Section 3.11: HIGH WIND EVENTS

(Tornado and Straight-line Winds)

2014 SHMP Updates

- The 2011 Tornado Section has been updated to High Wind Events, which includes tornado and straight-line winds.
- Fujita and Enhanced Fujita Scale comparison table and Enhanced Fujita Damage Scale have been added.
- Historical Tornado Tracks map has been added.
- Historical Tornado Events table by County was consolidated to one table, to capture Historical and Recent High Wind Events and Losses.
- Presidential Declared Tornado Disaster table and map has been added.
- Vulnerability and loss data from local plans have been addressed.

3.11.1 High Wind Events Profile

New York State is located in a region highly susceptible to high wind events; this includes tornado and straight-line wind events. These events can cause significant damage to communities and infrastructure which has caused the State millions of dollars in damage.

Characteristics

Hazard	Key Terms and Definitions
High Wind	• *Tornado-* local atmospheric storm, generally of short duration, formed by winds rotating at very high speeds, usually in counterclockwise direction. • *Straight-line Winds-* wind that comes out of a thunderstorm, but is not associated with rotation like a tornado winds. • *Downdraft*-is a small-scale column of air that rapidly sinks toward the ground. • *Downburst*– strong downdraft with horizontal dimensions larger than 4 km (2.5 mi) resulting in an outward burst or damaging winds on or near the ground. • *Microburst*– small, short lived, concentrated downburst that produces an outward burst of damaging winds at the surface. • *Gust Front*– a wind shift, temperature drop, and gusty winds out ahead of a thunderstorm. Sometimes the winds push up air above them, forming a shelf cloud or detached roll cloud. • *Derecho*– widespread wind storm that is associated with a band of rapidly moving showers or thunderstorms, it consists of numerous microbursts, downbursts, and downburst clusters.

Hazard	Key Terms and Definitions
	• *Haboob*– wall of dust that is pushed out along the ground from a thunderstorm downdraft at high speeds.

Tornado

A tornado is a local atmospheric storm, generally of short duration, formed by winds rotating at very high speeds, usually in a counterclockwise direction. The vortex, up to several hundred yards wide, is visible to the observer as a whirlpool-like column of winds rotating about a hollow cavity or funnel, when cool, dry air intersects and overrides a layer of warm, moist air forcing the warm air to rise rapidly. Winds have been estimated to be in excess of 300 miles per hour.

Tornadoes can occur in any state but are more frequent in the Midwest, Southeast, and Southwest. The states of Alabama, Arkansas, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Louisiana, Mississippi, Missouri, Nebraska, Oklahoma, South Dakota, and Texas are at greatest risk.

Damage caused by a tornado is a result of the high wind velocity and wind-blown debris. The destruction caused by tornadoes ranges from light to inconceivable depending on the intensity, size, and duration of the storm. Typically, tornadoes cause the greatest damage to structures of light construction such as residential homes (particularly mobile homes). The Fujita and Enhanced Fujita Scale for Tornadoes were developed to measure tornado strength (i.e., magnitude or intensity) and associated types of damages. **Table 3.11a** show the Fujita Scale Compared to Enhanced Fujita (EF) Scale.

Table 3.11a: Fujita Scale Compared to Enhanced Fujita (EF) Scale for Tornadoes

Fujita (F) Scale and Enhanced Fujita (EF) Scale				
F-Scale	**3-sec. gust speed (mph)**	**EF-Scale**	**3-sec. gust speed (mph)**	**Typical Damage**
F0	45-78	EF0	65-85	Light damage. Some damage to chimneys. Branches broken of trees. Shallow-rooted trees pushed over, signboards damaged.
F1	79-117	EF1	86-109	Moderate damages. Peels surface off roofs. Mobile homes pushed off foundations or overturned. Moving autos blown off roads.
F2	118-161	EF2	110-137	Considerable damage. Roofs torn off frame houses. Mobile homes demolished. Boxcars overturned. Large trees snapped or uprooted. Light-object missiles generated. Cars lifted off ground.
F3	162-209	EF3	138-167	Severe damage. Roofs and some walls torn off-well constructed homes. Trains overturned. Most trees in forest uprooted. Heavy cars lifted off the ground and thrown.
F4	210-261	EF4	168-199	Devastating damage. Well-constructed houses leveled. Structures with weak foundations blown away some distance. Cars thrown and large missiles generated.
F5	262-317	EF5	200-234	Incredible damage. Strong frame houses leveled off foundations and swept away. Automobile-sized missiles fly through the air in excess of 100 meters (109 yards). Trees debarked. Incredible phenomena will occur.

Source: National Weather Services, National Oceanic and Atmospheric Administration, Storm Prediction Center

Table 3.11b shows 28 damage indicators (DIs) used in the EF scale to categorize building use and construction type. Building use is grouped by the following: residential, commercial and retail structures, schools, professional buildings, metal buildings and canopies, towers/poles, and vegetation.

Table 3.11b: Enhanced Fujita Damage Indicator (DI) Scale

DI No.	Damage Indicator (DI)	Use
1	Small Barns or Farm Outbuildings (SBO)	Residential
2	One to Two Family Residences (FR12)	
3	Manufactured Home - Single Wide (MHSW)	
4	Manufactured Home - Single Double (MHDW)	
5	Apartments, Condos, Townhouses [three stories or less] (ACT)	
6	Motel (M)	Commercial and Retail Structures
7	Masonry Apartment or Motel Building (MAM)	
8	Small Retail Building [fast food restaurant] (SRB)	
9	Small Professional Building [e.g., doctor's office, branch bank] (SPB)	
10	Strip Mall (SM)	
11	Large Shopping Mall (LSM)	
12	Large, Isolated Retail Building [e.g., K-Mart, Wal-Mart] (LIRB)	
13	Automobile Showroom (ASR)	
14	Automobile Service Building (ASB)	
15	Elementary School [single story; interior or exterior hallways] (ES)	Schools
16	Junior or Senior High School (JHSH)	
17	Low-Rise Building [1-4 stories] (LRB)	Professional Buildings
18	Mid-Rise Building [5-20 stories] (MRB)	
19	High-Rise Building [more than 20 stories] (HRB)	
20	Institutional Building [e.g., hospital, government, or university] (IB)	
21	Metal Building Systems (MBS)	Metal Buildings and Canopies
22	Service Station Canopy (SSC)	
23	Warehouse Building [tilt-up walls or heavy timber construction] (WHB)	
24	Transmission Line Towers (TLT)	Towers/Poles
25	Free- Standing Towers (FST)	
26	Free-Standing Light Poles, Luminary Poles, Flag Poles (FSP)	
27	Trees: Hardwood (TH)	Vegetation
28	Trees: Softwood (TS)	

Source: National Weather Services, National Oceanic and Atmospheric Administration, Storm Prediction Center

Table 3.11c is an example of the EF Scales Degree of Damage for Damage Indicator No. 2 (One to Two Family Residences). The table shows the DOD number, description, and wind speeds. Please note: the differences between "lower bound," "upper bound," and "expected" wind speeds are complex. When assessing DIs a subject matter expert familiar with wind effects on buildings and/or building sciences should be consulted.

