampage, to a cyberattack that harms computer systems to the organized use of weapons of mass destruction (WMD). WMD events could involve chemical, biological, explosive, incendiary or radioactive weapons. A risk/threat assessment of potential WMD attacks was conducted by VEM and the Vermont State Police in 2000 that ranked potential targets by State Police district. At that time, no known or suspected terrorists (potential threat elements) were operating in Vermont, but the FBI was aware that many terrorist organizations have cells in the Montreal area, only 40 miles from the State (6/01 3-year Statewide Domestic Preparedness Strategy).

Additional analysis of the threat from terrorism is ongoing, due to the actual use of hijacked aircraft as flying bombs and biological weapons (anthrax in letters) in September and October, 2001. Vermont has a Terrorism Task Force and Homeland Security Unit that has outlined immediate needs of the State to better anticipate and respond to terrorism. For the moment, the most probable (though unlikely) attack considered by the Homeland Security Unit is still a conventional bombing, hijacking, kidnapping or shooting. Though there is widespread media attention to the possibility of a WMD attack, such an attack that would affect our region must still be considered a rare event, but with the potential for catastrophic consequences. The most probable scenario that would create such an event is the unintentional detonation/release of a WMD that was in transit to eastern US cities. All towns could have the smaller version of this hazard and could be affected by a larger event.

Frequency: Unlikely (for smaller acts of violence) to Rare (for larger acts)
Severity: Locally Extensive to Catastrophic
Vulnerability: Low to locally Moderate

Drought/Wildfire

Even though the region is blessed with rivers and lakes and has flooding as a likely disaster, the opposite situation, a drought, has occurred and will again. Several severe droughts have been recorded during the last century, while moderate and mild droughts are much more common. Between 1964 and 1966, there was a protracted drought, rated severe in 1964 and worsening to extreme in 1965 and 1966 *(NCDC)*. This drought made conditions ripe for wildfires and during 1966 there were 14 Class C wildfires in Vermont ranging from 10 to 100 acres, much larger than the average forest fire in Vermont of 2.5 acres.

Wildfire conditions in Vermont are typically at their worst either in spring when the dead grass and fallen leaves from the previous year are dry and new leaves and grass have not come out yet, or in late summer and early fall when that year's growth is dry. In drought conditions, this risk is obviously higher, and the risk of wildfire due to drought was severe enough to warrant a statewide ban on open burning in 1966. That was the last such statewide ban until one was issued in 1999 due to the drought during that year. The 1999 drought was ended by the arrival of heavy rains with Tropical Storm Floyd in September of 1999. But due to a very dry April 2000, the state once again had to declare a temporary burning ban. 2001 was another dry year and drought conditions were sporadic in 2002 and eased with a wetter than usual 2003. Drought patterns can vary widely due to the effect of individual storms. Therefore, while the hazard can be mapped for specific droughts, the region's vulnerability to it and consequent wildfires is rated as homogenous at this time and it is not mapped in Appendix I.

Frequency: Unlikely (though perhaps increasing)
Severity: Minor
Vulnerability: Low to locally Moderate

Climate Change

The state of the science behind climate change and global warming is now mature enough to be highly confident that warming is occurring and is being caused in part by man-made factors. The results of warming will differ considerably depending on where you live, and computers models are not yet sophisticated enough to give us short-term or state-level impacts. Models of projected change are currently looking at the next 100 years. The latest report on the subject and its effects on New England state that if climate change occurs as projected, it will "fundamentally change both the character and quality of life in the New England Region." The two models used for New England suggest generally warmer temperatures, while one predicts more dramatic warming and some droughts, and the other predicts a dramatic increase in precipitation. Either model predicts greater climate variation than New England has seen for at least 10,000 years, and global temperatures that have not been experienced in over two million years. Vermont's climate could shift to more like that of West Virginia or Tennessee within a lifetime.

The effects of global warming are generally going to occur over decades, and may slowly shift the native vegetation of Vermont, allowing the introduction of new species and possibly terminating our sugaring season. A warmer climate could also allow disease vectors into the state that our climate had previously precluded. Winters are expected to generally be less severe and summers slightly hotter. It is possible that extreme weather events would become more common. More drastic effects, such as the shutdown of the Gulf Stream, are not very probable at this point, but could occur in a matter of a few years and would have widespread ramifications.

Climate change itself does not have a frequency, as it is a long-term process without good data projections on any small area. The severity of its effects are difficult to anticipate, but appear to be sizable in the long term. There is no map associated with this hazard.

Frequency: Not Applicable
Severity: Minor to Extensive
Vulnerability: Low to Moderate

Landslides

Vermont actually has a relatively high danger due to landslides in places, though this type of disaster rarely occurs and usually does not result in injury. Landslides can be caused by seismic events, manmade or natural changes to groundwater flow that cause liquefaction, removal of vegetation and manmade or natural undercutting of steep banks. A recent major slide in Jeffersonville, Vermont demonstrates that we are vulnerable to this type of event. There is no quality mapping available for slide potential at this time, but slides along Gilead Brook in Bethel, the White River in Stockbridge and Blood Brook in West Fairlee are known problems, demonstrating the potential in disparate parts of the region.

