

## SECTION 3c - RISK ASSESSMENT: ESTIMATED DAMAGES IN HAZARD AREAS

### **SECTION 3c - RISK ASSESSMENT: ESTIMATED DAMAGES IN HAZARD AREAS**

44 CFR Part 201.6 (c)(2)(ii)(B) states, “[The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(i)(A) of this section and a description of the methodology used to prepare this estimate...” This section of the Plan is intended to satisfy this requirement.

#### **Methodology**

This plan aims to assess vulnerability to various hazards within the limitations of the available data, where generally accepted measures of vulnerability are established. Parcel data included assessed values for land and total assessed values; assessed values for improvements were calculated by subtracting the land value from the total value. Expanding upon the parcel data in the County’s GIS to include such information as building square footage, year built, type, foundation type, and condition, would allow for a more accurate assessment of vulnerability. Therefore, the Planning Committee has considered actions in this regard. Please see further sections of this plan for additional information on actions considered and ultimately selected.

#### *Atmospheric Hazards*

#### **Estimated Damages – Extreme Temperatures**

While all of Rensselaer County is exposed to extreme temperatures, existing buildings, infrastructure and critical facilities are not considered significantly vulnerable to substantial damage caused by extreme heat or cold events. Therefore any estimated property losses associated with these hazards are anticipated to be minimal across the planning area. Extreme temperatures do, however, present a significant life and safety threat to the planning area’s population.

Heat casualties are usually caused by lack of adequate air conditioning or heat exhaustion. The most vulnerable population to heat casualties are the elderly or infirmed, who frequently live on low fixed incomes and cannot afford to run air-conditioning on a regular basis. This population is sometimes isolated, with no immediate family or friends to look out for their well being.

Casualties resulting from extreme cold may result from a lack of adequate heat, carbon monoxide poisoning from unsafe heat sources and frostbite. The most vulnerable populations to cold casualties are the elderly or infirmed as well as low income households, as they may not be able to afford to operate a heat source on a regular basis and may not have immediate family or friends to look out for their well being.

Given the lack of historical data and limited likelihood for structural losses resulting from extreme heat or cold occurrences in the planning area, and that placing dollar damage amounts on non-structural costs, such as damages to human health, are beyond the scope of this study, annualized economic losses for each municipality in the county due to extreme temperatures are currently considered to be unquantifiable, but most likely negligible.

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### **Estimated Damages – Extreme Winds**

Sufficient data was not available at the time of the study to estimate detailed damages due to extreme winds. At this time, vulnerability is being expressed as the value of improvements exposed to the hazard as defined in the “Hazard Profiles” section. Because it cannot be predicted where extreme winds may occur, all existing and future buildings, facilities and populations are considered to be exposed to this hazard and could potentially be impacted.

First, while FEMA methodologies do exist to estimate damages due to extreme wind, specific information is required for buildings in order to employ these methodologies, such as type of construction and details on any existing protective features. At the time of plan preparation, this data was not available as part of GIS datasets within Rensselaer County and was not readily available from other sources.

Second, having even the year built data for each structure, one would be able to highlight structures built before codes and standards were adopted to make buildings more resistant to wind damage, thus being better candidates for mitigation. Without the year-built data, this can not be done.

Sufficient historical data regarding events and associated losses was not available to make even the roughest of estimates of potential future losses. While NCDC records for the 17 year period of record from November 1993 through March 2010 included 36 extreme and high wind events affecting Rensselaer County, resulting in a total of zero deaths, four injuries, and \$11,033,000 in property damages county-wide. Over the 17 year period of record this is equivalent to \$649,000 per year county-wide, and \$29,500 per year in each municipality (assuming an equal distribution).

While the NCDC does attribute the roughly \$11M in damages to Rensselaer County, further research into the event records behind this total reveals three key limitations in the data.

First, it is apparent that the NCDC data set (and the \$11M in damages, in particular) includes a significant amount of damages that were incurred in affected areas outside of Rensselaer County, thus overestimating the damages incurred within Rensselaer County itself.

Second, and in contrast to the overestimation just discussed, it is also apparent that the NCDC data set (and the \$161 in damages, in particular) in some ways underestimates damages by failing to include all losses actually incurred in affected areas within Rensselaer County itself. Many event records describe damages within Rensselaer County qualitatively; however, the record itself tallies zero dollars in damages to property/crops. For these records, there is no way to accurately quantify the damages per event.

Third, for the vast majority of event records, dollar damages are not tied to specific municipalities within the County.

Looking next to the SHELDUS database, it is beneficial that this dataset is somewhat more robust. More than 250 storm events featuring high winds affecting Rensselaer County were recorded going back as far as February 1960, resulting in \$38,675,966 in damages to property and crops across the County. Over the 48 year period of record this is equivalent to \$822,893 per year in average annual damages county-wide, and \$37,404 in each municipality (assuming an equal distribution). Similar to the NCDC dataset, however, there are key limitations in the data affecting the quality of these estimates. Reported damages are storm totals, and can be inclusive of damages caused by hazards other than wind (i.e., flooding, hail, snow, lightning). In addition, the database does not provide descriptions or locations of the impacts of individual events, and dollar damages are not tied to specific municipalities within the County.

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Given the nature of historical data and documented structural losses resulting from extreme wind occurrences in the planning area, it is not possible to extract from existing datasets an accurate quantification of the potential annual structural losses over a long period of time in Rensselaer County's municipalities. However, while unquantifiable, these losses are potentially significant on an average annual basis for municipalities in the planning area.

If more detailed information should become available in the future, it should be utilized for loss estimates incorporated into future updates of the plan. While one could make some blanket assumptions at this time to enable the use of various tools for loss estimation, this would be unlikely to yield meaningful results.