Table 3.11c: Example – EF Scale DOD for DI No. 2 (One to Two Family Residences)

DOD	Damage Description	Lower & Upper Bound Wind Speed Range (3-second gust in mph)	Expected Wind Speed (3-second gust in mph)
1	Threshold of visible damage	53-80	65
2	Loss of roof covering material (<20%), gutters, and/or awning; loss of vinyl or metal siding	63-97	79
3	Broken glass in doors and windows	79-114	96
4	Uplift of roof deck and loss of significant roof covering material (>20%); collapse of chimney; garage doors collapse inward; failure of porch or carport	81-116	97
5	Entire house shifts off foundation	103-141	121
6	Large sections of roof structure removed; most walls remain standing	104-142	122
7	Exterior walls collapsed	113-153	132
8	Most walls collapsed except small interior rooms	127-178	152
9	All walls collapsed	142-198	170
10	Destruction of engineered and/or well-constructed residence; slab swept clean	165-220	200

Source: National Weather Services, National Oceanic and Atmospheric Administration, Storm Prediction Center

Figures 3.11a and **3.11.b** are photos provided by the National Weather Service showing damage an EF2 tornado caused to a single family dwelling in Schenectady and Saratoga Counties, on May 29, 2013. No fatalities occurred, but one injury was reported. The tornados estimated path was 1 mile wide and 13 miles in length.

Figure 3.11a: Single Family Dwelling Schenectady County

Source: National Weather Service

Figure 3.11b: Single Family Dwelling Saratoga County

Source: National Weather Service

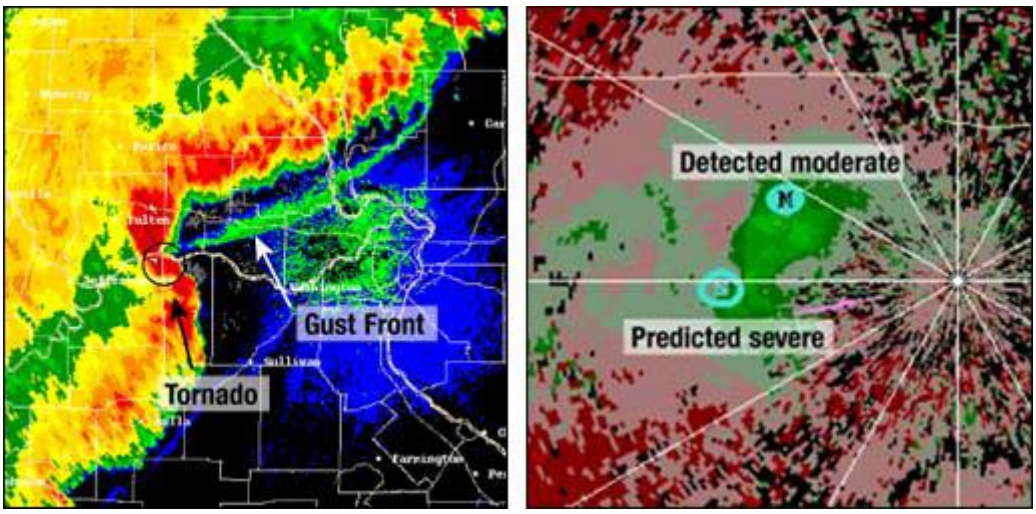
Straight-Line Winds

Straight-line winds meet or exceed 58 miles per hours then the storm is classified as severe by the National Weather Service. These winds are produced by the downward momentum in the downdraft region of a thunderstorm. An environment conducive to strong straight-line wind is one in which the updrafts (and downdrafts) are strong, the air is dry in the middle troposphere and the storm has a fast forward motion. Straight-line wind intensity can be as powerful as a tornado. The National Weather Service distinguishes between straight-line wind and wind produced from a tornado when conducting surveys of wind damage. Other types of damaging winds are described below according to the National Oceanic and Atmospheric Administration (NOAA):

- A *downdraft* is a small-scale column of air that rapidly sinks toward the ground.
- A *downburst* is a result of a strong downdraft. A downburst is a strong downdraft with horizontal dimensions larger than 4 km (2.5 mi) resulting in an outward burst or damaging winds on or near the ground. (Imagine the way water comes out of a faucet and hits the bottom of the sink.) Downburst winds may begin as a microburst and spread out over a wider area, sometimes producing damage similar to a strong tornado. Although usually associated with thunderstorms, downbursts can occur with showers too weak to produce thunder.
- A *microburst* is a small concentrated downburst that produces an outward burst of damaging winds at the surface. Microbursts are generally small (less than 4km across) and short-lived, lasting only 5-10 minutes, with maximum wind speeds up to 168 mph. There are two kinds of microbursts: **wet** and **dry**.
    - ***Wet microbursts*** are accompanied by heavy precipitation at the surface.
    - ***Dry microbursts***, common in places like the high plains and the intermountain west, occur with little or no precipitation reaching the ground.
- A *gust front* is the leading edge of rain-cooled air that clashes with warmer thunderstorm inflow. Gust fronts are characterized by a wind shift, temperature drop, and gusty winds out ahead of a thunderstorm. Sometimes the winds push up air above them, forming a shelf cloud or detached roll cloud.
- A *derecho* is a widespread, long-lived wind storm that is associated with a band of rapidly moving showers or thunderstorms. By definition, if the wind damage swath extends more than 240 miles (about 400 kilometers) and includes wind gusts of at least 58 mph (93 km/h) or greater along most of its length, then the event may be classified as a derecho. (A typical derecho consists of numerous microbursts, downbursts, and downburst clusters.)
- A *haboob* is a wall of dust that is pushed out along the ground from a thunderstorm downdraft at high speeds.

The National Weather Service uses the Doppler radar as a tool to detect damaging wind patterns. **Figure 3.11c** is a visual of a gust front (left) and velocity data (right). Doppler radar velocity data show areas of diverging winds at the surface, and the strength of those winds, indicating a downburst or microburst. Winds coming together at upper levels of the storm (convergence) can also be seen on velocity displays, and can indicate the development of a downburst or microburst.

Figure 3.11c: Gust Front and Velocity Data

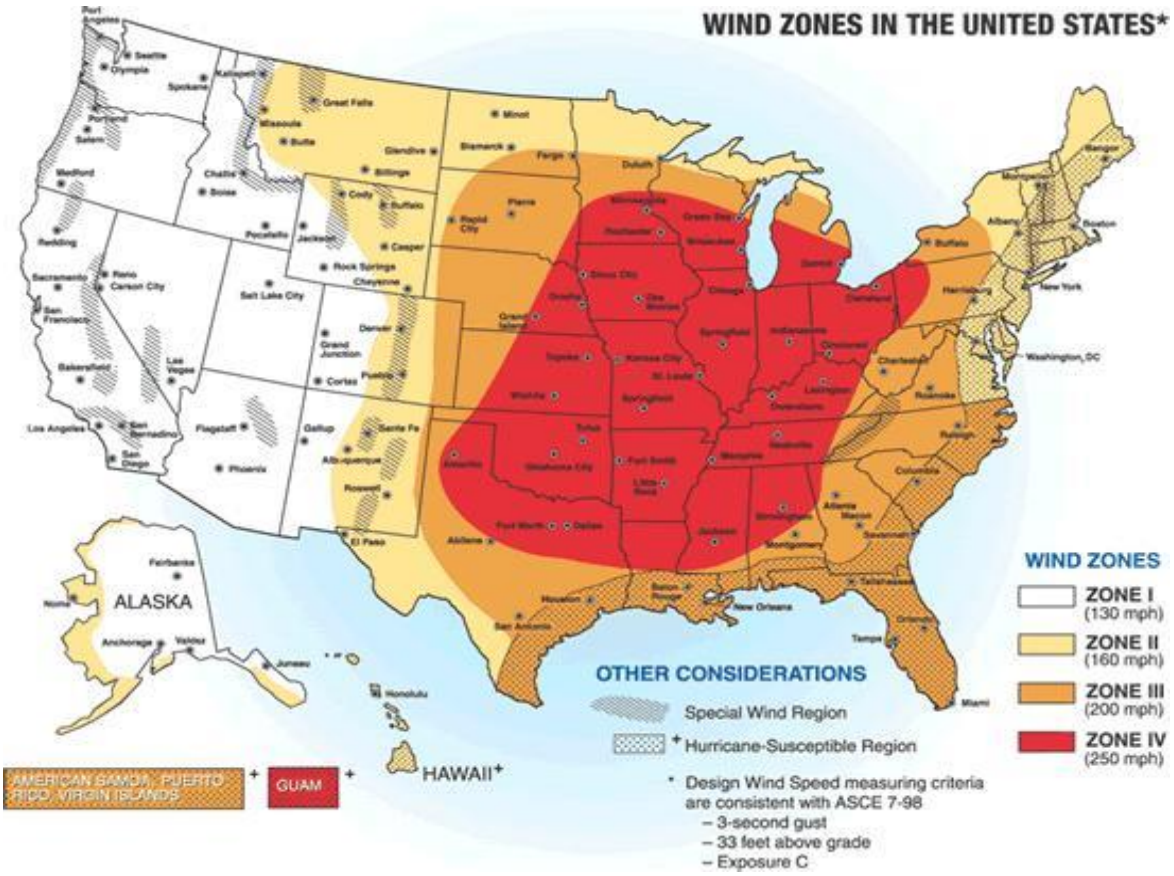


Source: *National Oceanic and Atmospheric Administration* (NOAA)