Frequency: Unlikely
Severity: Locally Serious
Vulnerability: Low to locally moderate

Earthquake

Surprising as it is to some, Vermont is classified as an area with "moderate" seismic activity. This can be compared to the west coast of the U.S., which is classified as "very high" and the north-central states classified as "very low." Sixty-three known or possible earthquakes have been centered in Vermont since 1843 *(Ebel, et. al. 1995).* The two strongest recorded quakes measured in Vermont were of a magnitude 4.1 on the Richter scale. One was centered in Swanton and occurred on July 6, 1943, and the second occurred in 1962 at Middlebury. The Swanton quake caused little damage, but the Middlebury quake did result in broken windows, cracked plaster and falling objects *(VEM, 1995)*.

In addition, earthquakes centered outside the state have been felt in Vermont. Twin quakes of 5.5 occurred in New Hampshire in 1940. In 1988, an earthquake with a magnitude 6.2 on the Richter scale took place in Saguenay, Quebec and caused shaking in the northern two-thirds of Vermont *(Ebel, et. al. 1995)*. A 5.1 quake centered in the Adirondacks occurred on April 20, 2002 and caused minor damage in northwestern Vermont.

A HAZUS analysis conducted by the Vermont State Geologist's office estimated damage for parts of the region based on the estimated 500-year quakes that could occur from several epicenters – a 5.7 in

Swanton, a 5.7 in Middlebury, a 6.8 in Montreal, a 6.2 in Tamworth, New Hampshire and 6.6 in Goodnow, New York. See Appendix I for the HAZUS run. In general, where ground accelerations were predicted greater than 0.10 g (one tenth the acceleration of gravity), people would feel the quake enough to run outdoors and some buildings with poor construction (especially unreinforced masonry) would be damaged. To give an idea of scale, an earthquake with 0.40 g is a heavily damaging earthquake.

Of the several possible once-in-500-year quakes, the greatest identified threat varies by town depending on the epicenter. Overall, the worst damage would be to Hancock from the Middlebury quake, with peak ground accelerations of 0.31-0.36, and over $12 million dollars in potential damage, with millions more in surrounding towns. The Tamworth and Goodnow quakes would cause widespread damages in the millions, and the Montreal quake would cause several hundreds of thousands of dollars damage in many towns. Only the Swanton quake does not cause significant damage in the Region.

Frequency: Rare
Severity: Extensive to locally Catastrophic
Vulnerability: Low in the northern and central parts of the region and Moderate in the eastern and western edges

<u>Extreme Temperature</u>

Extreme cold or heat, while often associated with other disasters, can create emergencies by themselves if they continue for several days. Extreme cold, especially when the ground is not insulated by snow, can freeze water lines, overburden power and heating systems, hamper transportation and directly threaten individuals exposed to weather with frostbite and hypothermia. Extreme heat can overload power and cooling systems, buckle rail lines, wither crops and threaten people with heat exhaustion and stroke.

Luckily, Vermont has a climate where extreme cold is unusual and extreme heat is unlikely. However, these types of events do occur. In February of 1979, for over two weeks the state had an average temperature of only 9° F, with minimum recordings of -40° F. In 1972, Woodstock got down to -41° F and Randolph to -40° F. January 2003 saw an extended stretch of severely cold weather. On the other end of the scale, are extended heat waves, such as in July of 1911, when Northfield had a 12-day average of 90.75° F. The summer of 1949 was also very hot with 25 days above 90 ° F. Reminders of this hazard from afar occurred in 1995, which brought a short period of extreme heat to the upper mid-West, and the heat wave of 2003 that killed an estimated 19,000 people across Europe, with over 14,000 of these in France. There is no indication that any one town is more vulnerable than another to this hazard, and consequently there is no mapping done at this time.

Frequency: Unlikely
Severity: Minor to Serious
Vulnerability: Low

<u>Infestations/Invasive Species</u>

Infestations by insects can ruin crops or forests. While most of Vermont does not have to deal with these occurrences, a historical invasion of “worms” occurred in 1770 in the Connecticut River valley. It seems that an untold number of “worms” originated near Lancaster, New Hampshire, beginning in late July of 1770, and streamed down the valley all through August. These “worms” were most likely the army worms (actually a type of caterpillar) that very recently caused over $8 million dollars in damage to the 2001 hay crop, again largely along this valley. Some farmers lost up to 90% of this year’s hay crop and in some places entire hay fields were eaten in one night. Forests are also threatened by such insects as the wooly adelgid (hemlock) and spotted beetle (maple and ash).

Other non-native, invasive plants and animals, from Eurasian milfoil to zebra mussels cause millions more in damage in Vermont. Invasive species do not generally pose a direct health threat, but they are capable of altering ecosystems, damaging fields and forests, clogging waterways and even causing problems with vehicles and air systems functioning properly. There is no mapping available for this hazard at this time.

Frequency: Unlikely
Severity: Minor
Vulnerability: Low

Shortages

Shortages of power, fuel, food and water are likely to be temporary and the indirect result of either a localized disaster creating disruption in transportation and supply systems or of a widespread weather event. Loss of power has occurred in the past and utility crews can rectify that with their forces and call in forces from other parts of the state or nation. Availability of fuel (though prices certainly rise) should not be a problem except in a very unusual extended event that would affect the entire Northeast. Food and water can become critical needs as a result of some other disaster, and disaster relief organizations such as the Red Cross and National Guard can respond quickly to natural disasters. Getting supplies to people or people to the supplies can be a logistical need and both the National Guard and the Vermont Agency of Transportation can quickly create needed access or transport people. In addition, the Army Corp of Engineers Special Cold Weather Unit can be used to access isolated communities in extreme cold.