### **Estimated Damages – Lightning**

While qualitative information on historic occurrences was available for some events, available data such as the numbers and locations of lightning strikes and damages attributed to them was not sufficient at the time of the study to generate detailed estimates of damages due to lightning. At this time, vulnerability is being expressed as the value of improvements exposed to the hazard, as presented in the "Hazard Profiles" section of this plan.

First, current loss estimation methodologies are not available for estimating lightning damages.

Second, having even the year built data for each structure, one would be able to highlight structures built before codes and standards were adopted to make buildings more resistant to lightning damage, thus being better candidates for mitigation. Without the year-built data, this can not be done.

If this information should become available in the future, it could be incorporated into future updates of the plan.

NOAA's NCDC database records 11 lightning events over the 15 year period of record between July 1994 and August 2009, causing 11 injuries and \$286,000 in property damages. This is equivalent to \$19,067 in average annual damages county-wide, or \$866 average annual damages per municipality (assuming an equal distribution across the county).

The SHELDUS database is in some ways more robust. Going back as far as April 1961, a total of 67 events are reported causing a total of \$2,946,712 in property damages and \$7,626 in crop damages. Over the 43 year period of record this is equivalent to \$68,706 in average annual damages county-wide, or \$3,123 in average annual damages per municipality (assuming an equal distribution across the county).

Given the previously discussed limitations in both the NCDC and SHELDUS datasets, combined with the high degree of variation in type and density of development in the study area, acting upon such rough estimates of annual damages shown above could result in an unwise use of limited resources.

In general terms, estimated damages due to a single lightning event could be quite severe in any one location, however no one location or municipality in the county is any more vulnerable than another. Lightning mitigation projects would likely yield the greatest benefit for critical facilities. Because of the limitations in data, annual damages from lightning in the study area are considered to be unquantifiable and generally negligible.

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### Estimated Damages – Tornadoes

For the purpose of estimating annual tornado damages at this time, we have evaluated the NOAA NCDC database for tornado events in the full period for which NCDC records tornado event details for Rensselaer County (1973-2010). The NCDC database records nine significant tornadoes in Rensselaer County – one of magnitude F0, five of magnitude F1 and three of magnitude F2. The NCDC database records that these events resulted in a total of approximately \$10.63 million in property damages, and an additional \$200,000 in crop damages, or approximately \$293,000 in average annual damages county-wide over the 37 year period of record. As a proportion of the total value of improved property in Rensselaer County, this represents estimated damages to 0.00235 percent of the improved property in the County on an annual basis. Applying this same percentage uniformly across the County (since tornadoes can occur at any location, and there is not a delineable tornado hazard area) produces the estimated annual loss figures presented in Table 3c.1, which are quite negligible when considered on an average annual basis, while particular event damages could be quite significant.

Because it cannot be predicted where a tornado may touch down, all existing and future buildings, facilities, and populations are considered to be exposed to this hazard and could potentially be impacted.

**Table 3c.1**  
**Estimated Annual Average Damages – Tornado**

Jurisdiction	Total Value of Improvements	Estimated Annual Percent Damages	Distributed Annual Loss Estimate, Tornado
Berlin, Town of	\$161,460,296	0.00235%	\$3,794
Brunswick, Town of	\$935,076,250	0.00235%	\$21,974
Castleton-on-Hudson, Village of	\$173,218,901	0.00235%	\$4,071
East Greenbush, Town of	\$1,478,535,900	0.00235%	\$34,746
East Nassau, Village of	\$36,635,844	0.00235%	\$861
Grafton, Town of	\$160,142,003	0.00235%	\$3,763
Hoosick, Town of	\$276,325,323	0.00235%	\$6,494
Hoosick Falls, Village of	\$335,334,980	0.00235%	\$7,880
Nassau, Town of	\$207,267,186	0.00235%	\$4,871
Nassau, Village of	\$101,812,537	0.00235%	\$2,393
North Greenbush, Town of	\$1,126,168,100	0.00235%	\$26,465
Petersburgh, Town of	\$85,588,579	0.00235%	\$2,011
Pittstown, Town of	\$296,057,020	0.00235%	\$6,957
Poestenkill, Town of	\$315,226,879	0.00235%	\$7,408
Rensselaer, City of	\$527,411,852	0.00235%	\$12,394
Sand Lake, Town of	\$618,731,110	0.00235%	\$14,540
Schaghticoke, Town of	\$393,627,712	0.00235%	\$9,250
Schaghticoke, Village of	\$48,285,342	0.00235%	\$1,135
Schodack, Town of	\$846,788,002	0.00235%	\$19,900
Stephentown, Town of	\$187,025,080	0.00235%	\$4,395
Troy, City of	\$4,097,481,405	0.00235%	\$96,291
Valley Falls, Village of	\$24,983,624	0.00235%	\$58,712
<b>Rensselaer County Total</b>	<b>\$12,433,183,925</b>	<b>0.00235%</b>	<b>\$292,568</b>

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### **Estimated Damages – Winter Storms**

Sufficient data was not available at the time of the study to estimate detailed damages due winter storms. At this time, vulnerability is being expressed as the value of improvements exposed to the hazard as defined in the “Hazard Profiles” section. All existing and future buildings, facilities and populations are considered to be uniformly exposed to this hazard and could potentially be impacted.

Sufficiently detailed data regarding the damages attributed to the numerous winter storms recorded by NCDC and SHELDUS in Rensselaer County was not available at the time of the study to adequately estimate damages due to winter storms. While the NCDC and SHELDUS databases record a total of roughly \$50 million in property damages that have been caused by winter storms in the Rensselaer County area since 1960, these damages often apply to a wide region covering multiple affected counties and further breakdowns giving damages by individual counties or municipalities are not readily available from NCDC, SHELDUS or any other source.

