

RISK ASSESSMENT: IDENTIFICATION OF POTENTIAL HAZARDS

SECTION 2 - IDENTIFICATION OF POTENTIAL HAZARDS

FEMA's current regulations and interim guidance require, at a minimum, an evaluation of a full range of natural hazards. An evaluation of "human-caused" hazards (i.e., technological hazards and/or terrorism) is encouraged, though not required, for plan approval under DMA 2000. Rensselaer County has chosen to focus solely on natural hazards at this time. Human-caused hazards can be evaluated in future versions of the plan, as it is a "living document" which will be monitored, evaluated and updated regularly.

After consideration of a full range of natural hazards, the participating jurisdictions have identified several hazards that are addressed in this Hazard Mitigation Plan. These hazards were identified through an extensive process that utilized direct input from Mitigation Planning Committee members, research of past disaster declarations in the County, and review of the New York State Hazard Mitigation Plan (2008), and the existing HAZNY study completed by the County in 2005. HAZNY (Hazards New York) is an automated hazard analysis program which asks questions concerning hazards faced by a community and, rates and ranks each hazard based upon the responses. Readily available online information from reputable sources (such as Federal and state agencies) was also evaluated to supplement information from these key sources. The most prominent online sources of data used in this assessment to identify the occurrence of various hazards were records of declared disasters and emergencies maintained by FEMA and NYSEMO, the National Climatic Data Center (NCDC) Storm Event Database, and the Spatial Hazard Events and Losses Database for the United States (SHELDUS) maintained by the Hazards and Vulnerability Research Institute at the University of South Carolina.

The following table (Table 2.1) presents the full range of natural hazards considered and provides a brief description of each hazard. Subsequently, Table 2.2 documents the evaluation process for the hazards listed in Table 2.1 to determine the hazards worthy of further consideration in the plan. For each hazard considered, Table 2.2 indicates whether or not the hazard was identified as a significant hazard to be addressed in the plan, how this determination was made (i.e. the sources of information that were consulted while researching each hazard) and why this determination was made. The table summarizes not only those hazards that *were* identified (and why) but also those that *were not* identified as a significant hazard (and why not).

Some of these hazards are considered to be interrelated or cascading (e.g., hurricanes can cause wind damage and flooding), but for preliminary hazard identification purposes these individual hazards have been broken out separately. It should also be noted that some hazards, such as earthquakes or winter storms may impact a large area yet cause little damage, while other hazards, such as a tornado, may impact a small area yet cause extensive damage within that area.

Because this Hazard Mitigation Plan is a living document, hazard events not identified for inclusion and profiling at this time could be addressed during future evaluations and updates of the plan if deemed necessary by the Mitigation Planning Committee at that time.

Table 2.3 provides a summary checklist of the hazard identification and evaluation process noting which of the 23 initially identified hazards are considered significant enough for further evaluation through the risk assessment (marked with a "☑"). Table 2.4 provides a summary of the results of the 2005 HAZNY analysis for reference and comparison.

RISK ASSESSMENT: IDENTIFICATION OF POTENTIAL HAZARDS

Table 2.1	
Descriptions of the Full Range of Initially Identified Hazards	
Hazard	Description
ATMOSPHERIC	
Avalanche	A rapid fall or slide of a large mass of snow down a mountainside.
Extreme Temperatures	Extreme heat and extreme cold constitute different conditions in different parts of the country. Extreme cold can range from near freezing in the South to temperatures well below zero in the North. Similarly, extreme heat is typically recognized as the condition whereby temperatures hover ten degrees or more above the average high temperature for a region for an extended period.
Extreme Wind	Wind is air that is in constant motion relative to the surface of the earth. Extreme wind events can occur suddenly without warning. They can occur at any time of the day or night, in any part of the country. Extreme winds pose a threat to lives, property, and vital utilities primarily due to the effects of flying debris and can down trees and power lines. Extreme winds are most commonly the result of hurricanes, tropical storms, nor'easters, severe thunderstorms and tornadoes, but can also occur in their absence as mere "windstorms." One type of windstorm, the downburst, can cause damage equivalent to a strong tornado.
Hailstorm	Any storm that produces hailstones that fall to the ground; usually used when the amount or size of the hail is considered significant. Hail is formed when updrafts in thunderstorms carry raindrops in to parts of the atmosphere where the temperatures are below freezing.
Hurricane and Tropical Storm	Hurricanes and tropical storms are classified as cyclones and defined as any closed circulation developing around a low-pressure center in which the winds rotate counter-clockwise in the Northern Hemisphere (or clockwise in the Southern Hemisphere) and with a diameter averaging 10 to 30 miles across. When maximum sustained winds reach or exceed 39 miles per hour, the system is designated a tropical storm, given a name, and is closely monitored by the National Hurricane Center. When sustained winds reach or exceed 74 miles per hour the storm is deemed a hurricane. The primary damaging forces associated with these storms are high-level sustained winds, heavy precipitation and tornadoes. Coastal areas are also vulnerable to the additional forces of storm surge, wind-driven waves and tidal flooding which can be more destructive than cyclone wind. The majority of hurricanes and tropical storms form in the Atlantic Ocean, Caribbean Sea and Gulf of Mexico during the official Atlantic hurricane season, which extends from June through November.
Lightning	Lightning is a discharge of electrical energy resulting from the buildup of positive and negative charges within a thunderstorm, creating a "bolt" when the buildup of charges becomes strong enough. This flash of light usually occurs within the clouds or between the clouds and the ground. A bolt of lightning can reach temperatures approaching 50,000 degrees Fahrenheit. Lightning rapidly heats the sky as it flashes, but the surrounding air cools following the bolt. This rapid heating and cooling of the surrounding air causes thunder. On average, 73 people are killed each year by lightning strikes in the United States.
Nor'easter	Similar to hurricanes, nor'easters are ocean storms capable of causing substantial damage to coastal areas in the Eastern United States due to their associated strong winds and heavy surf. Nor'easters are named for the winds that blow in from the northeast and drive the storm up the East Coast along the Gulf Stream, a band of warm water that lies off the Atlantic coast. They are caused by the interaction of the jet stream with horizontal temperature gradients and generally occur during the fall and winter months when moisture and cold air are plentiful. Nor'easters are known for dumping heavy amounts of rain and snow, producing hurricane-force winds, and creating high surf that causes severe beach erosion and coastal flooding.
Tornado	A tornado is a violently rotating column of air that has contact with the ground and is often visible as a funnel cloud. Its vortex rotates cyclonically with wind speeds ranging from as low as 40 mph to as high as 300 mph. Tornadoes are most often generated by thunderstorm activity when cool, dry air intersects and overrides a layer of warm, moist air forcing the warm air to rise rapidly. The destruction caused by tornadoes ranges from light to catastrophic depending on the intensity, size and duration of the storm.