Location

The U.S. Wind Zone Map, found below in **Figure 3.11d,** shows the areas affected by extreme windstorms. This map was developed by the U.S. Army Corps of Engineers, which is based on a 40 year history of tornadoes and 100 year history of hurricanes.

Figure 3.11d: Wind Zones in the United States



Source: National Weather Service

The State of New York is located in Wind Zones II and III. The Atlantic Coastal Plain, New England Upland, and the Hudson Mohawk Lowland Regions are susceptible to hurricanes. New York State has a definite vulnerability to tornadoes. Research indicates that over 350 tornadoes ranging from F0 to F4 on the Fujita-Pearson Tornado Intensity Scale have occurred in New York State since 1952.

According to statistics, nearly 3 in 4 tornadoes occurring in New York State are classified as magnitude F0 or F1 on the Fujita-Pearson Scale. A significant number, approximately 1 in 3, are classified as F0. Magnitude F0 indicates a tornado wind speed range of 40-72 mph. F0 wind velocity typically produces only minor damage to property. A slim majority of tornados occurring in NYS produce winds ranging from 73-112 mph (F1 on Fujita scale), strong enough to move mobile homes from foundations.

Previous High Wind Event Occurrences

New York State is extremely vulnerable to high wind events according to data researched by the New York State Division of Homeland Security and Emergency Management (DHSES) mitigation staff. Several data sources for historical flood records including DHSES archives, FEMA statistics, Disaster Declaration data, Spatial Hazard Events and Losses Databases for the United States (SHELDUS), and NOAA's National Climatic Data Center (NCDC) storm event database were used to obtain historical data found within the State.

Between 1960 and 2012, NYS was impacted by 10,688 high wind events. These events were either classified as tornado, straight-line wind, or severe thunderstorm activity. Erie, Chautauqua, Oneida, Cattaraugus, and Otsego were the top five counties with the most events totaling 1,464. **Table 3.11d,** Historical and Recent High Wind Events and Losses, documents total events, fatalities, injuries, property damage, and crop damage from 1960-2012, as well as more recent occurrences from 2010-2013.

Table 3.11d Historical and Recent High Wind Events and Losses

	Historical Record (1960-2012)							Recent Record (2010-2012)				
County	Future Probability %	Recurrence Interval	No. of Events	Fatalities	Injuries	Property Damage	Crop Damage	No. of Events	Fatalities	Injuries	Property Damage	Crop Damage
Albany	306	0.33	159	1	24	$7,075,672	$250,966	2	0	0	$32,000	$0
Allegany	352	0.28	183	0	3	$4,603,342	$91,470	33	0	0	$764,000	$0
Bronx	138	0.72	72	4	17	$1,551,247	$308	16	1	8	$675,111	$0
Broome	485	0.21	252	0	25	$4,814,655	$19,416	50	0	0	$525,000	$0
Cattaraugus	490	0.2	255	1	8	$43,503,358	$147,520	37	0	0	$10,722,500	$100,000
Cayuga	398	0.25	207	1	94	$30,731,695	$1,177,294	31	0	0	$496,000	$20,000
Chautauqua	623	0.16	324	3	29	$18,336,771	$166,470	42	0	0	$5,995,500	$20,000
Chemung	269	0.37	140	0	6	$12,507,827	$13,989	26	0	0	$10,868,000	$0
Chenango	452	0.22	235	3	12	$4,896,135	$29,141	36	0	0	$1,021,000	$0
Clinton	417	0.24	217	1	4	$6,572,435	$253,615	42	0	0	$2,537,000	$100,000
Columbia	323	0.31	168	0	14	$19,477,571	$129,896	1	0	0	$4,000	$0
Cortland	356	0.28	185	0	14	$3,653,421	$32,064	15	0	0	$105,000	$0
Delaware	415	0.24	216	0	2	$4,334,947	$45,821	31	0	0	$475,000	$0
Dutchess	387	0.26	201	2	8	$13,041,212	$180,946	1	0	0	$40,000	$0
Erie	631	0.16	328	9	38	$35,243,508	$31,470	45	0	4	$1,270,000	$0
Essex	373	0.27	194	0	1	$6,143,993	$117,970	42	0	0	$899,000	$50,000
Franklin	390	0.26	203	0	2	$3,251,357	$68,276	32	0	0	$806,000	$50,000
Fulton	288	0.35	150	1	11	$5,371,608	$86,054	0	0	0	$0	$0
Genesee	304	0.33	158	3	8	$7,394,862	$46,470	18	0	0	$493,000	$0
Greene	240	0.42	125	1	21	$15,468,697	$798,546	1	0	0	$4,000	$0
Hamilton	204	0.49	106	12	7	$78,148,859	$153,615	0	0	0	$0	$0
Herkimer	321	0.31	167	3	13	$13,740,682	$126,215	0	0	0	$0	$0

	Historical Record (1960-2012)							Recent Record (2010-2012)				
County	Future Probability %	Recurrence Interval	No. of Events	Fatalities	Injuries	Property Damage	Crop Damage	No. of Events	Fatalities	Injuries	Property Damage	Crop Damage
Jefferson	406	0.25	211	1	11	$45,062,427	$132,544	37	0	0	$774,000	$0
Kings	160	0.63	83	7	26	$10,225,116	$308	22	1	1	$9,536,142	$0
Lewis	362	0.28	188	1	2	$19,359,488	$143,419	36	0	0	$527,000	$8,000
Livingston	300	0.33	156	0	5	$4,501,643	$41,470	22	0	0	$510,000	$15,000
Madison	308	0.33	160	2	9	$7,170,880	$93,469	16	0	0	$137,000	$0
Monroe	392	0.25	204	6	17	$28,566,409	$2,226,470	23	0	0	$853,000	$0
Montgomery	300	0.33	156	1	14	$6,091,053	$301,054	0	0	0	$0	$0
Nassau	258	0.39	134	7	35	$7,151,101	$308	56	2	2	$2,736,111	$0
New York	181	0.55	94	6	24	$2,709,801	$6,331	35	2	1	$1,632,781	$0
Niagara	473	0.21	246	4	11	$8,063,024	$2,726,470	32	0	0	$1,548,000	$0
Oneida	581	0.17	302	6	26	$84,919,553	$45,965	34	0	0	$212,000	$0
Onondaga	388	0.26	202	11	31	$96,383,621	$67,364	29	0	0	$169,000	$0
Ontario	298	0.34	155	1	8	$6,297,295	$189,470	22	0	0	$469,000	$48,000
Orange	329	0.3	171	19	57	$13,866,429	$614,346	38	0	1	$556,000	$0
Orleans	267	0.37	139	3	3	$10,446,495	$5,576,470	9	0	0	$445,000	$0
Oswego	460	0.22	239	0	10	$7,622,384	$166,294	31	0	0	$729,000	$34,000
Otsego	490	0.2	255	5	25	$4,751,312	$47,886	25	0	1	$407,000	$0
Putnam	167	0.6	87	0	13	$5,785,291	$17,696	22	0	0	$113,750	$0
Queens	215	0.46	112	16	42	$20,447,828	$308	37	5	1	$19,512,104	$0
Rensselaer	365	0.27	190	1	25	$14,242,944	$209,210	4	0	1	$75,000	$0
Richmond	121	0.83	63	2	8	$4,046,265	$308	8	1	0	$2,812,000	$0
Rockland	142	0.7	74	3	6	$1,084,047	$6,563	23	1	1	$406,750	$0
Saratoga	437	0.23	227	4	91	$69,449,234	$148,284	0	0	0	$0	$0
Schenectady	233	0.43	121	0	7	$7,824,933	$15,704	1	0	0	$7,000	$0