While it is assumed that all municipalities are essentially equally vulnerable to winter storms, since neither standard loss estimating methodologies for winter storms or the required data are readily available, we have determined that while annual losses due to winter/ice storms are potentially significant, though they are currently unquantifiable.

Given the nature of historical data and documented structural losses resulting from extreme wind occurrences in the planning area, it is not possible to extract from existing datasets an accurate quantification of the potential annual structural losses over a long period of time in Rensselaer County’s municipalities. However, while unquantifiable, these losses are potentially significant on an average annual basis for municipalities in the planning area.

If more detailed information should become available in the future, it should be utilized for loss estimates incorporated into future updates of the plan. While one could make some blanket assumptions at this time to enable the use of various tools for loss estimation, this would be unlikely to yield meaningful results.

## ***Hydrologic Hazards***

### **Estimated Damages – Dam Failure**

Generally accepted methodologies do exist for estimating potential annual losses to vulnerable structures due to dam failure events; however, historical data regarding past events and losses was not sufficient to generate meaningful estimates.

Sufficient data was not available at the time of the study to estimate average annual damages due to dam failure. At this time, vulnerability is being expressed as the value of improvements that have been identified as exposed to the hazard, as presented in the “Hazard Profiles” section of this plan. While methodologies do exist for quantifying damages to structures due to the inundation and wave action resulting from dam failure, the application of such techniques is beyond the scope of this study and would require additional data such as detailed structure characteristics and hydraulic data (flood depths and wave heights) which are not readily available.

Given the very few identified historical occurrences of significant dam failure in Rensselaer County, and that it would be inappropriate to make assumptions regarding the effectiveness of future dam inspection

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and maintenance activities, it is assumed that major dam failures are considerably rare in the County. Therefore, while a major dam failure event may result in significant losses, annualizing these structural losses over a long period of time would most likely yield negligible average annual loss estimates for jurisdictions exposed to this hazard.

### **Estimated Damages – Drought**

According to FEMA's How-To #2, there are currently no standard loss estimation methodologies available for estimating drought damages. If new information or techniques should become available in the future, it could be incorporated into future updates of the plan. While blanket assumptions could be made regarding the overall economic impact of drought, at this time to use various tools for loss estimation, this would likely yield erroneous data given the high degree of variation in type and density of development. Acting upon such rough estimates could result in an unwise use of limited resources. At this time, overall vulnerability is being expressed in qualitative terms in terms of types of damages.

Because drought impacts large areas and cross jurisdictional boundaries, all existing and future buildings, facilities and populations are considered to be exposed to this hazard and could potentially be impacted. However, drought impacts are mostly experienced in water shortages (affecting domestic uses and businesses) and crop losses on agricultural lands and have no impact on buildings.

Crop failure is one common impact of drought. According to the 2007 USDA Census of Agriculture, Rensselaer County has 506 farms. The Census notes that the market value of production on Rensselaer County farms in 2007 was \$37.5 million. Slightly more than half of this value is accounted for by milk and other dairy products, with total crop sales accounting for approximately 38 percent.

While agricultural losses during a drought, specifically losses to crops and produce, could be significant to individual farm operators, the overall impact of agricultural losses on the County economy is likely to be slight. When drought begins, the agricultural sector is usually the first to be impacted because of its heavy reliance on stored soil water, which can rapidly be depleted during extended dry periods. When precipitation returns to normal, impacts on the agricultural sector are quick to diminish again due to the reliance on stored soil moisture.

For the purpose of estimating annual drought damages at this time, we have evaluated the NOAA NCDC and SHELDUS databases for drought events directly experienced in Rensselaer County. For the 22 year period of record between 1988 and 2010, records indicate four significant drought events which specifically lists Rensselaer County as an affected area totaling an estimated \$7 million in crop losses. Over the 22 year period of record this is equivalent to \$319,024 in average annual damages county-wide. Applying the same percentage (2.26 percent) of loss to current crop production values (2007 total crop sales of \$14,102,000), annualizing over the 22 year period of record, and distributing the total among the 22 municipalities according to their share of cultivated cropland (as per the USGS National Land Cover Data, GIS, 2003) produces the estimated annual loss figures presented in Table 3c.2.

This methodology does not take into account the degree of variation in value of various crop types between the municipalities, or the degree of drought resistance, and should be used for mitigation planning purposes only.

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**Table 3c.2  
Annual Loss Estimates – Drought**

<b>Jurisdiction</b>	<b>Total Acres Cultivated Crop Land (Acres)</b>	<b>Percent of Total Cultivated Crop Land in Rensselaer County</b>	<b>Distributed Annual Loss Estimate, Drought</b>
Berlin, Town of	217	1.34%	\$4,261
Brunswick, Town of	2,143	13.18%	\$42,062
Castleton-on-Hudson, Village of	0	0.00%	\$0
East Greenbush, Town of	559	3.44%	\$10,977
East Nassau, Village of	1	0.01%	\$20
Grafton, Town of	32	0.20%	\$628
Hoosick, Town of	0	0.00%	\$0
Hoosick Falls, Village of	1,763	10.85%	\$34,620
Nassau, Town of	134	0.82%	\$2,631
Nassau, Village of	0	0.00%	\$0
North Greenbush, Town of	139	0.86%	\$2,730
Petersburgh, Town of	796	4.90%	\$15,631
Pittstown, Town of	2,136	13.15%	\$41,945
Poestenkill, Town of	416	2.56%	\$8,169
Rensselaer, City of	19	0.12%	\$373
Sand Lake, Town of	353	2.17%	\$6,932
Schaghticoke, Town of	4,793	29.50%	\$94,121
Schaghticoke, Village of	6	0.04%	\$118
Schodack, Town of	2,339	14.40%	\$45,931
Stephentown, Town of	385	2.37%	\$7,560
Troy, City of	9	0.06%	\$177
Valley Falls, Village of	7	0.04%	\$137
<b>Rensselaer County Total</b>	<b>16,246</b>	<b>100%</b>	<b>\$319,024</b>