RISK ASSESSMENT: IDENTIFICATION OF POTENTIAL HAZARDS

Table 2.1 Descriptions of the Full Range of Initially Identified Hazards	
Hazard	Description
Winter Storm	Winter storms may include snow, sleet, freezing rain, or a mix of these wintry forms of precipitation. Blizzards, the most dangerous of all winter storms, combine low temperatures, heavy snowfall, and winds of at least 35 miles per hour, reducing visibility to only a few yards. Ice storms occur when moisture falls and freezes immediately upon impact on trees, power lines, communication towers, structures, roads and other hard surfaces. Winter storms and ice storms can down trees, cause widespread power outages, damage property, and cause fatalities and injuries to human life.
HYDROLOGIC	
Coastal Erosion	Landward displacement of a shoreline caused by the forces of waves and currents. Coastal erosion is measured as the rate of change in the position or horizontal displacement of a shoreline over a period of time. It is generally associated with episodic events such as hurricanes and tropical storms, nor'easters, storm surge and coastal flooding but may also be caused by human activities that alter sediment transport. Construction of shoreline protection structures can mitigate the hazard, but may also exacerbate it under some circumstances.
Dam Failure	Dam failure is the collapse, breach, or other failure of a dam structure resulting in downstream flooding. In the event of a dam failure, the energy of the water stored behind even a small dam is capable of causing loss of life and severe property damage if development exists downstream of the dam. Dam failure can result from natural events, human-induced events, or a combination of the two. The most common cause of dam failure is prolonged rainfall that produces flooding. Failures due to other natural events such as hurricanes, earthquakes or landslides are significant because there is generally little or no advance warning.
Drought	A prolonged period of less than normal precipitation such that the lack of water causes a serious hydrologic imbalance. Common effects of drought include crop failure, water supply shortages, and fish and wildlife mortality. High temperatures, high winds, and low humidity can worsen drought conditions and also make areas more susceptible to wildfire. Human demands and actions have the ability to hasten or mitigate drought-related impacts on local communities.
Flood	The accumulation of water within a water body which results in the overflow of excess water onto adjacent lands, usually floodplains. The floodplain is the land adjoining the channel of a river, stream, ocean, lake or other watercourse or water body that is susceptible to flooding. Most floods fall into the following three categories: riverine flooding, coastal flooding, or shallow flooding (where shallow flooding refers to sheet flow, ponding and urban drainage).
Ice Jams	A formation of ice over a body of water that limits the flow of the water due to freezing. Ice jam flooding occurs when warm temperatures and heavy rain cause the snow to melt rapidly, causing frozen rivers or lakes to overflow. As the water lifts, the ice that's formed on top of the body of water breaks into small pieces of varying sizes. These pieces or large chunks of ice tend to float downstream and often pile up near narrow passages or near obstructions, such as bridges and dams. This accumulation can impact the integrity of the structures and also cause upstream flooding as water backs up behind the obstruction.
Storm Surge	A storm surge is a large dome of water often 50 to 100 miles wide and rising anywhere from four to five feet in a Category 1 hurricane up to more than 30 feet in a Category 5 storm. Storm surge heights and associated waves are also dependent upon the shape of the offshore continental shelf (narrow or wide) and the depth of the ocean bottom (bathymetry). A narrow shelf, or one that drops steeply from the shoreline and subsequently produces deep water close to the shoreline, tends to produce a lower surge but higher and more powerful storm waves. Storm surge arrives ahead of a storm's actual landfall and the more intense the hurricane is, the sooner the surge arrives. Storm surge can be devastating to coastal regions, causing severe beach erosion and property damage along the immediate coast. Further, water rise caused by storm surge can be very rapid, posing a serious threat to those who have not yet evacuated flood-prone areas.
Wave Action	The characteristics and effects of waves that move inland from an ocean, bay, or other large body of water. Large, fast moving waves can cause extreme erosion and scour and their impact on buildings can cause severe damage. During hurricanes and other high-wind events, storm surge and wind increase the destructiveness of waves and cause them to reach higher elevations and penetrate further inland.