	Historical Record (1960-2012)							Recent Record (2010-2012)				
County	Future Probability %	Recurrence Interval	No. of Events	Fatalities	Injuries	Property Damage	Crop Damage	No. of Events	Fatalities	Injuries	Property Damage	Crop Damage
Schoharie	258	0.39	134	1	7	$4,188,496	$150,852	0	0	0	$0	$0
Schuyler	198	0.5	103	1	2	$1,364,524	$13,989	5	0	0	$105,000	$0
Seneca	215	0.46	112	1	5	$2,053,485	$14,239	9	0	1	$108,000	$0
St Lawrence	456	0.22	237	1	10	$39,153,494	$63,240	47	0	0	$1,173,000	$0
Steuben	356	0.28	185	1	12	$3,226,238	$18,970	33	0	0	$737,000	$0
Suffolk	290	0.34	151	9	25	$7,585,868	$308	67	4	1	$5,362,650	$0
Sullivan	344	0.29	179	1	15	$10,102,481	$69,263	15	0	0	$1,438,000	$0
Tioga	290	0.34	151	1	13	$3,882,999	$25,689	22	0	0	$246,000	$0
Tompkins	281	0.36	146	1	1	$2,208,909	$14,989	9	0	0	$305,000	$0
Ulster	363	0.28	189	5	5	$505,686,535	$27,446	2	1	0	$2,000	$0
Warren	260	0.39	135	3	17	$13,663,270	$68,556	2	0	2	$1,000	$0
Washington	315	0.32	164	0	4	$3,801,624	$5,019,281	0	0	0	$0	$0
Wayne	344	0.29	179	0	8	$14,606,026	$629,739	38	0	0	$944,000	$68,000
Westchester	288	0.35	150	16	49	$14,816,093	$6,563	49	4	2	$2,271,250	$0
Wyoming	300	0.33	156	0	2	$31,191,705	$51,470	17	0	0	$457,000	$10,000
Yates	198	0.5	103	0	2	$1,561,910	$33,970	13	0	0	$95,000	$0

Source: SHELDUS

Figure 3.11e show historical straight-path tornado tracks for the State of New York from 1960 to 2012. Albany, Schoharie, Green, Chautauqua, Montgomery, and Columbia Counties have all encountered F4 wind speeds of 210-261 mph, causing devastating damage to any area the tornado travels through. Please note: NYS has never been impacted by F5 wind speeds.

Figure 3.11f references New York State's wind events by county from 1960-2012. The highest number of events occurred in Chautauqua, Cattaraugus, Erie, Niagara, Broome, Chenango, Otsego, Oneida, Oswego, Delaware, and Saratoga Counties with an average of 221-328 events reported. Yates, Schuyler, Seneca, Hamilton, Schenectady, Greene, Putnam, Rockland, Bronx, Kings, Queens, and Richmond reported the least number of severe wind events that averaged 60-89 occurrences over a 52 year period.

Figure 3.11e: Historical Tornado Tracks 1960-2012

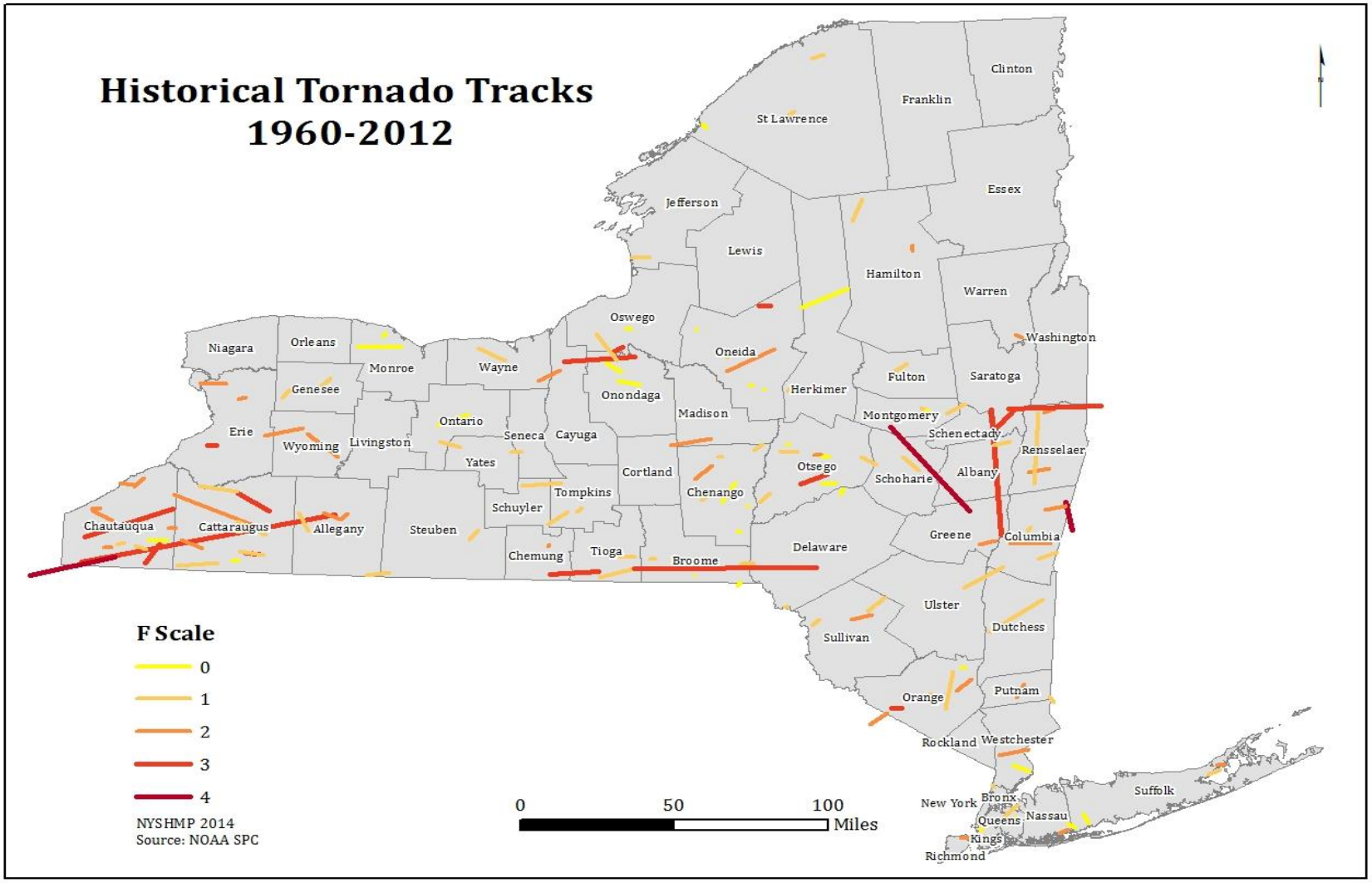
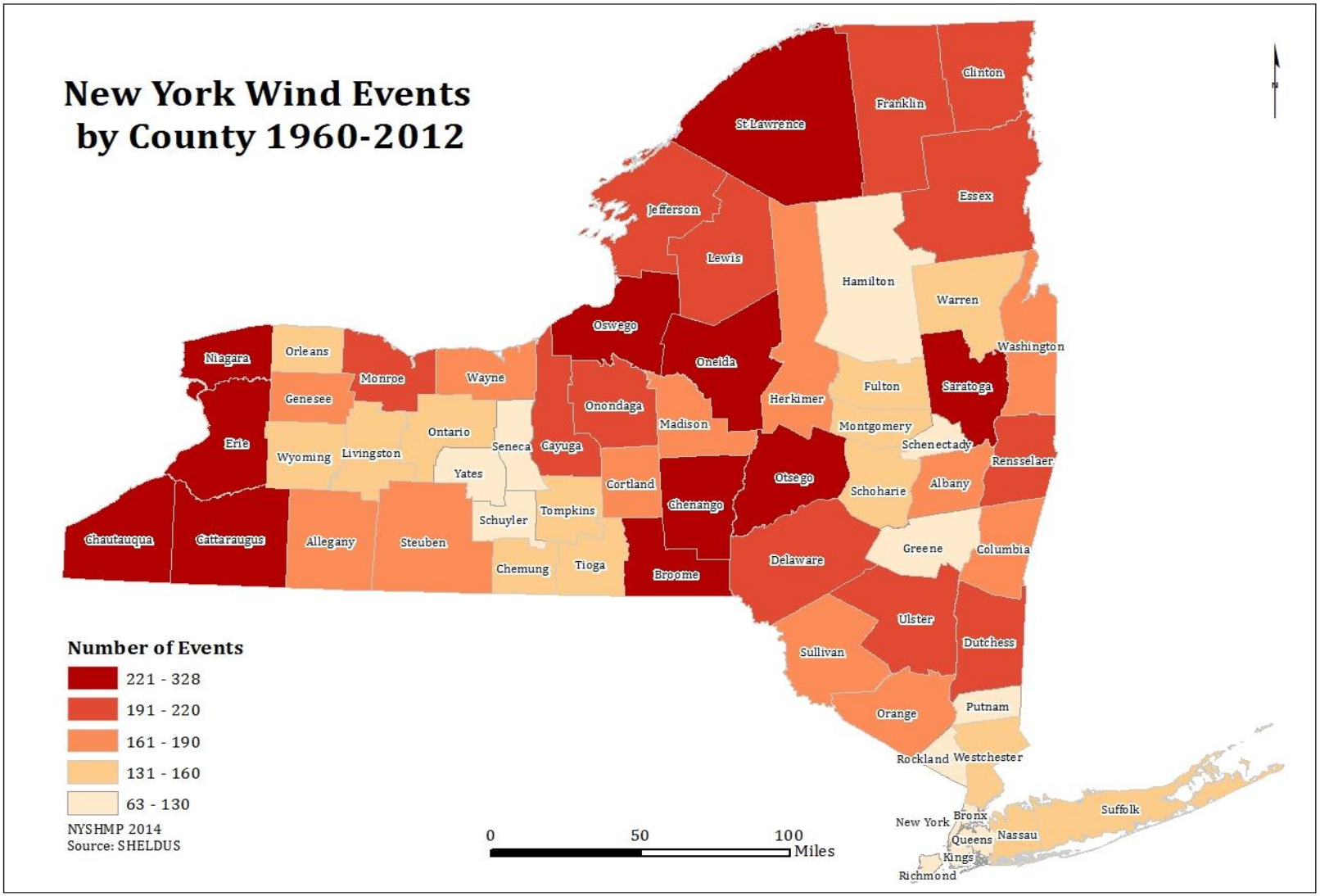