Water supply shortages are a second effect of drought. While water shortages and use restrictions imposed as a result of drought conditions have a detrimental effect on many businesses, particularly certain sectors of the manufacturing industry, calculating actual dollar losses resulting from shortages and use restrictions is beyond the current scope of this study. Rensselaer County’s total withdrawal of fresh water for public supply is 18.37 million gallons per day, with 10% percent from groundwater sources and 90 percent from surface water sources. Groundwater is fairly resistant to drought conditions, while surface water is more immediately susceptible to the effects of drought. The extent to which crops in the participating communities are vulnerable to drought conditions will depend to a great extent on from where they draw their water supply. The greatest source of agricultural losses under drought conditions is likely to be from those nursery, greenhouse, or floriculture businesses which rely predominantly on surface water supplies.

A third common affect of drought is fish and wildlife mortality. Nearly 55 percent of the county is undeveloped land (either used for agricultural purposes, vacant, or dedicated parkland/open space) with diverse populations of fish and wildlife, and abundant creeks, aquifers and reservoirs providing essential water resources. Because Rensselaer County has significant undeveloped land, aquatic and other wildlife habitat is fairly significant and therefore losses to fish and wildlife could potentially be significant.

A fourth common affect of drought is the increased incidence and severity of wildfires. The baseline risk of wildfire in Rensselaer County is significant, with 84 percent of the land area and 46 percent of the total

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estimated improved value located within wildfire hazard areas as defined in this plan. In the planning area, wildfire fuel tends to be most plentiful in areas where development densities are lowest; since Rensselaer County is largely rural in nature, and the majority of the wildfire hazard areas consist of undeveloped protected land, this works to reduce possible property damages and loss of life; however, the wildland-urban interface would be particularly vulnerable as well as transportation routes. Wildfires are a unique hazard addressed separately in this plan.

### **Estimated Damages – Flood**

Sufficient data was not available at the time of the study to undertake detailed formal estimates of damages due to flooding. At this time, vulnerability is being expressed as the value of improvements in the current mapped flood hazard areas as presented in the “Hazard Profiles” section of this plan. First, while FEMA methodologies do exist to estimate damages due to flooding, specific information is required for buildings in order to employ these methodologies, such as first floor elevation, type of construction, foundation type, and details on any existing protective features. This data was not available as a part of the GIS data provided for this study.

Second, having even the year built data for each structure, one would be able to highlight structures built before codes and standards were adopted to make buildings more resistant to flood damage, thus being better candidates for mitigation. Without the year-built data, this can not be done. If this information should become available in the future, it could be incorporated into future updates of the plan. While one could make some blanket assumptions at this time to use various tools for loss estimation, this would likely yield erroneous data. Acting upon such rough estimates could result in an unwise use of limited resources.

For the purpose of estimating annual flood damages at this time, the NOAA NCDC database has been evaluated for flood events in Rensselaer County in the last 17 years (March 1993 to June 2010, i.e. the period for which NCDC records flood events in Rensselaer County in any detail), which records approximately \$14.5 million in damages assumed to be specifically occurring in Rensselaer County during this period.

Other readily available sources of data for flood losses in the county include FEMA NFIP records, which show that there has been a total of approximately \$1.5 million in flood insurance payments made to cover flood damage in Rensselaer County since the first municipalities in the County joined the NFIP in 1978. In addition, the SHELDUS database documents an additional 21 flood events not captured by the NCDC records between 1960 and 1987 causing approximately \$45 million in property damage.

Combining these three sources of data and annualizing over the periods they cover gives annual flood damages of \$2,566,483 for the whole County. This estimate does not reflect crop losses.

Because the flood hazard is not uniform across the county, these annual damages have been distributed across the municipalities in the County based on the total value of improved property in the 1% annual probability floodplain (Zones A and AE, 100-year) in each one. These scaled damages have been added to the annualized NFIP losses to derive the total damages presented in Table 3c.3. These estimates should be considered conservative, due to the limited amount and incomplete nature of the relevant historical data.

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**Table 3c.3**  
**Estimated Annual Damages – Flood**  
*(Source: NCDC/NFIP)*