RISK ASSESSMENT: IDENTIFICATION OF POTENTIAL HAZARDS

Table 2.1 Descriptions of the Full Range of Initially Identified Hazards	
Hazard	Description
GEOLOGIC	
Earthquake	A sudden, rapid shaking of the Earth caused by the breaking and shifting of rock beneath the surface. This movement forces the gradual building and accumulation of energy. Eventually, strain becomes so great that the energy is abruptly released, causing the shaking at the earth's surface which we know as an earthquake. Roughly 90 percent of all earthquakes occur at the boundaries where plates meet, although it is possible for earthquakes to occur entirely within plates. Earthquakes can affect hundreds of thousands of square miles; cause damage to property measured in the tens of billions of dollars; result in loss of life and injury to hundreds of thousands of persons; and disrupt the social and economic functioning of the affected area.
Expansive Soils	Soils that will exhibit some degree of volume change with variations in moisture conditions. The most important properties affecting degree of volume change in a soil are clay mineralogy and the aqueous environment. Expansive soils will exhibit expansion caused by the intake of water and, conversely, will exhibit contraction when moisture is removed by drying. Generally speaking, they often appear sticky when wet, and are characterized by surface cracks when dry. Expansive soils become a problem when structures are built upon them without taking proper design precautions into account with regard to soil type. Cracking in walls and floors can be minor, or can be severe enough for the home to be structurally unsafe.
Landslide	The movement of a mass of rock, debris, or earth, down a slope when the force of gravity pulling down the slope exceeds the strength of the earth materials that comprise to hold it in place. Slopes greater than 10 degrees are more likely to slide, as are slopes where the height from the top of the slope to its toe is greater than 40 feet. Slopes are also more likely to fail if vegetative cover is low and/or soil water content is high.
Land Subsidence	The gradual settling or sudden sinking of the Earth's surface due to the subsurface movement of earth materials. Causes of land subsidence include groundwater pumpage, aquifer system compaction, drainage of organic soils, underground mining, hydrocompaction, natural compaction, sinkholes, and thawing permafrost.
Tsunami	A series of waves generated by an undersea disturbance such as an earthquake. The speed of a tsunami traveling away from its source can range from up to 500 miles per hour in deep water to approximately 20 to 30 miles per hour in shallower areas near coastlines. Tsunamis differ from regular ocean waves in that their currents travel from the water surface all the way down to the sea floor. Wave amplitudes in deep water are typically less than one meter; they are often barely detectable to the human eye. However, as they approach shore, they slow in shallower water, basically causing the waves from behind to effectively "pile up", and wave heights to increase dramatically. As opposed to typical waves which crash at the shoreline, tsunamis bring with them a continuously flowing 'wall of water' with the potential to cause devastating damage in coastal areas located immediately along the shore.
Volcano	A mountain that opens downward to a reservoir of molten rock below the surface of the earth. While most mountains are created by forces pushing up the earth from below, volcanoes are different in that they are built up over time by an accumulation of their own eruptive products: lava, ash flows, and airborne ash and dust. Volcanoes erupt when pressure from gases and the molten rock beneath becomes strong enough to cause an explosion.
OTHER	
Wildfire	An uncontrolled fire burning in an area of vegetative fuels such as grasslands, brush, or woodlands. Heavier fuels with high continuity, steep slopes, high temperatures, low humidity, low rainfall, and high winds all work to increase risk for people and property located within wildfire hazard areas or along the urban/wildland interface. Wildfires are part of the natural management of forest ecosystems, but most are caused by human factors. Over 80 percent of forest fires are started by negligent human behavior such as smoking in wooded areas or improperly extinguishing campfires. The second most common cause for wildfire is lightning.

RISK ASSESSMENT: IDENTIFICATION OF POTENTIAL HAZARDS

Table 2.2
Documentation of the Hazard Evaluation Process

Natural Hazards Considered	Was this hazard identified as a significant hazard to be addressed in the plan at this time? (Yes or No)	How was this determination made?	Why was this determination made?
ATMOSPHERIC HAZARDS			
Avalanche	NO	<ul style="list-style-type: none"> • Review of US Forest Service National Avalanche Center web site • Review of NY State Hazard Mitigation Plan • Review of FEMA’s Multi-Hazard Identification and Risk Assessment • Rensselaer County Hazards New York (HAZNY) • Core Planning Group feedback 	<ul style="list-style-type: none"> • Avalanches are not included in the NY State Hazard Mitigation Plan, and are not discussed for NY on the US Forest Service Avalanche Center web site. • While avalanches are not unknown in northern New York State, the topography and climate in Rensselaer County do not support conditions required for the occurrence of significant avalanches. • Avalanches were not included in the Rensselaer County HAZNY study of 2005.
Extreme Temperatures	YES	<ul style="list-style-type: none"> • Review of NY State Hazard Mitigation Plan • Review of National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center (NCDC) Storm Events Database • Review of the Spatial Hazard Events and Losses Database for the United States (SHELDUS) • Review of FEMA’s Multi-Hazard Identification and Risk Assessment • Rensselaer County HAZNY • Core Planning Group feedback 	<ul style="list-style-type: none"> • Extreme heat events are mentioned in the NY State plan as a discrete hazard. Extreme cold is mentioned in the context of winter storms. • The state plan describes one significant extreme heat event affecting Rensselaer County since 1994 and shows that the percentage of the population in 2006 most susceptible to extreme heat (those under 5yrs and over 65yrs) is 18.5%, which is slightly lower than the statewide average of 19.5%. • NCDC reports 12 relevant extreme temperature events for areas including Rensselaer County between February 1993 and May 2010 (including five extreme summer heat events and seven extreme winter cold events). For these events \$50,000 in recorded property damages was recorded, with no attributed fatalities, injuries or crop damages across the County. • The SHELDUS database reports one additional extreme heat event affecting Rensselaer County in July 1988. • The Rensselaer County HAZNY study of 2005 ranked extreme temperatures as a Moderately Low Hazard: The 8th most significant natural hazard in the County out of 12 included in the assessment.
Extreme Wind	YES	<ul style="list-style-type: none"> • Review of NY State Hazard Mitigation Plan • Review of FEMA’s Multi-Hazard Identification and Risk Assessment • Review of NOAA NCDC Storm Events Database • Review of SHELDUS database • Review of American Society of Civil Engineers (ASCE) Standard 7-02 	<ul style="list-style-type: none"> • Extreme wind events are included in the NY State plan in the context of hurricane and tornado events. • The state plan ranks Rensselaer County as 12th out of 62 counties in the state for the threat of extreme wind and vulnerability to extreme wind losses. • Rensselaer County is located in a climate region that is highly susceptible to numerous types of extreme wind events including straight line winds, severe thunderstorms, hurricanes, tropical storms, and nor’easters. • According to FEMA-320 Figure I-4, Rensselaer County is located in a wind zone where extreme wind speeds of 160mph are possible.