Frequency: Unlikely
Severity: Minor
Vulnerability: Low

Displaced Persons

Displaced persons, commonly thought of as evacuees or refugees, is the correct term for people who have fled a natural disaster but remained in their own country and are not returning to their origins shortly after the disaster. Several disasters, including pandemic, tsunami, and mid-Atlantic hurricane, all the potential to cause millions of people to flee the eastern megalopolis, and at least tens of thousands to come to Vermont for weeks or months. For example, a Category 3 hurricane centered on New York City (which may be a 50-year event) could cause the evacuation of ten times the number of people that evacuated during hurricanes Rita or Katrina. Since we are not in any cooperative sheltering system, as southeastern US states are for hurricane evacuation, and since sheltering capacity within the region is not sufficient even for native populations, this type of self-directed mass movement of people would present large logistical challenges.

Frequency: Unlikely
Severity: Minor
Vulnerability: Low

Vulnerability Assessment

The vulnerability a jurisdiction has to a type of disaster should affect how much priority is placed on mitigation planning for that type of event, since any community only has limited resources and cannot prepare for all types of events, no matter how remote. The region’s, as well as the generic local jurisdictions’ vulnerability to the hazards above is summarized below in Figure 2.

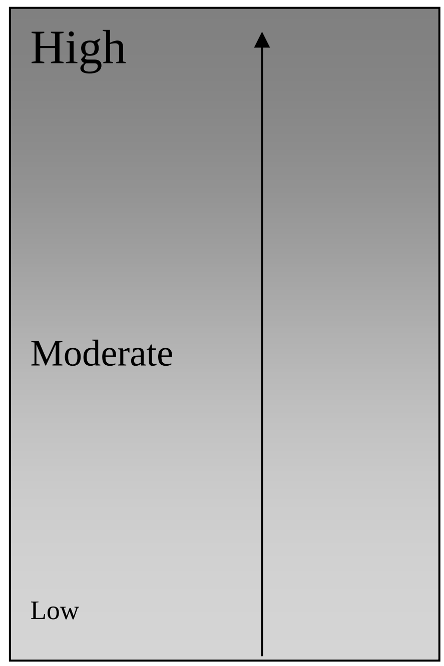
This plan will not consider further those four hazards that are rated below as Low due to the need to prioritize any mitigation efforts. For the hazards that rank Low to Moderate and higher, additional vulnerability assessment is conducted below using available information. Where information needed to perform a more thorough analysis is needed, gathering it is noted as a future mitigation measure.

Three things that can be looked at in terms of assessing vulnerability are:

- whether there are any assets such as critical infrastructure or residences at risk from that hazard,
- what are the estimated losses from a potential occurrence of that hazard, and
- what is the trend of vulnerability to that hazard either from changes in the hazard itself, or changes in society or the built environment.

Figure 2: Summary of Hazards and Their Risks

Flood
Structural Fire*
Technological Hazards
Winter Storm*
Hurricane/Tropical Storm*
Severe Weather*
Epidemic and Health Threats*
Terrorism and Civil Hazards
Drought/Wildfire*
Climate Change*
Landslide
Earthquake
Extreme Temperature*
Infestation/Invasive Species*
Shortage*
Displaced Persons*



* These hazards are homogenous across the region and so no local analysis will be done.

Assets at Risk by Region or Locally-specific

Five of our ranked hazard types threaten entire areas and are not limited to certain places. Lacking data on each structure's actual construction in the region, we have assumed that every structure in the region may be equally vulnerable to these widespread hazard types. Therefore, all assets in the region may be vulnerable to the following:

- Structural Fire
- Winter Storms (Snow blizzards and ice storms)
- Severe Weather (Thunderstorm/Lightning/Hail/Tornado)
- Hurricane and Tropical Storm

- Drought/Wildfire

There is a need for a more refined vulnerability analysis, and this has been identified as a mitigation action under these hazards.

The main threats associated with two other ranked hazards (Global Warming and Epidemic and other Health Threats) that are equally likely across the region are not threats to physical assets as much potential sources of injury, loss of life and ecosystem disruption. Since these are outside the scope of quantification at this time, damages to assets from these threats is not calculated below. The need for better frequency and impact analysis has been identified as a mitigation action under these hazards.

Due to the nature of Terrorism and Civil Hazards, this hazard is *possible* in all towns, but is more likely a concern only along major routes, at critical facilities or in the more densely settled areas. There is not sufficient information at this time to delineate such areas are facilities, though better spatial information is being developed. Also, the main concerns associated with these two hazards are not damage to assets, but rather injury and loss of life. Due to the poor spatial component and non-asset focus of this hazard, no additional analysis of these hazards on assets will be done at this time. The need for better threat analysis has been identified as a mitigation action under this hazard.

Where spatial information exists that would show areas vulnerable to specific hazards, this can be used with existing Geographic Information System (GIS) point data to do a basic assessment of assets that are in that hazard area. The GIS building point data is relatively thorough in Vermont, but has very little attribute information at this time so we are not able to identify individual facilities that might be threatened using available data.