Jurisdiction	Total Value of Improvements	Total Value of Improvements in the Flood Hazard Area*	Annual Loss Estimates; Flood
Berlin, Town of	\$161,460,296	\$7,360,983	\$33,329
Brunswick, Town of	\$935,076,250	\$41,246,252	\$193,020
Castleton-on-Hudson, Village of	\$173,218,901	\$42,107,756	\$35,756
East Greenbush, Town of	\$1,478,535,900	\$40,485,331	\$305,202
East Nassau, Village of	\$36,635,844	\$3,574,931	\$7,562
Grafton, Town of	\$160,142,003	\$4,706,800	\$33,057
Hoosick, Town of	\$276,325,323	\$6,462,770	\$57,040
Hoosick Falls, Village of	\$335,334,980	\$16,069,381	\$69,221
Nassau, Town of	\$207,267,186	\$6,404,721	\$42,785
Nassau, Village of	\$101,812,537	\$6,880,164	\$21,016
North Greenbush, Town of	\$1,126,168,100	\$54,158,943	\$232,466
Petersburgh, Town of	\$85,588,579	\$5,892,023	\$17,667
Pittstown, Town of	\$296,057,020	\$9,976,431	\$61,113
Poestenkill, Town of	\$315,226,879	\$17,127,575	\$65,070
Rensselaer, City of	\$527,411,852	\$123,812,754	\$108,869
Sand Lake, Town of	\$618,731,110	\$33,867,439	\$127,720
Schaghticoke, Town of	\$393,627,712	\$16,952,644	\$81,253
Schaghticoke, Village of	\$48,285,342	\$990,359	\$9,967
Schodack, Town of	\$846,788,002	\$18,401,402	\$174,796
Stephentown, Town of	\$187,025,080	\$5,411,373	\$38,606
Troy, City of	\$4,097,481,405	\$323,453,520	\$845,810
Valley Falls, Village of	\$24,983,624	\$543,986	\$5,157
<b>Rensselaer County Total</b>	<b>\$12,433,183,925</b>	<b>\$785,887,538</b>	<b>\$2,566,483</b>

\*Zones A, AE, only

**Estimated Damages – Ice Jams**

Flooding caused by ice jams is similar to flash flooding. Ice jam formation causes a rapid rise of water at the jam and extending upstream. Failure or release of the jam causes sudden flooding downstream.

It is difficult to identify particular areas that are generally prone to ice jam flooding because the hazard can be very localized. The formation of ice jams depends on the weather and physical conditions in river channels. Unlike the typical violent flash flooding occurrences where steep terrain is present, ice jams are most likely to occur where the channel slope naturally decreases, where culverts freeze solid at headwaters of reservoirs, at natural channel restrictions such as bends and bridges, and along shallows where channels may freeze solid. The ice jam hazard and associated damages are assumed to be possible in five of Rensselaer County’s municipalities where past occurrences are documented, based on a review of historical records, Flood Insurance Studies, the USACE CRREL database of events, and information provided by Core Planning Group members (Buskirk in the Town of Hoosick, the Village of Castleton-on-Hudson, Eagle Bridge in the Town of Hoosick, Petersburgh, Poestenkill, and Troy). The CRELL database notes 38 events for the 85 year period of record between 1925 and 2010. Damages are not included in the database.

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Due to the nature of the terrain and the climate in Rensselaer County, ice jam events are essentially certain to occur in the future, although whether or not such events will cause significant damage is less easy to predict, since detailed records of actual damage caused by ice jams are scarce. The available data (historical records, Flood Insurance Studies, and local information) also does not easily allow for a meaningful average number of occurrences per year to be computed, since the actual number of recorded incidents is quite low and information on historic damages incurred per event was unavailable. For damage estimation purposes, it was assumed that if historic damages for noted occurrences was significant, more detailed information would have been uncovered during the research phase of this project. Lack of quantifiable damages was deemed to imply a likelihood of negligible average annual damages for the susceptible municipalities (where negligible has been defined as less than \$5,000 per year). This assumption should be revisited in future updates of the plan if better data should become available.

Damage from ice jam flooding usually exceeds that caused by open water flooding. Flood elevations are usually higher than predicted for free-flow conditions and water levels may change rapidly. Additional physical damage is caused by the force of ice impacting buildings and other structures. Because of the sometimes unpredictable nature of ice jam floods, FEMA's Flood Insurance Rate Maps often do not reflect ice jam flood threats.

Loss estimation methodologies are not currently available for estimating ice jam damages. Sufficient historical data regarding events and associated losses was not available to quantify here. For the purpose of this analysis, we have assumed that annual losses would be realized as an unquantifiable component within the flood damage estimate.

### ***Geologic Hazards***

#### **Estimated Damages – Earthquakes**

As stated previously in the plan in the Hazard Profile section, according to the Earthquake Hazard Map of New York State, there is a 10 percent chance over 50 years that an earthquake with a PGA of greater than 3 to 5%g will be centered within Rensselaer County. This earthquake, if it were to occur, would likely have associated with it light to moderate perceived shaking and little to no damage. PGA's of between 8 and 10%g would most often be required to cause appreciable damage, say, to unreinforced masonry buildings. While it is true that earthquakes are possible in this part of New York, they are not particularly likely, or likely to be particularly intense. Therefore, a full earthquake loss estimation was not conducted at this time for individual jurisdictions. However, countywide data included in the State Plan has been evaluated and is presented later in this section.

Examples of the types of damages that could be observed during an earthquake with a PGA of 3 to 5%g include:

- ⇒ Felt indoors by many, outdoors by few during the day
- ⇒ At night, some awakened.
- ⇒ Dishes, windows, doors disturbed and possibly broken
- ⇒ Walls make cracking sounds
- ⇒ Unstable objects could be overturned
- ⇒ Sensation like heavy truck striking building
- ⇒ Standing automobiles rocked noticeably

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For earthquakes, the hazard area encompasses the entire study area and therefore all assets could be impacted.

FEMA's How-To #2 suggests that for earthquake loss estimation, data regarding building type, type of foundation, building code design level, and date of construction, is required for a quality analysis. This is because certain structures are more susceptible to earthquake damage than others. In the State of New York, regulations accounting for earthquake risk exist for new construction. Older buildings, built before these standard building codes went into effect, are more susceptible to earthquake damage. Similarly, unreinforced masonry buildings are more likely to sustain earthquake damage. While extensive damage to even these structures is unlikely, based on the mapped hazard areas, identifying this subset of buildings is important, particularly with regard to critical facilities that may meet these criteria. This information was not readily available at the time of the study for the planning area.