RISK ASSESSMENT: IDENTIFICATION OF POTENTIAL HAZARDS

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Natural Hazards Considered	Was this hazard identified as a significant hazard to be addressed in the plan at this time? (Yes or No)	How was this determination made?	Why was this determination made?
		<p>(Minimum Design Loads for Buildings and Other Structures)</p> <ul style="list-style-type: none"> • Review of Wind Zones in the United States as per FEMA Publication 320 – Taking Shelter From the Storm • Rensselaer County HAZNY • Core Planning Group feedback 	<ul style="list-style-type: none"> • NCDC reports 30 high wind events (wind speed > 50 knots/58 mph) affecting Rensselaer County since 1993, causing four injuries and approximately \$11 million in property damage across the region including Rensselaer County. NCDC also records more than 130 significant thunderstorm wind events in the County since 1962, including more than 60 events since 1993 which have caused more than \$2 million dollars in damages and one fatality. • The SHELDUS database records more than 250 high wind/severe storm events in Rensselaer County since 1960, with approximately \$40 million in attributed damages. • The 3 second wind gust for Rensselaer County for building design purposes as per ASCE 7-02 is 90 mph. The standard also shows that the southeastern part of Rensselaer County is located in a Special Wind Region, i.e. an area where wind anomalies are known to occur and in which wind speeds may be substantially higher than specified. • The Rensselaer County HAZNY study of 2005 ranked severe storms as a Moderately High Hazard: The 2nd most significant natural hazard in the County out of 12 included in the assessment.
Hailstorm	NO	<ul style="list-style-type: none"> • Review of NY State Hazard Mitigation Plan • Review of FEMA's Multi-Hazard Identification and Risk Assessment • Review of NOAA NCDC Storm Events Database • Review of SHELDUS database • NOAA National Severe Storms Laboratory (NSSL) website • National Agricultural Statistics Service website • Rensselaer County HAZNY • Core Planning Group feedback 	<ul style="list-style-type: none"> • The state plan includes hailstorms as a discrete hazard but includes no recorded incidents of damaging hail in Rensselaer County. • While NCDC reports 59 significant hailstorm events (3/4 inch diameter hail or greater) for Rensselaer County between 1959 and 2009, there are only \$42,000 in recorded property damages associated with these events, or less than \$1,000 per year over the whole County. • The SHELDUS database records an additional 49 storm events between 1960 and 2008 which featured hail, but does not record damages in these events which were solely attributable to the effects of hail. • According to NSSL mapping, Rensselaer County is located in a region with the lowest annual number of days with hailstorms (less than 2), and where the annual average number of damaging hail events is essentially zero. • There are minimal hazard mitigation techniques available to reduce hailstorm impacts to property, outside of the emergency preparedness procedures and severe weather warning systems already in place (i.e. mass public notifications that recommend immediate protective actions such as moving automobiles into protected spaces). • Agriculture is an integral part of the economy of Rensselaer County; approximately 20 percent of the County land area is devoted to agricultural uses, with approximately 10 percent devoted to cropland. The National Agricultural

RISK ASSESSMENT: IDENTIFICATION OF POTENTIAL HAZARDS

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Natural Hazards Considered	Was this hazard identified as a significant hazard to be addressed in the plan at this time? (Yes or No)	How was this determination made?	Why was this determination made?
			<p>Statistics Service ranked Rensselaer County 40th out of 62 counties in the state for the amount of land in agricultural use, and 41st in the state for the market value of all agricultural products sold from County farms in 2007. Agricultural losses during a significant hail event have the potential to be significant; however, there are no known hail mitigation measures for crops, which would be exposed to the greatest hail damages.</p>
Hurricane and Tropical Storm	YES	<ul style="list-style-type: none"> • Review of NY State Hazard Mitigation Plan • Analysis of NOAA historical tropical cyclone tracks • Review of NOAA National Hurricane Center (NHC) website • Review of NOAA NCDC Storm Events Database • Review of SHELDUS database • Review of FEMA's Multi-Hazard Identification and Risk Assessment • Rensselaer County HAZNY • Core Planning Group feedback 	<ul style="list-style-type: none"> • Hurricane and tropical storm events are discussed in the state plan, which includes FEMA mapping showing Rensselaer County located in a hurricane-susceptible area where extreme wind speeds of 160 mph are possible. • NYSEMO records show that Rensselaer County has been included in the area covered by major disaster declarations due to hurricanes or tropical storms on two occasions since 1953 (Hurricane Belle in 1976 and Tropical Storm Floyd in 1999). • NOAA historical records indicate three hurricane tracks, nine tropical storm tracks, and six tropical depressions passing within 65 nautical miles of Rensselaer County between 1861 and 2008. • The most recent of these tracked events was Tropical Storm Beryl, which passed over the eastern United States in August 1994, causing heavy rainfall and flash flooding in eastern New York State. The most proximate tropical events to Rensselaer County during the last 100 years were an unnamed tropical storm which passed directly over the county in 1949, and the famously destructive New England Hurricane of 1938, which was still considered a Category 2 hurricane when it passed approximately 10-12 miles to the east of Rensselaer County • While the NCDC database does not record any hurricane or tropical storm events affecting Rensselaer County, the SHELDUS database reports three such events causing small amounts of damage (about \$65,000 in total) in the County in 1960, 1971, and 1979. • While the Rensselaer County HAZNY study did not specifically include hurricanes/tropical storms as a hazard for consideration, "severe storms" were ranked the 2nd most significant natural hazard in the County.
Lightning	YES	<ul style="list-style-type: none"> • Review of NY State Hazard Mitigation Plan • Review of NOAA NCDC Storm Events Database, NOAA lightning statistics, and NSSL web site • Review of SHELDUS database 	<ul style="list-style-type: none"> • Lightning is not considered as a discrete hazard in the NY State Hazard Mitigation Plan or the County HAZNY study. • While NOAA records that New York State has experienced the fourth most deaths and third most damages from lightning in the United States from 1959 to 1994, FEMA and NOAA data also shows that Rensselaer County is located in an area of the country that experiences an average of 20 to 30 thunder days annually, and two to four