Figure 3.11f: New York Wind Events by County 1960-2012



Data found in the table and figure below was derived from a FEMA data source that examines Presidential Declarations from 1954 to 2013. **Table 3.11e** and **Figure 3.11d** illustrates the affected counties from high wind events. Although the data dates back to 1954, New York State's first Presidential Declaration was in June 1998.

Table 3.11e: Major Tornado Presidential Declared Disasters

Disaster Number	Date Declared	Affected Locations
DR-1993	6/10/2011	Allegany, Broome, Chemung, Chenango, Clinton, Delaware, Essex, Franklin, Hamilton, Herkimer, Lewis, Livingston, Madison, Niagara, Oneida, Onondaga, Ontario, Steuben, Tioga, Ulster, Warren, Wyoming, and Yates Counties
DR-1943	10/14/2010	Kings, Queens, and Richmond Counties
DR-1724	8/31/2007	Kings and Queens Counties
DR-1486	8/29/2003	Allegany, Cattaraugus, Chemung, Columbia, Delaware, Fulton, Livingston, Madison, Montgomery, Ontario, Schuyler, Steuben, Sullivan, Wyoming and Yates Counties
DR-1222	6/16/1998	Broome, Chenango, Otsego, Rensselaer, Saratoga, and Wyoming Counties

Source: FEMA

Figure 3.6g displays the Presidential Declared Disaster totals by county for tornado events for the period of 1954 through July 2013. Damages caused by tornado events are over $51.8 million with Wyoming County having the highest number of Presidential Declarations recorded.