The New York State Hazard Mitigation Plan includes HAZUS-MH runs for earthquake losses in counties across New York State. The data prepared by the State estimates the following potential earthquake losses for Rensselaer County as shown in Table 3c.4. This includes; Total Exposure – representing dollar value of all general building stock and calculated potential total losses (Capital Stock + Income Losses) for the four return periods of 2500, 1000, 500, & 250-years.

<b>Return Period (Years)</b>	<b>Total Losses</b>
2,500	\$376,809,000
1,000	\$112,760,00
500	\$39,707,000
250	\$11,936,000

The State Plan goes on to show estimated annualized total earthquake losses for Rensselaer County (factoring in NEHRP soil classifications) of \$818,101, of which 86 percent is attributed to structure damage, and the remainder to income losses. The total figure ranks Rensselaer County 11<sup>th</sup> for annualized earthquake losses among all of New York State's 62 counties. For comparison purposes, the highest annualized losses were calculated in New York County (\$3,798,860) and the lowest were calculated in Yates County at (\$4,215).

For the purposes of estimating annual earthquake damages in more detail, the estimated annual earthquake losses from the State Plan to structures for the County (\$818,101) have been distributed among the municipalities according to their estimated total value of improvements and the results presented in Table 3c.5. These estimates assume a consistent level of seismic risk across the whole County and, while the overall county-wide estimate does factor in NEHRP soil classifications, distribution of this total across the individual municipalities does not address variations in damages due to soil type between municipalities.

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**Table 3c.5**  
**Estimated Annual Average Damages – Earthquake**

Jurisdiction	Total Value of Improvements	Annual Loss Estimate, Earthquakes
Berlin, Town of	\$161,460,296	\$10,624
Brunswick, Town of	\$935,076,250	\$61,528
Castleton-on-Hudson, Village of	\$173,218,901	\$11,398
East Greenbush, Town of	\$1,478,535,900	\$97,287
East Nassau, Village of	\$36,635,844	\$2,411
Grafton, Town of	\$160,142,003	\$10,537
Hoosick, Town of	\$276,325,323	\$18,182
Hoosick Falls, Village of	\$335,334,980	\$22,065
Nassau, Town of	\$207,267,186	\$13,638
Nassau, Village of	\$101,812,537	\$6,699
North Greenbush, Town of	\$1,126,168,100	\$74,102
Petersburgh, Town of	\$85,588,579	\$5,632
Pittstown, Town of	\$296,057,020	\$19,480
Poestenkill, Town of	\$315,226,879	\$20,742
Rensselaer, City of	\$527,411,852	\$34,704
Sand Lake, Town of	\$618,731,110	\$40,712
Schaghticoke, Town of	\$393,627,712	\$25,901
Schaghticoke, Village of	\$48,285,342	\$3,177
Schodack, Town of	\$846,788,002	\$55,718
Stephentown, Town of	\$187,025,080	\$12,306
Troy, City of	\$4,097,481,405	\$269,613
Valley Falls, Village of	\$24,983,624	\$1,644
<b>Rensselaer County Total</b>	<b>\$12,433,183,925</b>	<b>\$818,101</b>

### Estimated Damages – Landslides

This version of the Rensselaer County plan does not include a description of potential dollar loss estimations by jurisdiction for the landslide hazard because of the absence of certain essential information. At this time, vulnerability is being expressed as the value of improvements in the current mapped landslide hazard area (of high susceptibility, low incidence) presented in the “Hazard Profiles” section of this plan.

The New York State Geological Survey records landslide damages totaling \$1.65 million over a 152 year period of record (or \$10,822 annually, 1980s dollars, countywide). While a fair amount of historical data exists, many event records lack either specific dates, or specific damages, making it impossible to make any reasonable assumptions to tally up and annualize damages by jurisdiction. While preliminary loss estimates could perhaps have been generated through various assumptions for unknowns (including: inventory estimates of the more vulnerable structures such as those near steep slopes, steep slopes prone to erosion or structures near previous landslide occurrence areas, as well as historical, or critical structures and the type of and dollar damage figures), the many generalizations and guess work would result in loss estimates with little accuracy and potentially misleading indications of a jurisdiction’s vulnerability and potential loss to the landslide hazard. The NYS Hazard Mitigation Plan notes certain actions that are

## **SECTION 3c - RISK ASSESSMENT: ESTIMATED DAMAGES IN HAZARD AREAS**

planned at the state level to improve data availability for landslide hazard risk assessments. As this data becomes available, it will be evaluated and incorporated as applicable into future updates of this county plan.

Further, according to FEMA's How-To #2, current loss estimation methodologies are not available for estimating landslide damages. While the guide indicates that structures within a landslide hazard area could be assumed to be "severely" damaged and those outside could be assumed to be "undamaged", applying this methodology would not be appropriate for Rensselaer County given the lack of historical data from which to derive the frequencies of landslide events necessary for the calculation of annual loss estimates. In addition, specific information would be required for buildings in order to employ these methodologies, such as type of construction, foundation type, and details on any existing protective features. This data was not available as a part of the County GIS during this study.

Having even the year built data for each structure, one would be able to highlight structures built before codes and standards (such as steep slope ordinances) were adopted to make buildings more resistant to landslide damage, thus being better candidates for mitigation. Without the year-built data, this can not be done.

If this information should become available in the future, it could be incorporated into future updates of the plan. While one could make some blanket assumptions at this time to use various tools for loss estimation, this would likely yield erroneous data given the high degree of variation in type and density of development. Acting upon such rough estimates could result in an unwise use of limited resources.

In general terms, estimated damages due to a single landslide event could be severe in any one location, and are most likely in areas of highest risk (municipalities located generally in the western part of the county).