Existing spatial data that allows a preliminary analysis of assets at risk by hazard are for:

- Flood
- Technological Hazards (related to hazardous material truck or rail spills)
- Earthquake

Assets at risk from flooding are in mapped flood hazard areas, unmapped areas along smaller streams, areas where the flooding risk is due to lateral movement of streams due to instability, areas prone to flooding caused by ice or debris jams along watercourses or with undersized drainage systems, especially culverts. The only available spatial information at this time is that which shows mapped flood hazard areas. These areas, along with building point data, are shown in the local annexes. A summary of the number of structures at risk by town is in Table 3 below. Of particular concern would be any critical infrastructure that would be vulnerable to flooding. As critical infrastructure mapping is still being developed, this data will be refined in future versions of the plan

Assets vulnerable to Technological Hazards (hazardous materials truck or rail spills) are logically along major roads and rail lines (which also includes all concentrated settlements). These linear routes have been buffered 1,000 feet on either side as an average distance that could be affected. Actual distances would obviously vary by the specific agent. For example, a large spill of sulfuric acid might need only a 600 foot buffer, but a large spill of flammable gas from a propane tanker could require evacuation for one mile around the site. All building points within the 1,000 foot buffer zones are shown by town in Tables 1 and 2 and mapped in the local annexes in Appendix II.

The HAZUS Earthquake run does not spatially show effects, except at a Census tract scale. In the region, this scale is generally a town level. Therefore, no particular assets in any town can be identified as vulnerable. Lacking detailed building data, the best that can be said is that unreinforced, multi-story structures in those towns identified on the regional HAZUS maps in Appendix I as having greater damage would be most susceptible to this hazard.

Estimated Losses from Hazards with Sufficient Data

Dollar losses through direct damage to structures has been estimated for hazards where there is sufficient spatial and frequency information to make such estimates. Secondary economic damages for any hazard due to loss of business have not been estimated. Damages due to injury and loss of life are hard to quantify, as a value must be put on human life. Consequently, this plan does not attempt to quantify any losses due to death or injury either.

As explained above, the vulnerabilities to Global Warming, Drought/Wildfire, and Epidemic and other Health Threats are not primarily to physical assets, so losses are not estimated for these hazards. Frequency information needs to be improved for Structural Fire, Winter Storms, Hurricanes/Tropical Storm, Severe Weather, and Terrorism and Civil Hazards in order to predict loss estimates. The only hazards for which there are existing damage estimates, or where a defensible estimate can be made using available information are for Technological hazards, Flood, and Earthquake.

Estimates for damage due to Technological Hazards were limited to hazardous materials events. (Although a few towns express concerns about dam failure, this is actually highly unlikely, and would only occur if there was widespread extreme flooding, so the estimates of that possibility are already considered to some extent under flooding.) Since spatial information on hazardous facilities is still not readily available, transport routes were used, with a standard distance of effect of 1,000 feet used to buffer major roads and rail lines to arrive at a potential area of effect. Again, property values were created by town, however, since it is not anticipated that there would be an event that would cover the region or even an entire town (as a flood might), a 5% weighting was used to estimate damages (see Tables 1 and 2). Flood damage estimates were made by intersecting the available GIS coverage for areas subject to 100-year floods and building point data. Building values were derived from tax information for each town and were assumed as total losses (see Table 3). For earthquake, the HAZUS run generated losses based on most likely epicenters and building values from the US Census (see Table 4).

Table 1:
Losses estimated for Technological Hazards (HAZMAT events only) by those towns with areas within 1,000 feet of rail lines, with 5% damage factor

Town Name	Residences	Commercial	Mean Res. Value	Mean Com. Value	Total Damage	5% of Damage
Bethel	186	45	$90,581	$210,370	$26,314,716	$1,315,736
Bradford	111	32	$95,368	$252,487	$18,665,432	$933,272
Braintree	198	3	$76,069	$184,261	$15,614,445	$780,722
Fairlee	153	50	$143,164	$342,870	$39,047,592	$1,952,380
Granville	19	0	$51,404	$107,450	$976,676	$48,834
Newbury	167	37	$80,562	$190,082	$20,486,888	$1,024,344
Randolph	287	81	$102,591	$260,908	$50,577,165	$2,528,858
Royalton	281	62	$97,278	$242,530	$42,371,978	$2,118,599
Sharon	133	14	$92,294	$155,725	$14,455,252	$722,763
Thetford	116	32	$123,775	$239,759	$22,030,188	$1,101,509
					TOTAL	**$12,527,017**

Table 2:
Losses estimated for Technological Hazards (HAZMAT events only) by town within 1,000 feet of major roads (state routes or interstates), with 5% damage factor