Figure 3.11g: Presidential Disaster Declarations for Tornado Events

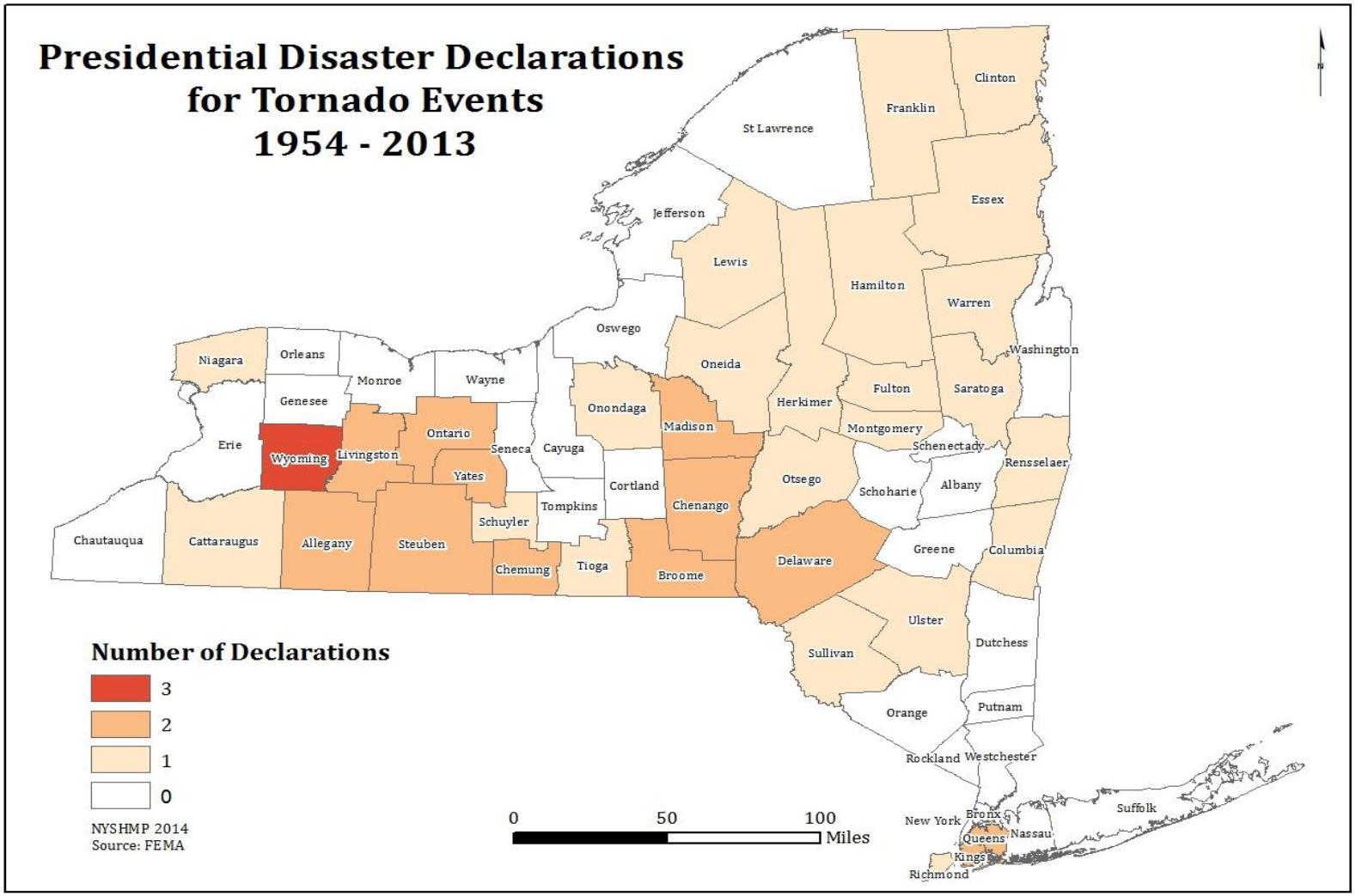


Table 3.11f displays undeclared historical tornadoes from 1857-1993. The seven counties affected during this time frame were: Genesee (1993), Orange (1989), Chautauqua (1983), Jefferson (1935), Onondaga (1912), Allegany (1884), and Oneida (1857). As a result of these tornadoes there were 23 deaths and 94 injuries.

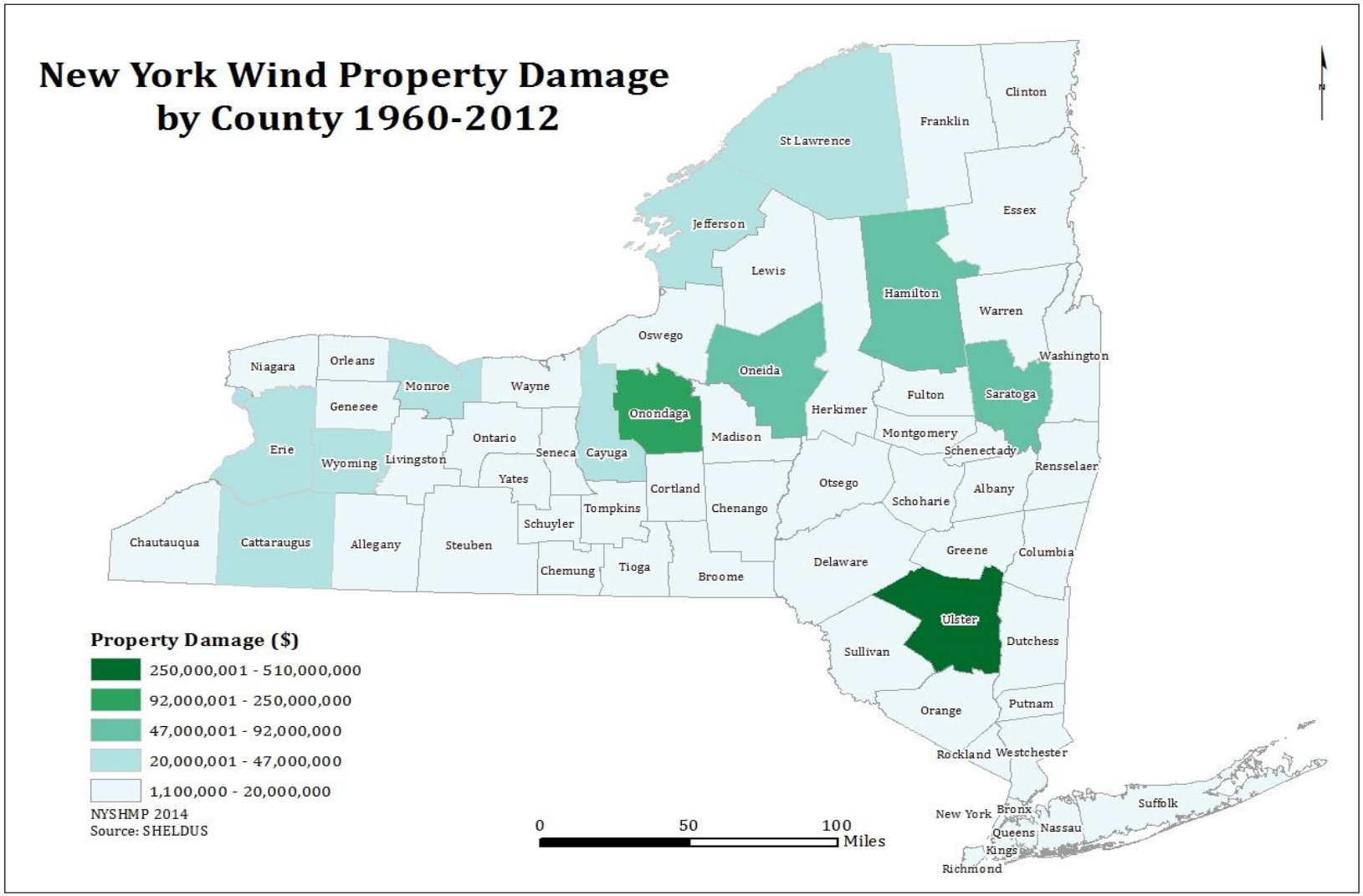
Table 3.11f: Undeclared Historical Tornadoes Events from 1857 – 1993 in New York State Causing Two or More Deaths

Date/Time	Results
SEPT 03, 1993/1:15pm	2 dead, 0 injured Near Batavia, a delivery van was dropped onto an oncoming tractor trailer. Both drivers were killed. The following event was called a tornado by the NWS. However, experts in severe storm analysis later concluded that it was a microburst, not a tornado. The event continues to be erroneously listed as a tornado by the NWS.
NOV 16, 1989/ 12:05 pm	9 dead; 18 injured 9 children were killed at the Coldenham School in Orange County when a cafeteria wall was blown over.
MAY 2, 1983/ 4:05 pm	2 dead; 2 injured A tornado destroyed 100 buildings after moving over Chautauqua Lake.
JULY 19, 1935 3:30 pm	2 dead; 2 injured A mother and daughter were killed as their farmhouse was destroyed near Philadelphia, Jefferson County.
SEPT 15, 1912 /5:25 pm	3 dead; 40 injured This tornado moved from the outlet of Onondaga Lake, and passed just north of the Syracuse City limits.
SEPT 28, 1884/ 5:20 pm	3 dead; 31 injured A balloon-shaped tornado ripped apart the east half of Shongo, Allegany County.
JUN 13, 1857/ 4:00 pm	2 dead; 1 injured What was called a "funnel-shaped black moving body of nebulous character" hit the edge of Utica.

Source: NOAA, NCDC

From 1960-2012 every county in New York State has been affected by a high wind event. **Figure 3.11h** illustrates the property loss of each county within the State of New York. Property damage exceeded $1.4 billion over this particular 52 year period. The agriculture industry also experienced damage with approximately $23 million crop loss during the 52 year period. The State loss 197 lives and 1,047 people were injured. Additionally, 55 of the 62 NYS counties have encountered at least one event from 2010-2012.

Figure 3.11h: New York Wind Property Damage 1960-2012



Probability of Future High Wind Events

Using the historical occurrence, or more specific documentation if available, a *future probability and average annual losses* analysis was performed for high wind events. The number of years recorded was divided by the number of occurrences, resulting in a simple past-determined recurrence interval. If the hazard lacked a definitive historical record, the probability was assessed qualitatively based on county history or other supporting data.