Given the available sufficient historical data on past landslide occurrences, it is assumed that while one major event may result in significant losses, annualizing structural losses over a long period of time would most likely yield a negligible annual loss estimate for jurisdictions in mapped low-risk areas with no known historic occurrences (specifically, the Towns of Grafton, Nassau and Sand Lake and the Villages of Nassau and East Nassau). For all other municipalities in the County, the available record of historic occurrences seems to indicate greater susceptibility and therefore it is generally assumed that annualizing structural losses over a long period of time could yield significant annual loss estimates for the jurisdictions in mapped higher risk areas with records of historic occurrences.

### ***Other Hazards***

#### **Estimated Damages – Wildfires**

As described in Section 3a, available data such as the numbers and locations of wildfires and damages attributed to them was not sufficient at the time of the study to make meaningful estimates regarding damages due to wildfires. At this time, vulnerability is being expressed as the value of improvements exposed to the hazard, as presented in the "Hazard Profiles" section of this plan.

First, according to FEMA's How-To #2, current loss estimation methodologies are not available for estimating wildfire damages. In addition, specific information would be required for buildings in order to develop alternate methodologies, such as type of construction, and details on any existing protective features. This data was not available as a part of the County GIS during this study.

## **SECTION 3c - RISK ASSESSMENT: ESTIMATED DAMAGES IN HAZARD AREAS**

Second, having even the year built data for each structure, one would be able to highlight structures built before codes and standards were adopted to make buildings more resistant to wildfire damage, thus being better candidates for mitigation. Without the year-built data, this can not be done.

If this information should become available in the future, it could be incorporated into future updates of the plan. While one could make some blanket assumptions at this time to use various tools for loss estimation, this would likely yield erroneous data given the high degree of variation in type and density of development. Acting upon such rough estimates could result in an unwise use of limited resources.

Standard loss estimation methodologies are not currently available for estimating wildfire damages. Sufficient historical data regarding events and associated losses was not available to quantify here. For the purpose of this analysis, at this time we have determined that annual losses are unquantifiable. While damages associated with any single event could be significant, it is estimated that damages are most likely negligible when evaluated on an average annual basis.

### ***Estimated Damages Summary***

The following table (Table 3c.6) is a useful tool to summarize vulnerability in terms of annual damages estimated for various hazards in communities across the 22 municipalities that form Rensselaer County. For mitigation planning purposes only, municipalities could use this information in their evaluation and prioritization of mitigation options, and development of a mitigation strategy, as municipalities may wish to stress mitigation of those hazards for which annual loss estimates are the highest. These estimated damages are not intended for use in any more formal benefit-cost analyses.

During future updates of this plan, additional efforts should be made to seek out new sources of data and approved methodologies with which to estimate potential annualized dollar losses for those hazards that lack them in this current version of the plan.