Town Name	Residences	Commercial	Mean Res. Value	Mean Com. Value	Total HAZMAT Damage	5% Damage
Barnard	166	7	$154,270	$368,815	$28,190,525	$1,409,526
Bethel	328	55	$90,581	$210,370	$41,280,918	$2,064,046
Bradford	552	129	$95,368	$252,487	$85,213,959	$4,260,698
Braintree	240	7	$76,069	$184,261	$19,546,387	$977,319
Bridgewater	229	33	$146,589	$309,950	$43,797,231	$2,189,862
Brookfield	238	8	$102,342	$118,270	$25,303,556	$1,265,178
Chelsea	231	32	$82,832	$191,251	$25,254,224	$1,262,711
Corinth	49	10	$86,195	$77,653	$5,000,085	$250,004
Fairlee	263	49	$143,164	$342,870	$54,452,762	$2,722,638
Granville	77	10	$51,404	$107,450	$5,032,608	$251,630
Hancock	156	20	$63,054	$307,126	$15,978,944	$798,947
Newbury	382	52	$80,562	$190,082	$40,658,948	$2,032,947
Plymouth	247	22	$131,690	$112,378	$34,999,746	$1,749,987
Pomfret	20	1	$163,384	$252,556	$3,520,236	$176,012
Randolph	877	142	$102,591	$260,908	$127,021,243	$6,351,062
Rochester	262	50	$93,836	$162,048	$32,687,432	$1,634,372
Royalton	404	65	$97,278	$242,530	$55,064,762	$2,753,238
Sharon	184	17	$92,294	$155,725	$19,629,421	$981,471
Stockbridge	222	17	$90,326	$150,008	$22,602,508	$1,130,125
Strafford	N/A	N/A	N/A	N/A	N/A	N/A
Thetford	505	58	$123,775	$239,759	$76,412,397	$3,820,620
Topsham	188	5	$65,897	$72,300	$12,750,136	$637,507
Tunbridge	155	9	$83,674	$89,248	$13,772,702	$688,635
Vershire	111	5	$91,965	$148,945	$10,952,840	$547,642
West Fairlee	107	2	$91,592	$224,168	$10,248,680	$512,434
Woodstock	689	164	$246,615	$391,546	$234,131,279	$11,706,564
					TOTAL	**$40,468,611**

Table 3:
Losses estimated for Flood by town (100-year event in mapped zones)

Town Name	Residences	Commercial	Mean Res. Value	Mean Com. Value	Total Flood Damage
Barnard	40	1	$154,270	$368,815	$6,539,615
Bethel	24	11	$90,581	$210,370	$4,488,014
Bradford	10	10	$95,368	$252,487	$3,478,550

Braintree	6	3	$76,069	$184,261	$1,009,197
Bridgewater	64	7	$146,589	$309,950	$11,551,346
Brookfield	20	0	$102,342	$118,270	$2,046,840
Chelsea	51	15	$82,832	$191,251	$7,093,197
Corinth	25	0	$86,195	$77,653	$2,154,875
Fairlee	70	0	$143,164	$342,870	$10,021,480
Granville	31	4	$51,404	$107,450	$2,023,324
Hancock	15	5	$63,054	$307,126	$2,481,440
Newbury	69	5	$80,562	$190,082	$6,509,188
Plymouth	50	3	$131,690	$112,378	$6,921,634
Pomfret	28	4	$163,384	$252,556	$5,584,976
Randolph	21	5	$102,591	$260,908	$3,458,951
Rochester	28	12	$93,836	$162,048	$4,571,984
Royalton	52	5	$97,278	$242,530	$6,271,106
Sharon	34	3	$92,294	$155,725	$3,605,171
Stockbridge	52	3	$90,326	$150,008	$5,146,976
Strafford	24	1	$141,662	$171,949	$3,571,837
Thetford	62	10	$123,775	$239,759	$10,071,640
Topsham	14	0	$65,897	$72,300	$922,558
Tunbridge	16	2	$83,674	$89,248	$1,517,280
Vershire	11	0	$91,965	$148,945	$1,011,615
West Fairlee	10	0	$91,592	$224,168	$915,920
Woodstock	65	21	$246,615	$391,546	$24,252,441
					$137,221,155

Table 4:
Maximum Direct losses estimated for 500-year Earthquakes by HAZUS*

Epicenter	**Town with Greatest Damage**	**Estimated Damage**
Montreal	Randolph	$786,000-907,000
Goodnow, NY	Randolph	$1,771,000-2,076,000
Tamworth, NH	Bradford	$1,490,000-1,749,000
Middlebury, VT	Hancock	$10,584,000-12,647,000
Swanton, VT	Randolph	$150,000-175,000

*This data is being further developed with additional HAZUS runs

Effect of Development Trends on Risk

The regional trends (which are generally mirrored at the local level) that would affect the *occurrence* of disasters are largely those related to manmade disasters. Steady future increases in population, and consequent increases in hazardous materials shipments as well as storage of materials, are expected. This would logically make for an increased likelihood of Technological Hazards occurring. Mitigation for this type of hazard is difficult and is best approached through sound preparedness and better response. Preparedness levels are increasing due to recent grant funding for equipment and greater levels of emergency planning.

Development trends such as increasing impermeable surface area, poor construction practices or allowing additional building in hazard prone areas can affect an area's vulnerability to hazards. Current regional trends in the TRORC service area that would affect the *amount of damages* resulting from a hazard occurring are largely favorable. The threat from future flooding, despite projected additional development, is being mitigated by several actions. Virtually the entire region, and all of the region with high risk flood areas, is covered under NFIP. Therefore, additional at risk development should be minimized. Several of the local flood hazard area regulations are also being strengthened and flood maps are being modernized which should lead to more useful and usable local regulations. Culverts are also being upsized and roads are being built to better standards in order to reduce road damage from heavy rains.