RISK ASSESSMENT: IDENTIFICATION OF POTENTIAL HAZARDS

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		<ul style="list-style-type: none"> • Review of FEMA’s Multi-Hazard Identification and Risk Assessment • Rensselaer County HAZNY • Core Planning Group feedback 	<p>lightning flashes per square kilometer per year. For comparison, large areas of the country experience more than 40 thunder days per year and twice as many flashes per square kilometer.</p> <ul style="list-style-type: none"> • NCDC reports 11 significant lightning events for Rensselaer County since July 1994 resulting in 11 injuries and a total of \$286,000 in property damages. • The SHELDUS database records an additional 59 lightning events in Rensselaer County between 1961 and 2009, causing almost \$2.8 million in damages. Almost 60% of the strikes involved damages of more than \$1,000. • A direct strike to the RCBPS building in July 2010 damaged equipment and required temporary operations out of the BPS trailer for several days.
Nor’easter	NO	<ul style="list-style-type: none"> • Review of NY State Hazard Mitigation Plan • Review of FEMA’s Multi-Hazard Identification and Risk Assessment • Rensselaer County HAZNY • Core Planning Group feedback 	<ul style="list-style-type: none"> • The NCDC and SHELDUS databases do not specifically list nor’easters as individual hazard events. • Although the Rensselaer County HAZNY study ranked “severe storms” the 2nd most significant natural hazard in the county, the study did not consider nor’easters as a discrete hazard for individual assessment. • Nor’easters are discussed in the state plan as a common cause of flooding and severe snowstorms in the southern and eastern portion of the state. Typically, nor’easters affect the New York City and Long Island region. On occasion, the storms are large enough to encompass most of the state. • Rensselaer County is only directly affected by individual nor’easter events on an occasional basis, and the principal potential impacts of such storms (high winds, flooding and heavy snow) are considered as individual hazards of concern to be addressed separately in this plan.
Tornado	YES	<ul style="list-style-type: none"> • Review of NY State Hazard Mitigation Plan • Review of NOAA NCDC Storm Events Database • Review of NSSL website • Review of SHELDUS database • Review of FEMA’s Multi-Hazard Identification and Risk Assessment • Rensselaer County HAZNY • Core Planning Group feedback 	<ul style="list-style-type: none"> • The state plan reports that New York State has a definite vulnerability to tornadoes, with an average occurrence of approximately six tornadoes per year since 1952. • NCDC reports nine damage-causing tornado events in Rensselaer County since August 1973. Of the nine recorded events, three were of magnitude F2 on the Fujita Scale (severe damage), five were of magnitude F1 (moderate damage), and the remaining one was F0 (light damage). A tornado of magnitude F2 in May 1998 is recorded as causing \$10 million in property damage in Rensselaer County. • The SHELDUS database records an additional two damage-causing tornado events in 1961 and 1980, but does not record their magnitude. • NSSL tornado probability data indicate that while Rensselaer County is in an area that experiences only 0.2 to 0.4 tornado events per year, such events are likely to be life-

RISK ASSESSMENT: IDENTIFICATION OF POTENTIAL HAZARDS

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			threatening and cause significant damages when they occur. <ul style="list-style-type: none"> The Rensselaer County HAZNY study ranked tornados as the 5th most significant natural hazard in the County.
Winter Storm	YES	<ul style="list-style-type: none"> Review of NY State Hazard Mitigation Plan Review of FEMA's Multi-Hazard Identification and Risk Assessment Review of NOAA NCDC Storm Events Database Review of SHELUDS database New York State Climate Office web site Rensselaer County HAZNY Core Planning Group feedback 	<ul style="list-style-type: none"> Winter storms including heavy snow and ice storms are discussed in the state plan, which ranks Rensselaer County 17th out of 62 counties in the state for most threatened by snow and vulnerable to snow losses. The plan also ranks Rensselaer County 38th out of 62 for most vulnerable to ice storms and ice storm losses. Average annual snowfall in Rensselaer County is almost 63 inches, slightly less than the statewide average of 65 inches. NCDC reports that Rensselaer County has been affected by 106 significant snow and ice events since January 1993. \$20.5 million in property damages are attributed to these events, including damages occurring outside of Rensselaer County. The SHELUDS database records an additional 107 winter-related events in Rensselaer County, to which \$29 million in damages are attributed. NCDC mapping shows Rensselaer County to be located in an area with an average of 18-21 hours of freezing rain per year. According to NOAA, Rensselaer County is located in an area where snow depths of 75-100 inches have a 5% chance of being equaled or exceeded in any given year. Rensselaer County has been included in three winter-related Federal disaster declarations and two emergency declarations. The Rensselaer County HAZNY study ranked winter storms in general as the 9th most significant natural hazard in the county but ice storms in particular as the 3rd most significant in the county.
HYDROLOGIC HAZARDS			
Coastal Erosion	NO	<ul style="list-style-type: none"> Review of NY State Hazard Mitigation Plan Review of FEMA's Multi-Hazard Identification and Risk Assessment Rensselaer County HAZNY Core Planning Group feedback 	<ul style="list-style-type: none"> While coastal erosion is identified as a hazard and discussed in the NY State plan, the state plan does not identify any mapped coastal erosion hazard areas in Rensselaer County. For the purposes of this plan the Hudson River shoreline in the County is not considered to be a coastal environment, and no evidence has been found to indicate that riverine erosion is a significant threat to life and property in Rensselaer County. The Rensselaer County HAZNY study did not include erosion as a hazard for consideration.
Dam Failure	YES	<ul style="list-style-type: none"> Review of NY State Hazard Mitigation Plan 	<ul style="list-style-type: none"> Dam Failure is briefly discussed in the state plan as a potential cause of flooding.

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Documentation of the Hazard Evaluation Process