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Table 3c.6 Summary of Annual Loss Estimates by Municipality, All Natural Hazards *													
Municipality	Total Value of Improvements	Extreme Temperatures	Extreme Wind	Lightning	Tornadoes	Winter Storms	Dam Failure	Drought	Flood	Ice Jams	Earthquake	Landslides	Wildfires
Berlin, Town of	\$161,460,296	U <sub>N</sub>	U <sub>S</sub>	U <sub>N</sub>	\$3,794	U <sub>S</sub>	U <sub>N</sub>	\$4,261	\$33,329	U <sub>N</sub>	\$10,624	U <sub>S</sub>	U <sub>N</sub>
Brunswick, Town of	\$935,076,250	U <sub>N</sub>	U <sub>S</sub>	U <sub>N</sub>	\$21,974	U <sub>S</sub>	U <sub>N</sub>	\$42,062	\$193,020	U <sub>N</sub>	\$61,528	U <sub>S</sub>	U <sub>N</sub>
Castleton-on-Hudson, Vill. of	\$173,218,901	U <sub>N</sub>	U <sub>S</sub>	U <sub>N</sub>	\$4,071	U <sub>S</sub>	U <sub>N</sub>	\$0	\$35,756	U <sub>N</sub>	\$11,398	U <sub>S</sub>	U <sub>N</sub>
East Greenbush, Town of	\$1,478,535,900	U <sub>N</sub>	U <sub>S</sub>	U <sub>N</sub>	\$34,746	U <sub>S</sub>	U <sub>N</sub>	\$10,977	\$305,202	U <sub>N</sub>	\$97,287	U <sub>S</sub>	U <sub>N</sub>
East Nassau, Village of	\$36,635,844	U <sub>N</sub>	U <sub>S</sub>	U <sub>N</sub>	\$861	U <sub>S</sub>	U <sub>N</sub>	\$20	\$7,562	U <sub>N</sub>	\$2,411	U <sub>N</sub>	U <sub>N</sub>
Grafton, Town of	\$160,142,003	U <sub>N</sub>	U <sub>S</sub>	U <sub>N</sub>	\$3,763	U <sub>S</sub>	U <sub>N</sub>	\$628	\$33,057	U <sub>N</sub>	\$10,537	U <sub>S</sub>	U <sub>N</sub>
Hoosick, Town of	\$276,325,323	U <sub>N</sub>	U <sub>S</sub>	U <sub>N</sub>	\$6,494	U <sub>S</sub>	U <sub>N</sub>	\$0	\$57,040	U <sub>N</sub>	\$18,182	U <sub>S</sub>	U <sub>N</sub>
Hoosick Falls, Village of	\$335,334,980	U <sub>N</sub>	U <sub>S</sub>	U <sub>N</sub>	\$7,880	U <sub>S</sub>	U <sub>N</sub>	\$34,620	\$69,221	U <sub>N</sub>	\$22,065	U <sub>S</sub>	U <sub>N</sub>
Nassau, Town of	\$207,267,186	U <sub>N</sub>	U <sub>S</sub>	U <sub>N</sub>	\$4,871	U <sub>S</sub>	U <sub>N</sub>	\$2,631	\$42,785	U <sub>N</sub>	\$13,638	U <sub>N</sub>	U <sub>N</sub>
Nassau, Village of	\$101,812,537	U <sub>N</sub>	U <sub>S</sub>	U <sub>N</sub>	\$2,393	U <sub>S</sub>	U <sub>N</sub>	\$0	\$21,016	U <sub>N</sub>	\$6,699	U <sub>N</sub>	U <sub>N</sub>
North Greenbush, Town of	\$1,126,168,100	U <sub>N</sub>	U <sub>S</sub>	U <sub>N</sub>	\$26,465	U <sub>S</sub>	U <sub>N</sub>	\$2,730	\$232,466	U <sub>N</sub>	\$74,102	U <sub>S</sub>	U <sub>N</sub>
Petersburgh, Town of	\$85,588,579	U <sub>N</sub>	U <sub>S</sub>	U <sub>N</sub>	\$2,011	U <sub>S</sub>	U <sub>N</sub>	\$15,631	\$17,667	U <sub>N</sub>	\$5,632	U <sub>S</sub>	U <sub>N</sub>
Pittstown, Town of	\$296,057,020	U <sub>N</sub>	U <sub>S</sub>	U <sub>N</sub>	\$6,957	U <sub>S</sub>	U <sub>N</sub>	\$41,945	\$61,113	U <sub>N</sub>	\$19,480	U <sub>S</sub>	U <sub>N</sub>
Poestenkill, Town of	\$315,226,879	U <sub>N</sub>	U <sub>S</sub>	U <sub>N</sub>	\$7,408	U <sub>S</sub>	U <sub>N</sub>	\$8,169	\$65,070	U <sub>N</sub>	\$20,742	U <sub>S</sub>	U <sub>N</sub>
Rensselaer, City of	\$527,411,852	U <sub>N</sub>	U <sub>S</sub>	U <sub>N</sub>	\$12,394	U <sub>S</sub>	U <sub>N</sub>	\$373	\$108,869	U <sub>N</sub>	\$34,704	U <sub>S</sub>	U <sub>N</sub>
Sand Lake, Town of	\$618,731,110	U <sub>N</sub>	U <sub>S</sub>	U <sub>N</sub>	\$14,540	U <sub>S</sub>	U <sub>N</sub>	\$6,932	\$127,720	U <sub>N</sub>	\$40,712	U <sub>N</sub>	U <sub>N</sub>
Schaghticoke, Town of	\$393,627,712	U <sub>N</sub>	U <sub>S</sub>	U <sub>N</sub>	\$9,250	U <sub>S</sub>	U <sub>N</sub>	\$94,121	\$81,253	U <sub>N</sub>	\$25,901	U <sub>S</sub>	U <sub>N</sub>
Schaghticoke, Village of	\$48,285,342	U <sub>N</sub>	U <sub>S</sub>	U <sub>N</sub>	\$1,135	U <sub>S</sub>	U <sub>N</sub>	\$118	\$9,967	U <sub>N</sub>	\$3,177	U <sub>S</sub>	U <sub>N</sub>
Schodack, Town of	\$846,788,002	U <sub>N</sub>	U <sub>S</sub>	U <sub>N</sub>	\$19,900	U <sub>S</sub>	U <sub>N</sub>	\$45,931	\$174,796	U <sub>N</sub>	\$55,718	U <sub>S</sub>	U <sub>N</sub>
Stephentown, Town of	\$187,025,080	U <sub>N</sub>	U <sub>S</sub>	U <sub>N</sub>	\$4,395	U <sub>S</sub>	U <sub>N</sub>	\$7,560	\$38,606	U <sub>N</sub>	\$12,306	U <sub>S</sub>	U <sub>N</sub>
Troy, City of	\$4,097,481,405	U <sub>N</sub>	U <sub>S</sub>	U <sub>N</sub>	\$96,291	U <sub>S</sub>	U <sub>N</sub>	\$177	\$845,810	U <sub>N</sub>	\$269,613	U <sub>S</sub>	U <sub>N</sub>
Valley Falls, Village of	\$24,983,624	U <sub>N</sub>	U <sub>S</sub>	U <sub>N</sub>	\$58,712	U <sub>S</sub>	U <sub>N</sub>	\$137	\$5,157	U <sub>N</sub>	\$1,644	U <sub>S</sub>	U <sub>N</sub>
<b>Rensselaer County Total</b>	<b>\$12,433,183,925</b>	<b>U<sub>N</sub></b>	<b>U<sub>S</sub></b>	<b>U<sub>N</sub></b>	<b>\$292,568</b>	<b>U<sub>S</sub></b>	<b>U<sub>N</sub></b>	<b>\$319,024</b>	<b>\$2,566,483</b>	<b>U<sub>N</sub></b>	<b>\$818,101</b>	<b>U<sub>S</sub></b>	<b>U<sub>N</sub></b>

\* It is important to note that this table reflects estimates of average annual damages. For any hazard, individual event damages could be substantially higher.

U<sub>N</sub>: Annual losses currently unquantifiable but assumed to be negligible on an annual basis (less than \$5,000); individual event damages, however, could be significant.

U<sub>S</sub>: Annual losses currently unquantifiable but assumed to be potentially significant on an annual basis (more than \$5,000); individual event damages, however, could be significant.