The downside effects of development are the creation of impermeable surface, which can make watersheds "flashier" in terms of peak runoff, and the poor state of knowledge regarding riverine stability. Unstable rivers continue to threaten roads, fields and homes. Mapping programs are underway to better identify these areas, but flood regulations need to take this erosional hazard into account.

The threat from Structural Fire, Earthquake, Winter Storms and Severe Weather should not increase proportionally with more development, as new public or commercial structures often include sprinkler systems, have sufficient engineering to handle roof and wind loading, and are built to higher life safety codes. New residential structures that are contractor-built can generally withstand our level of threat from these hazards and are now typically hardwired for smoke detection. Also, this plan with the local annexes, and efforts underway at the state level, have raised awareness of mitigation to a greater level.

MITIGATION STRATEGY

Mitigation Goals

The overall goals of this plan are:

1) To reduce the loss of life and injury resulting from all hazards.
2) To lessen financial losses and property damage incurred by municipalities, businesses and private citizens due to disasters.

These overarching goals can be further refined as follows:

1. The impacts of hazards should be first avoided, then reduced where they cannot be reasonably avoided. For flooding and riverine erosion, this can best be achieved by precluding development from hazard areas, and where development exists through property buyouts or flood protection sympathetic to the natural and human resources of the area.
2. The connections between land use, development siting, drainage systems, building standards, and road design and maintenance and the effects of disasters on the Region should be recognized and incorporated into policy so that there is no adverse impact (increased hazard) from development.
3. Mitigation actions should be part of a larger, systematic efforts at disaster reduction based on the highest threats. Flooding should be addressed on a watershed scale. Structural fire and technological hazards should be lessened through statewide safety education and code compliance.

Each local annex may have additional goals.

Identification of Mitigation Measures

Mitigation actions put forth in this plan and the local annexes were done so in the context of the above goals and after a review of the hazards, especially the hazards to which the region is highly or moderately vulnerable. As there are many more hazards that need addressing than possible funding, no hazards where our vulnerability was rated as "Low" were considered when thinking about potential mitigation measures.

All of the locally proposed mitigation measures found in Appendix II were developed in cooperation with the local legislative body, which is usually the implementing body. This ensures that measures that are identified are measures that can be acted upon. As many of these measures also depend upon the actions of a local person or agency, such as the road crew or fire department, these were also consulted and had a hand in identifying which measures the town wanted to pursue. Many measures will require funding from outside the town, and this necessary ingredient is listed if applicable. The list of proposed measures was intentionally kept short to increase the likelihood of action.

A full cost-benefit analysis is not called for under PDM planning guidelines, and in many cases would cost more in staff time than was available to write the entire local annex. Similarly, engineering and permitting cannot be done with any degree of completeness at this stage in the planning. However, all measures were considered in light of regular permitting concerns, were roughly scoped for cost, and were deemed to be of sufficient potential return in value for towns to list them in their plans with the understanding that they would have to fund at least 25% of the project cost.

Prioritization Method for Mitigation

Local and regional prioritization of mitigation measures was the product of six factors. The more that a measure could qualitatively answer each of these factors in the affirmative, the more they were ranked as high priorities. No actions have been included that are or were ranked as "Low", since that would essentially indicate that they were not likely to be acted upon. The six factors were:

1. can the measure be implemented immediately or soon?
2. can the measure be done with current or minimal additional resources?
3. does the measure have public support, and is it aimed at producing wide public benefit?
4. are the measure's benefits proportional to its cost (cost effective)?
5. does the measure address an urgent situation that will worsen if not addressed?
6. does the measure address the greatest identified vulnerability or multiple hazards?

Local Mitigation Measures

Most mitigation measures contained in this plan are local measures that can be found under each town's annex in Appendix II. Therefore, the implementation and administration of those measures is largely addressed there. Implementation of local mitigation measures depends upon the towns undertaking the actions they have assigned to themselves. However, there are ways in which TRORC can help bring local actions to fruition.

Where the main impediment to action is lack of resources, TRORC will work with the towns to try to get such resources through grant writing. Continuation of PDM-C grant funding, HMGP grant funding and other sources is essential to help any of the larger projects to be accomplished. In some cases, prior to writing grant applications, larger projects may also need to do more preliminary work in order to properly understand a problem or devise a solution, and TRORC will work with towns as funding permits to refine the scope of projects and their cost estimates. In other cases, the nature of annually elected volunteer government at the town level can lead to the best of plans lying on the shelf, and so TRORC will provide continuity and support to help local measures succeed through gentle reminders about proposed mitigation activities and an ongoing education process about their worth.

Regional Mitigation Measures by Hazard

Regional mitigation measures can address each of the following hazards that we are vulnerable to. Actions are listed below under each hazard type. All of these actions are related to hazards where there is at least a local or regional moderate vulnerability. All of the actions are medium or high priorities for that hazard, and high priority actions are **bolded** and are proposed for action by TRORC itself. Actions that address a hazard where we have high vulnerabilities are a higher priority than a similarly ranked action on a hazard where we are less vulnerable. As is stated above, no low priority actions are listed and no action is considered for the hazards where we only have a low vulnerability.

Flood

- **TRORC staff will work to better identify areas prone to riverine instability or flooding through the FEMA map modernization program and VTDEC's stream stability assessment tool.**
- **TRORC staff will assist all towns in participating in the NFIP program, and review and suggest revisions to existing local regulations to ensure that new structures are at least one**

foot above base flood elevation, are built with no fill or net fill in the floodplain, avoid floodways and minimize overall floodplain development when practical. These recommendations will also be added to the Regional Plan.