Based on the historical record from 1960-2012 found in **Table 3.11d**, the following can be expected on average in a typical year in New York State:

- 172 high wind events
- $24 million in property and crop damage
- 17 injuries
- 3 fatalities

The historical data collected displays that in Erie, Chautauqua, Oneida, Cattaraugus, and Otsego Counties are most vulnerable to high wind occurrences. The data provided by SHELDUS shows these counties having high future probability of future wind events.

Table 3.11g: Percentage Probability* of Future Occurrences, by County

County	Future Probability %
Cattaraugus	490
Chautauqua	623
Erie	631
Oneida	581
Otsego	490

Source: SHELDUS (*Future Probability equals the number of events divided by the number of years of record [52], expressed as a percentage.)

Climate change is a major factor when it comes to forecasting potential natural disasters. As New York State continues to become more vulnerable to severe thunderstorms and tornados it will continue to be impacted by high wind events. Local counties are taking the following measures to mitigate wind events: enforcing building codes and instituting new measures that would call for the use of high wind-resistant materials, hurricane clips, and wind shutters.

3.11.2 Assessing High Wind Vulnerability and Losses by Jurisdiction

Local jurisdictions have recognized their susceptibility to high wind events and although tornados have occurred throughout the region; NYS has been affected more by derecho's straight-line winds. Several counties seem to have higher occurrences than others from 1962-2012; after reviewing several local mitigation plans, Otsego, Ulster, Jefferson, Lewis, Suffolk and Orange Counties reported severe wind events as a high risk disaster. Delaware, Schenectady, Westchester, and Genesee Counties reported medium risk to wind disasters.

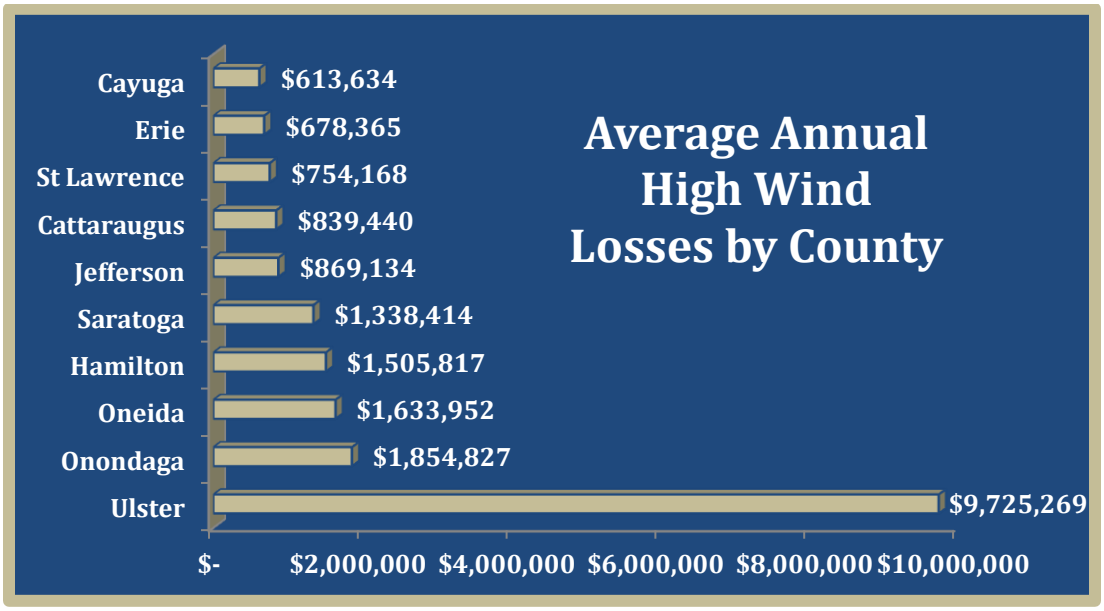
Table 3.11h provides the annualized losses for high wind events. The data used was based on SHELDUS records from 1960-2012, with the exception of hurricane, earthquake, and flood hazards which were derived from Hazus-MH 2.1. For those specific hazards, a probabilistic run was generated to determine the total annual losses for each county found within the State. The information provided by SHELDUS was determined by taking the total economic losses divided by the number of years of record (52) to obtain the losses per year. **Figure 3.11i,** illustrates the top ten counties annualized losses with a total of $28,999,613 in high wind losses for the entire State of New York.

Table 3.11h: Average Annual High Wind Losses by County 1960-2012

County	High Wind	County	High Wind	County	High Wind
Ulster	$ 9,725,269	Rensselaer	$ 277,926	Fulton	$ 104,955
Onondaga	$ 1,854,827	Herkimer	$ 266,671	Chenango	$ 94,717
Oneida	$ 1,633,952	Warren	$ 264,074	Broome	$ 92,963
Hamilton	$ 1,505,817	Dutchess	$ 254,272	Otsego	$ 92,292
Saratoga	$ 1,338,414	Chemung	$ 240,804	Allegany	$ 90,285
Jefferson	$ 869,134	Niagara	$ 207,490	Livingston	$ 87,368
Cattaraugus	$ 839,440	Kings	$ 196,643	Delaware	$ 84,246
St Lawrence	$ 754,168	Sullivan	$ 195,610	Schoharie	$ 83,449
Erie	$ 678,365	Washington	$ 169,633	Richmond	$ 77,819
Cayuga	$ 613,634	Schenectady	$ 150,781	Tioga	$ 75,167
Wyoming	$ 600,830	Oswego	$ 149,782	Cortland	$ 70,875
Monroe	$ 592,171	Suffolk	$ 145,888	Franklin	$ 63,839
Queens	$ 393,233	Genesee	$ 143,103	Steuben	$ 62,408
Columbia	$ 377,067	Albany	$ 140,897	New York	$ 52,233
Lewis	$ 375,056	Madison	$ 139,699	Tompkins	$ 42,767
Chautauqua	$ 355,832	Nassau	$ 137,527	Seneca	$ 39,764
Greene	$ 312,832	Clinton	$ 131,270	Yates	$ 30,690
Orleans	$ 308,134	Ontario	$ 124,745	Bronx	$ 29,838
Wayne	$ 292,995	Montgomery	$ 122,925	Schuyler	$ 26,510
Westchester	$ 285,051	Essex	$ 120,422	Rockland	$ 20,973
Orange	$ 278,476	Putnam	$ 111,596	Total	$ 28,999,613

Source: SHELDUS, 2013

Figure 3.11i: Average Annual High Wind Losses by County 1960-2012



Source: SHELDUS, 2013

Local Plan Integration/Risk Assessment

Since August of 2013, 56 FEMA-approved local hazard mitigation plans (LHMP) have been reviewed for the 2014 Update. The State's planning team had the opportunity to review local county risk assessments to help the State better understand its vulnerability in terms of the jurisdictions most threatened by classified hazards. In its analysis, the State of New York reviewed the processes of local governments and how their hazards were ranked based on their jurisdictions and the potential losses (i.e., people, buildings, and dollar values) associated with the hazards of greatest concern.

Where data was available, the State extracted the ranking impact information from the LHMP hazard analysis. This ranking feature is based on a combination of probability, severity, and extent of the hazard and was determined to be the best measure of overall risk in the plans. This ranking was either numeric or described in terms of high, moderately high, moderate, or low. In cases where this information was not available, ranking values were not determined yet considered if identified in the individual county local plans.

For the sake of the 2014 Update, a proper analysis and summary of the data was required. During the review of the local plan risk assessments, all rankings used were based on the New York HAZNY ranking system, and measured on a scale rating from 44 (low) to 400 (high). This analysis revealed that selected county-level plans did include manmade hazards in their analysis, but the State hazard mitigation plan's 2014 Update focused solely on natural hazards.