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		<ul style="list-style-type: none"> • Review of New York State Department of Environmental Conservation (NYSDEC) Bureau of Flood Protection and Dam Safety web site • Review of U.S. Army Corps of Engineers (USACE) National Inventory of Dams (NID) database • Review of Stanford University’s National Performance of Dams Program (NPDP) database • Review of FEMA’s Multi-Hazard Identification and Risk Assessment • Rensselaer County HAZNY • Core Planning Group feedback 	<ul style="list-style-type: none"> • The NYSDEC database lists 96 dams in Rensselaer County, of which nine are classified as having “High” hazard potential, 17 are classified as having “Moderate” hazard potential. The remainder is classified as having “Low” or “Negligible” hazard potential. • According to US Geological Survey (USGS) criteria, there are four “Major” dams in the County, by virtue of having a dam height of 50 feet or more, or a normal storage volume of at least 5,000 acre-feet. All four “Major” dams are classified by NYSDEC as of high hazard potential. • One of the above “Major” dams (the Tomhannock Reservoir) meets both the dam height and normal storage criteria. • Emergency Action Plans are in place for five of the “High” hazard potential dams and two of the “moderate” hazard dams”. • The Stanford NPDP database records two minor dam incidents in the county since detailed records began in 1868. One involved a moderate hazard dam and one involved a low hazard dam. Neither resulted in dam any failure, breach, or recorded damages to property other than repairs to the structure of the dam itself. • Despite the lack of recorded dam failure incidents, dam failure is considered a hazard of concern due to the number of high and moderate hazard dams in the county, and the absence of full coverage of these dams by emergency action plans. • The Rensselaer County HAZNY study of 2005 ranked dam failure as the 12th most significant natural hazard in the County (out of 12 natural hazards considered).
Drought	YES	<ul style="list-style-type: none"> • Review of NY State Hazard Mitigation Plan • Review of FEMA’s Multi-Hazard Identification and Risk Assessment • Review of NOAA NCDC Database • Review of SHELDUS database • Review of National Drought Mitigation Center /NOAA web sites • Rensselaer County HAZNY • Core Planning Group feedback 	<ul style="list-style-type: none"> • Drought is discussed in the state plan, which describes one significant local drought specifically affecting Rensselaer County and one statewide drought assumed to have affected the county since 1993. • According to the Palmer Drought Severity Index (PDSI) Map for the USA, Rensselaer County is located in an area that experienced drought conditions (PDSI ≤ 3, severe or extreme drought) for between five and ten percent of the period 1895 to 1995. • NCDC reports that Rensselaer County has been affected by three drought events since 1993. One of these events is recorded as extending from August to December 1993, affecting an area covering 10 counties in south eastern New York State. This event is recorded as causing \$50 million in crop damages. NCDC records two other drought events in April and August 1999 for which no losses are reported. The NCDC descriptions indicate that these two droughts could be considered components of a single event.

RISK ASSESSMENT: IDENTIFICATION OF POTENTIAL HAZARDS

Table 2.2
Documentation of the Hazard Evaluation Process

Natural Hazards Considered	Was this hazard identified as a significant hazard to be addressed in the plan at this time? (Yes or No)	How was this determination made?	Why was this determination made?
			<ul style="list-style-type: none"> • The SHELDUS database reports a further two drought events affecting Rensselaer County in 1988 and 1991, for which \$1.7m and \$185,000 in crop damages are respectively reported. • For the purposes of mitigation plans of this nature the primary impacts of drought are assumed to fall on agriculture. Agriculture is an integral part of the economy of Rensselaer County. Approximately 20 percent of the County is devoted to agricultural uses, and 10 percent of the County land area is devoted to cultivated cropland. The National Agricultural Statistics Service ranked Rensselaer County 30th out of 62 counties in the state for value of crops sold. • The Rensselaer County HAZNY study ranked drought the 10th most significant natural hazard in the County out of 12 natural hazards considered • The four noted historic drought events (1988, 1991, 1993, and 1999) have caused approximately \$6.9 million damages (or approximately \$313,000 per year).
Flood	YES	<ul style="list-style-type: none"> • Review of NY State Hazard Mitigation Plan • Review of NOAA NCDC Storm Events Database • Review of SHELDUS database. • Review of FEMA's Multi-Hazard Identification and Risk Assessment • Review of FEMA's National Flood Insurance Program (NFIP) Community Status Book and Community Rating System (CRS) status data • Review of FEMA Q3 flood data • Rensselaer County HAZNY • Core Planning Group feedback 	<ul style="list-style-type: none"> • Flooding is described in the state plan as the primary natural hazard in the State of New York and is discussed in comprehensive detail. • Half of all the Federal disaster declarations that affected Rensselaer County have involved flooding (for the period 1953 to 2010). • Rensselaer County has been affected by six flood-related Presidential disaster declarations since 1953, with the most recent due to severe storms and flooding in July 2006. • NCDC records 42 flood events affecting Rensselaer County since March 1993. More than \$14.5 million in property damage was attributed to these events, including damage occurring outside the County boundaries. • The SHELDUS database records an additional 21 flood events which caused damage in Rensselaer County between 1960 and 1987. • According to data tabulated in the state plan, based on FEMA's Q3 flood mapping, 5.7 percent of Rensselaer County land and 3.2 percent of all residential properties lie within the identified 100-year floodplain. The state plan ranks Rensselaer County as the 20th most threatened and vulnerable to flood loss out of the 62 counties in the state on this basis. • Appendix 1 of the current state plan reports 2,183 residential properties in the 100-year floodplain in Rensselaer County, with a total value of almost \$204 million. Based on the number of residential properties so exposed, Rensselaer County ranks 10th in the State among those counties for which Q3 data is available, and 18th on

RISK ASSESSMENT: IDENTIFICATION OF POTENTIAL HAZARDS

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Documentation of the Hazard Evaluation Process

Natural Hazards Considered	Was this hazard identified as a significant hazard to be addressed in the plan at this time? (Yes or No)	How was this determination made?	Why was this determination made?
			<p>the estimated value of exposed residential property.</p> <ul style="list-style-type: none"> All 22 municipal jurisdictions in Rensselaer County participate in the NFIP but none are eligible to participate in the CRS. According to data tabulated in the current New York State Hazard Mitigation Plan, Rensselaer County ranks 12th out of 62 for both the total number of NFIP policies and the total dollar amount of NFIP coverage. Also according to this Appendix, Rensselaer County ranks 28th in the state for the total number of NFIP claims since 1978, and 37th for the total dollar amount of claims paid. NFIP records include 200 individual paid flood loss claims totaling almost \$1.5 million in Rensselaer County since 1978. The State Plan Appendix also reports that Rensselaer County ranks 30th in the state for the number of repetitive loss properties. The Rensselaer County HAZNY ranked flooding as the most significant natural hazard in the County.
Ice Jams	YES	<ul style="list-style-type: none"> Review of NY State Hazard Mitigation Plan Review of FEMA's Multi-Hazard Identification and Risk Assessment USACE Cold Regions Research & Engineering Laboratory (CRREL) Ice Jams Database Rensselaer County HAZNY Core Planning Group feedback 	<ul style="list-style-type: none"> Ice jams are mentioned as a significant cause of flooding in the state plan and New York State has, overall, experienced more ice jam events than any other U.S. state except Montana in the period 1867 through 2007. The Rensselaer County HAZNY study ranked ice jams as the 12th most significant natural hazard in the County out of the 12 included in the study. However, ice jams occur regularly in Rensselaer County. The USACE CRREL Ice Jams Database records 38 ice jam incidents in total on all watercourses in Rensselaer County since 1920. Most of these events occurred on the Hoosic/Little Hoosic Rivers, Poesten Kill, and Moordener Kill. The 38 ice jam records in the CRREL database for Rensselaer County do not include detailed event information until 1996. Prior to that year, event records are limited to general notes regarding discharges and gage heights. Beginning in 1996, record details begin to include qualitative assessments of impacts including overbank flooding, road closures, evacuations, etc. Though dollar damages are listed as unknown in the CRREL records, research of the NCDC database shows that these events recorded as flood events totaling approximately \$40,000 in damages.
Storm Surge	No	<ul style="list-style-type: none"> Review of NY State Hazard Mitigation Plan Review of FEMA's Multi-Hazard Identification and Risk Assessment Rensselaer County HAZNY study 	<ul style="list-style-type: none"> Storm surge is discussed in the state plan under flood hazard and hurricane/tropical storm hazard. Storm surges are considered to be a coastal phenomenon and Rensselaer County is located approximately 100 miles from the nearest open sea. The Rensselaer County HAZNY study did not include storm surges as a hazard for consideration.