- TRORC staff will work with town review boards to better understand and regulate stormwater runoff, especially as the 8-12% limit on watershed impermeability is approached.
- TRORC staff will work with interested towns to get mitigation grants for projects to address this hazard.
- TRORC staff will work with ANR, VEM, USACOE, NWS and USGS to maintain and improve gage and warning systems.

Structural Fire

- **TRORC staff will work with towns to ensure they are using the latest Vermont life safety codes.**
- **TRORC will place public education newspaper ads about the importance of smoke alarms.**
- TRORC staff will work with the Vermont Fire Marshal to improved the level of information on vulnerability to this hazard and integrate these assessments when available.

Technological Hazards

- **TRORC and the LEPC #12 will acquire better data on the types of hazardous materials transported through the region and on the Tier II locations within the region.**
- **TRORC will map recommended isolation zones for fixed Tier facilities and provide this data to towns.**
- **TRORC staff will work with VEM and VTHSU to get towns equipped to respond to hazards through grantwriting assistance.**
- TRORC will seek to lessen the danger from hazardous facilities through proper permit conditions during ACT 250 proceedings.
- TRORC's transportation planning program will coordinate with local communities and the state agency of transportation to improve truck routes to lessen hazardous road conditions.
- TRORC will work with the LEPC to ensure that Tier II facilities have adequate response and prevention plans.

Winter Storm

- **TRORC's website will continue to provide web link to the Icy Road site.**
- **TRORC staff will provide technical and grant assistance to increase the backup power availability at shelters in the region.**
- TRORC's website will provide links to weather condition reports, and staff will forward alerts to local emergency responders.
- TRORC's website will disseminate winter travel tips.

Hurricane/Tropical Storm

- **TRORC's transportation planning program, as well as our involvement in permit reviews, will work with the state and towns to ensure that roads and drainage systems are constructed to withstand heavy rains, including helping towns to adopt sound road policies.**
- TRORC will support efforts to improve the frequency and impact assessment for this hazard, and use this information when available.

Severe Weather

- **TRORC will continue to provide safety tips on the emergency management section of our website.**

- TRORC will work with LEPC #12 and the National Weather Service to increase the SKYWARN spotter network and to improve Weather Radio coverage.
- TRORC will support efforts to improve the frequency and impact assessment for this hazard, and use this information when available.

Epidemic and Health Threats

- TRORC staff will work with the VT Department of Health and area hospitals to ensure they are prepared for this hazard, including participating in exercises, helping to identify patient intake or quarantine centers, and sponsoring volunteer training.
- TRORC will assist towns in COOP/COG planning for pandemics.
- TRORC will support efforts to improve the frequency and impact assessment for this hazard, and use this information when available.

Terrorism and Civil Hazards

- **TRORC staff will continue working with the Vermont Homeland Security Unit on training and equipping responders and conducting exercises.**
- TRORC will provide updated threat assessments when available from the Vermont State Police and Homeland Security Unit to area responders and potential targets.

Drought/Wildfire

- TRORC will support efforts to improve the frequency and impact assessment for this hazard, and use this information when available.
- TRORC will maintain crought and wildfire links on its website and work with the Vermont Drought Task Force if reestablished.
- TRORC will help fire departments get trained and equipped for this hazard.

Climate Change

- TRORC staff will stay abreast of prediction efforts and use these improved assessments when available to understand the potential effects on the region, and begin to plan adaptation strategies.
- TRORC staff will encourage energy conservation policies to reduce production of greenhouse gases in local plans and revise the Regional Plan to incorporate such policies.

Earthquake

- TRORC will work with the State Geologist and the HAZUS program to better refine assessments.
- TRORC staff will follow up with VEM on the Ebel report’s recommendations to upgrade building code standards.

Landslide

- TRORC will work with the state geologist and others to determine landslide risk and appropriate responses, including possible land use controls on potential slide areas.

PLAN MAINTENANCE

Updates

As noted in this plan, much of the information guiding mitigation is still very basic. Improved information that quantifies hazard risks will help to improve the efficacy and prioritization of mitigation measures. TRORC staff will work to improve natural hazard information, especially through the FEMA map modernization program, the use of HAZUS MH, and riverine stability assessments. Much of this work is dependent upon sustained federal funding to support pre-disaster mitigation, as well as increased MapMod funding to improve flood maps lacking detailed studies. Given *sustained*, *dependable*, *annual* PDM planning funding (which is not currently the case), it is the intention to update portions of this plan annually as new information becomes available, and to review the entire document at least every five years.

TRORC's Regional Plan and local towns' comprehensive plans expire every five years. Therefore, these will be updated within the next five years. The Regional Plan was last updated in 2007. It is our intent to incorporate relevant parts of this plan into those updates at the regional level and to work with towns to incorporate them in local plan revisions. For example, TRORC actively worked with all of our towns in Windsor County to revise flood regulations to bring them into compliance and to be more disaster resistant. Finally, the final State Mitigation Plan, which staff are involved in reviewing, may engender changes to this plan. Updates to this plan would be made by TRORC staff.

Ongoing Public Involvement

Local officials will be involved in ongoing PDM planning efforts. In Vermont, these officials are almost all volunteers elected or appointed from their communities; communities which are generally quite small. There is very little distinction between these officials and the public at-large.

We will communicate regularly with our Board of Directors, who are appointed by, and represent, our member towns. They will be kept abreast of our planning efforts through presentations at Board meetings and updates from the Executive Director, providing a link back to our towns about PDM activities and creating a means of giving local feedback and policy direction on these matters to staff. Our Executive Board and Board meet monthly.

Our LEPC#12 members, who are largely emergency responders, deal with the effects of disasters directly, interact with staff and serve as a check to see if there are mitigation opportunities or hazards that are not being addressed.

Our staff also work with watershed organizations and town road crews on a variety of projects. Both of these constituents have a lot to say regarding the prime threat of flooding and erosion from runoff and ways to mitigate the effects of such. Lastly, since most mitigation will entail local actions, outreach about the plan, the local annexes and mitigation opportunities will be the topic of occasional workshops to local officials.

The public gets direct communication about our programs through our website, as well as through our newsletters and occasional press releases to the media. All of our Board and LEPC meetings are open to the public to attend.

Monitoring and Evaluation

The process of updating this plan, as well as receiving regular input, are critical steps in the monitoring and evaluation of this plan. In order to ensure some level of attention to the plan and the local annexes, there will also be a survey sent to towns by TRORC with the annual update to their Rapid Response Plans (RRPs, these are basic local EOPs) that queries them as to whether any changes need to be made to their mitigation annex. This will ensure that local officials review their annex annually. Annual attention to the regional PDM plan would be best addressed by joining this plan and the LEPC's All-Hazards Operations Plan. In that way, mitigation will be integrated into preparedness, response, and recovery. These planning activities take funding however, and if current funding from such grants as EMPG lessen or have additional work items added, then updates will happen at a slower pace.

As for evaluation, this would be done in any of the updates (dependent upon funding), and would specifically focus on whether any better data for hazard analysis has become available, any vulnerabilities have increased or decreased, any new hazards have developed, and if major new programs become available to address mitigation activities. Any actual disasters in the region may also call into question assumptions in the plan, necessitating revision. To date, recent disasters during the plan's development and adoption have reconfirmed the priority on flood related hazards, but have also added displaced persons from major northeast urban centers as a disaster issue, and several local landslides have raised this hazard from a low to a moderate priority.

TRORC staff also sit on the State Hazard Mitigation Committee. In this way, they review revisions to the State PDM plan and this review can trigger changes to the TRORC plan if needed.

Implementation through Existing Regional and Local Efforts

TRORC is not a regulatory body or an agency that controls land or services, and cannot consequently implement many direct mitigation measures by itself. Regional mitigation measures therefore fall largely under providing technical assistance to towns and citizens. This regional multi-jurisdictional PDM plan will need to coordinate with ongoing local, state, and federal efforts to be most effective and bring many of the recommended actions to fruition. Current and future regional mitigation measures by TRORC staff include:

- Working with local road departments on ensuring that they are conducting culvert inventories, and have in place adequate road policies that are designed to create disaster-resistant roads through the use of proper surfacing, ditching, grading, stormwater control and maintenance. This is a standard part of our ongoing Transportation Planning Initiative work.
- Working with local planning commissions to ensure that their town plans have goals to preclude hazard areas, especially floodplains and areas near unstable rivers, from development. Local comprehensive plans are adopted every five years and it is common for us to assist towns in the writing of these plans.
- Working with planning commissions and Selectboards to implement regulations that ensure development does not create hazardous situations or place structures in dangerous areas.
- Working with local emergency responders on ensuring that Rapid Response Plans are up to date and that responders are properly equipped and trained. This activity is done annually.
- Working with the LEPC to coordinate this plan with the regional Emergency Operations Plan.
- Working with towns on writing grant applications.
- Working with the state Agency of Natural Resources on watershed planning and riverine stability efforts. Watershed planning activities are ongoing.

- Working with Vermont Emergency Management and the State Hazard Mitigation Committee on the State Hazard Mitigation Plan and in refining hazard data. TRORC staff are on this committee which meets several times a year.
- Working with groups such as the National Emergency Managers Association, FEMA and others on improving public understanding and acceptance of mitigation as the best model to deal with disasters, moving away from a response-oriented stance when feasible.
- Working with FEMA and Congressional staff to support continued improvement in flood mapping, river gauging, grant programs to undertake mitigation measures, and to incorporate disaster mitigation into federal programs.

Towns' activities are covered in more detail under each town's annex, but there are several ways that a town can integrate this planning effort into other efforts. Examples of this include:

- Reviewing this plan and their annex during revisions to their town plan, zoning, or flood hazard area regulations.
- Ensuring that developments going through Act 250 review are not increasing the danger of preventable hazards.
- Tying in mitigation into any capital budgeting programs, and ensuring that upgrades to municipal facilities are in keeping with mitigation goals.
- Revising local road policies to make sure that public and private roads are built in a manner that is disaster resistant.

APPENDIX I - REGIONAL HAZARD MAPS

APPENDIX II – LOCAL ANNEXES

APPENDIX III - CROSSWALK

APPENDIX IV - MITIGATION RESOURCES BY HAZARD

APPENDIX V- LEPC ROSTER

APPENDIX VI – HAZARD REFERENCES