RISK ASSESSMENT: IDENTIFICATION OF POTENTIAL HAZARDS

**Table 2.2
Documentation of the Hazard Evaluation Process**

Natural Hazards Considered	Was this hazard identified as a significant hazard to be addressed in the plan at this time? (Yes or No)	How was this determination made?	Why was this determination made?
		<ul style="list-style-type: none"> Core Planning Group feedback 	
Wave Action	NO	<ul style="list-style-type: none"> Review of NY State Hazard Mitigation Plan Review of FEMA's Multi-Hazard Identification and Risk Assessment Review of FEMA Q3 flood data Rensselaer County HAZNY Core Planning Group feedback 	<ul style="list-style-type: none"> While waves are discussed in the state plan under flood hazard, damage-causing waves are considered a coastal phenomenon, and since Rensselaer County is located approximately 100 miles from the nearest coastline likely to be affected by wave action, they are not regarded as a hazard for the purposes of this plan. Areas that subject to significant wave action (wave heights of three feet or more) are designated as V (Velocity) Zones on FEMA/NFIP flood maps. The existing Q3 mapping shows no V zones in Rensselaer County. The Rensselaer County HAZNY study did not include wave action as a hazard for consideration.
GEOLOGIC HAZARDS			
Earthquake	YES	<ul style="list-style-type: none"> Review of NY State Hazard Mitigation Plan Review of USGS Earthquake Hazards Program web site Review of FEMA's Multi-Hazard Identification and Risk Assessment Rensselaer County HAZNY Core Planning Group feedback 	<ul style="list-style-type: none"> Earthquakes are discussed in the state plan, since earthquakes have occurred in and around the State of New York in the past. The state plan ranks Rensselaer County 22nd out of 62 counties for potential annualized earthquake losses and 24th for potential annualized earthquake loss per capita. According to USGS seismic hazard maps, the peak ground acceleration (PGA) with a 10% probability of exceedance in 50 years for Rensselaer County is 3-4% of gravity. FEMA requires that earthquakes be further evaluated for mitigation purposes in areas with a PGA of 3% of gravity or more. USGS records do not show the occurrence of any earthquakes of magnitude 3.0 or greater centered in Rensselaer County between 1698 and 1998. In the area within 50 miles north and west of Rensselaer County, 13 earthquakes of magnitude 3.0-3.9 and four of magnitude 4.0- 4.9 were recorded in the same period. Earthquakes of magnitude less than 3.0 are considered too small to be felt or to be the cause of damage. The Rensselaer County HAZNY study ranked earthquakes as the 4th most significant natural hazard in the County.
Expansive Soils	NO	<ul style="list-style-type: none"> Review of NY State Hazard Mitigation Plan Review of FEMA's Multi-Hazard Identification and Risk Assessment US Department of Transport Federal Highway Administration (USDOT FHA) Geological Data 	<ul style="list-style-type: none"> Expansive soils are not identified as a hazard in the NY State plan. According to USDOT FHA Report No. FHWA-RD-76-82, Rensselaer County lies in an area mapped as non-expansive – the occurrence of expansive materials is extremely limited. New York State building codes are based on the International Building Code (2000, with 2001 supplement), in which Chapter 18 includes provisions for building on

RISK ASSESSMENT: IDENTIFICATION OF POTENTIAL HAZARDS

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Documentation of the Hazard Evaluation Process

Natural Hazards Considered	Was this hazard identified as a significant hazard to be addressed in the plan at this time? (Yes or No)	How was this determination made?	Why was this determination made?
		<ul style="list-style-type: none"> • Rensselaer County HAZNY • Core Planning Group feedback 	<p>expansive soils (through design, removal or stabilization) so that new construction will be protected.</p> <ul style="list-style-type: none"> • The Rensselaer County HAZNY study did not include expansive soils as a hazard for consideration.
Landslide	YES	<ul style="list-style-type: none"> • Review of NY State Hazard Mitigation Plan • Review of USGS Landslide Incidence and Susceptibility Hazard Map • Review of New York State Geological Survey landslide inventory mapping and database • Review of FEMA's Multi-Hazard Identification and Risk Assessment • Rensselaer County HAZNY • Core Planning Group feedback 	<ul style="list-style-type: none"> • Landslides are discussed in the NY state plan, which records 22 significant landslide events in Rensselaer County between 1837 and 2007, more than in any other county in the state. The state plan also describes two fatal landslides in Rensselaer County in which a total of 22 people were killed. • The state plan ranks Rensselaer County as the county most threatened by landslides and most vulnerable to landslide losses. • The "Landslide Inventory Map of New York" produced by the New York State Geological Survey (NYSGS) in cooperation with the United States Geological Survey, plots the location of 30 landslide events in Rensselaer County between 1837 and 1989, as well as several areas (mostly along the Hudson River) where individual slides are too numerous to map. • Data sheets obtained from the NYSGS for most of the mapped landslide events also record the dollar damages caused by many of these events, with average losses of approximately \$25,000 per event (1980s dollars). • USGS landslide hazard maps indicate "High landslide incidence" (more than 15% of the area is involved in landsliding) for a 2 - 5 mile wide strip of Rensselaer County along the length of the county's Hudson River shoreline, as well as an area of "high susceptibility / moderate incidence" up to four miles wide in the east of the county along the border with Massachusetts. The remainder of the county is identified as "Low incidence". • The Rensselaer County HAZNY study ranked landslides as the 6th most significant natural hazard in the County.
Land Subsidence	NO	<ul style="list-style-type: none"> • Review of NY State Hazard Mitigation Plan • Review of FEMA's Multi-Hazard Identification and Risk Assessment • Review of USGS Fact Sheet 165-00 Land Subsidence in the U.S. • Rensselaer County HAZNY • Core Planning Group feedback 	<ul style="list-style-type: none"> • The state plan delineates certain areas that are susceptible to land subsidence hazards in New York. Mapping in the state plan and from USGS indicates that a few areas in the north east and south east of Rensselaer County are underlain by carbonate karst rock such as limestone (in which there can be the potential for subsidence caused by sinkholes). • USGS Fact Sheet 165-00 indicates that Rensselaer County is located in an area where subsidence caused by compaction of aquifers or drainage of organic soils is not likely. • As a general rule, land subsidence occurrence can be expected where it has occurred in the past. The state plan notes that new sinkhole formation in the karst areas is rare,

RISK ASSESSMENT: IDENTIFICATION OF POTENTIAL HAZARDS

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Natural Hazards Considered	Was this hazard identified as a significant hazard to be addressed in the plan at this time? (Yes or No)	How was this determination made?	Why was this determination made?
			<p>while in contrast, subsidence occurring in areas that are already subsiding (expanding existing sink holes) are relatively common, occurring every few years.</p> <ul style="list-style-type: none"> • While land subsidence is common in areas which feature significant underground mining (as opposed to open quarrying). • No significant historical occurrences of land subsidence or a history of underground mining were found in Rensselaer County during general internet-based research. • The Rensselaer County HAZNY study did not include land subsidence as a hazard for consideration.
Tsunami	NO	<ul style="list-style-type: none"> • Review of NY State Hazard Mitigation Plan • Review of FEMA's Multi-Hazard Identification and Risk Assessment • Core Planning Group feedback 	<ul style="list-style-type: none"> • Tsunamis are not discussed in the state plan. Since the southernmost border of Rensselaer County is located approximately miles from the ocean, and no record exists of a catastrophic Atlantic basin tsunami impacting the mid-Atlantic coast of the United States. FEMA mitigation planning guidance suggests that locations in the eastern U.S. north of Virginia have a relatively low tsunami risk and need not conduct a tsunami risk assessment at this time.
Volcano	NO	<ul style="list-style-type: none"> • Review of NY State Hazard Mitigation Plan • Review of USGS Volcano Hazards Program web site • Core Planning Group feedback 	<ul style="list-style-type: none"> • No volcanoes are located within approximately 2,000 miles of Rensselaer County.
Wildfire	YES	<ul style="list-style-type: none"> • Review of NY State Hazard Mitigation Plan • Review of NOAA NCDC Storm Events Database • Review of SHELDUS database. • Review of NYSEMO and NYSDEC web sites • Review of FEMA's Multi-Hazard Identification and Risk Assessment • Rensselaer County HAZNY • Core Planning Group feedback 	<ul style="list-style-type: none"> • Wildfires are discussed in the state plan as a hazard of concern. • A significant proportion of the eastern half of Rensselaer County's land area is forested. • NCDC and SHELDUS databases between them record two wildfire events in Rensselaer County in 1962 and 2001 for which property damages were recorded causing a total of approximately \$10,000 in damages. • General internet research suggests that parts of Rensselaer County experience minor forest/brush fires somewhat frequently; however, major blazes that damage or threaten developed property are relatively rare. • The Rensselaer County HAZNY study ranked wildfires as the 7th most significant natural hazard in the County.

RISK ASSESSMENT: IDENTIFICATION OF POTENTIAL HAZARDS

Table 2.3 Summary Results of the Hazard Identification and Evaluation Process	
<p><u>ATMOSPHERIC</u></p> <ul style="list-style-type: none"> <input type="checkbox"/> Avalanche <input checked="" type="checkbox"/> Extreme Temperatures <input checked="" type="checkbox"/> Extreme Wind <input type="checkbox"/> Hailstorm <input checked="" type="checkbox"/> Hurricane and Tropical Storm <input checked="" type="checkbox"/> Lightning <input type="checkbox"/> Nor'easter <input checked="" type="checkbox"/> Tornado <input checked="" type="checkbox"/> Winter Storm <p><u>HYDROLOGIC</u></p> <ul style="list-style-type: none"> <input type="checkbox"/> Coastal Erosion <input checked="" type="checkbox"/> Dam Failure <input checked="" type="checkbox"/> Drought <input checked="" type="checkbox"/> Flood <input checked="" type="checkbox"/> Ice Jams <input type="checkbox"/> Storm Surge <input type="checkbox"/> Wave Action 	<p><u>GEOLOGIC</u></p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Earthquake <input type="checkbox"/> Expansive Soils <input checked="" type="checkbox"/> Landslide <input type="checkbox"/> Land Subsidence <input type="checkbox"/> Tsunami <input type="checkbox"/> Volcano <p><u>OTHER</u></p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Wildfire

= Hazard considered significant enough for further evaluation through the hazard risk assessment.

Table 2.4 Rensselaer County HAZNY Analysis Results (Natural Hazards Only) <i>(Rensselaer County Bureau of Public Safety, 2005)</i>		
Hazard	Analysis Rating	Classification
Flood	364.2	High
Severe Storm	306.5	Moderately High
Ice Storm	294.8	Moderately High
Earthquake	285.8	Moderately High
Tornado	273.5	Moderately High
Landslide	266.5	Moderately High
Wildfire	266.5	Moderately High
Extreme Temperatures	254.8	Moderately High
Winter Storm	240.5	Moderately High
Drought	223.5	Moderately Low
Ice Jam	210.5	Moderately Low
Dam Failure	200.8	Moderately Low