The local risk assessment summary allowed for an analysis of which hazards are of high concern to particular counties. **Table 3.2a** in **Section 3.2** lists all the hazards and the number of counties that ranked them at each of the scale levels: High, Moderately High, Moderate, and Low. As indicated previously, five of the local plans ranked high wind events as a high hazard. In addition, eighteen counties ranked it as moderately high, four moderate, fourteen moderately low, and none ranked it as a low hazard. **Table 3.11i** displays the highest ranked county hazard impacts and the high and / or moderately high ranked risk assessment scores for high wind.

Table 3.11i: Summary of High Wind Hazard Impacts and Rankings by County

Local County High Wind Hazard Impacts		
Highest Occurrences	**Highest Fatalities**	**Highest Property Damage**
Erie	Orange	Ulster
Chautauqua	Queens	Onondaga
Oneida	Westchester	Oneida
Cattaraugus	Hamilton	Hamilton
Otsego	Onondaga	Saratoga

Source: SHELDUS

Local County High Wind Hazard Rankings	
High	**Moderately High**
Fulton, Montgomery, Otsego, Saratoga, and Suffolk	Albany, Allegany, Chenango, Delaware, Nassau, Niagara, Ontario, Orange, Oswego, Rensselaer, Schenectady, Ulster, and Westchester

Source: LHMP

Hazus-MH 2.0

Hazus is used for mitigation, preparedness, and response. Government planners, GIS specialists, and emergency managers use Hazus to determine losses and the most beneficial mitigation approaches to minimize them. Hazus can be used in the assessment step in the mitigation planning process, which is the foundation for a community's long-term strategy to reduce disaster losses and break the cycle of disaster damage, reconstruction, and repetitive damage.

New York State uses Hazus to determine potential risk and vulnerability in local jurisdictions, support risk assessments and perform economic loss scenarios for flood, hurricane, and earthquake hazards.

Fulton County's LHMP is an example of how Hazus is used to determine high wind impact on life, health and safety; general building stock; critical facilities; the economy; and future growth. The county's vulnerability assessment using Hazus is documented below; however, the complete LHMP can be reviewed at Fulton County's website.[1]

[1] http://www.fultoncountyny.gov/hazard/hazmit.html.

Fulton County's HAZUS Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. For severe storms, the entire County has been identified as the hazard area. Therefore, all assets in Fulton County (population, structures, critical facilities and lifelines), as described in the County Profile section (Section 4), are vulnerable. The following text evaluates and estimates the potential impact of severe storms on the County including:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impact, including: (1) impact on life, safety and health of County residents, (2) general building stock, (3) critical facilities, (4) economy and (5) future growth and development
- Further data collections that will assist understanding of this hazard over time
- Overall vulnerability conclusion

Fulton County's Hazus-MH MR4 most recent hazard mitigation plan is available for review at http://www.fultoncountyny.gov/hazard/hazmit.html

Overview of Vulnerability

Severe storms include high winds and air speeds that result in power outages, disruptions to transportation corridors and equipment, loss of workplace access, significant property damage, injuries and loss of life, and the need to shelter and care for individuals impacted by the events. A large amount of damage can be inflicted by trees, branches, and other objects that fall onto power lines, buildings, roads, vehicles, and, in some cases, people. The risk assessment for severe storm evaluates available data for a range of storms included in this hazard category.

Due to the County's inland location, the loss associated with hurricanes is primarily associated with severe thunderstorm or tropical storm/hurricane-related severe winds and rain (see flooding discussion in Section 5.4.3 Flood). Secondary flooding associated with the torrential downpours during severe storms is also a primary concern in the County. The County has experienced flooding in association with numerous severe storms in the past.

In the study area, winds associated with a tropical/hurricane storm event are similar to a severe wind storm and therefore, can support analysis of the severe storm event for this study area. The entire inventory of the County is at risk of being damaged or lost due to impacts of severe wind. Certain areas, infrastructure, and types of building are at greater risk than others due to proximity to falling hazards and/or their manner of construction.

Potential losses associated with high wind events were calculated for the County for two probabilistic wind events, the 100-year and 500-year mean return period (MRP) wind events. The impacts on population, existing structures and critical facilities are presented below, following a summary of the data and methodology used.

Data and Methodology

After reviewing historic data, the Hazus-MH methodology and model were used to analyze the wind (severe storm) hazard for Fulton County. Data used to assess this hazard include data available in the Hazus-MH MR4 hurricane model, NOAA NCDC data, professional knowledge, and information provided by the Planning Committee.

A probabilistic scenario was run for Fulton County for annualized losses and the 100- and 500-year MRPs were examined for the wind/severe storm hazard. Figures 5.4.1-1 and 5.4.1-2, earlier in this section, show the Hazus-MH MR4 maximum peak gust wind speeds that can be anticipated in the study area associated with the 100- and 500-year MRP hurricane events. The estimated hurricane track for the 100- and 500-year events is also shown.

Hazus-MH contains data on historic hurricane events and wind speeds. It also includes surface roughness and vegetation (tree coverage) maps for the area. Surface roughness and vegetation data support the modeling of wind force across various types of land surfaces. Hurricane and inventory data available in Hazus-MH were used to evaluate potential losses from the 100- and 500-year MRP events (severe wind impacts). Locally available inventory data were reviewed to determine their appropriateness for inclusion. Other than data for critical facilities, the default data in Hazus-MH MR4 was the best available for use in this evaluation. The 11 residential and 10 commercial occupancy classes available in Hazus-MH were condensed into the following occupancy classes (residential, commercial, industrial, agricultural, religious, government, and educational) to facilitate the analysis and the presentation of results. Residential loss estimates address both multi-family and single family dwellings. In addition, impacts to critical facilities were evaluated for the 100-year and 500-year MRP events.

Impact on Life, Health and Safety

The impact of severe storms on life, health and safety is dependent upon the severity of the storm event. Residents may be displaced or require temporary to long-term sheltering. In addition, downed trees, damaged buildings and debris carried by high winds can lead to injury or loss of life. It is assumed that the entire County population is exposed to the severe storm hazard. Socially vulnerable populations are most susceptible, based on a number of factors including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. **Table 3.12j** summarizes the population over the age of 65 and individuals living below the Census poverty threshold. Additionally, residents living in mobile homes are particularly vulnerable to

wind events due to the construction of their housing. The Impact on General Building Stock subsection below discusses mobile homes in the County further.

Table 3.11j: Vulnerable Population Exposed to the Sever Storm Hazard in Fulton County

Population Category	Number of Persons Exposed**	Percent of Total Population**
Elderly (Over 65 years of age) (1)	9,729	17.0
Persons living below Census poverty threshold* (2)	6,235	10.9
Elderly (Over 65 years of age) living below Census poverty threshold (2)***	638	1.2
Population Category	**Number of Persons Exposed**	**Percent of Total County Population**
Elderly (Over 65 years of age) (1)	8,900	16.2
Persons living below Census poverty threshold* (2)	6,686	12.1
Elderly (Over 65 years of age) living below Census poverty threshold (2)	638	1.2

Source(s): (1) HAZUS-MH MR4; U.S. Census 2000
*The Census poverty threshold for ta three person family unit is approximately $15,000.
**These values represent Fulton County and the entire Village of Dolgeville.
***This value only represents the population within the Fulton County boundary and does not include the portion of the Village of Dolgeville located in Herkimer County.

For a 100-year and 500-year MRP events, Hazus-MH MR4 estimates that no households will be displaced and zero households will require temporary shelter. For the 100-year event, Hazus-MH MR4 estimates no debris will be generated. For a 500-year MRP event, Hazus-MH MR4 estimates 225 tons of brick and wood debris and a total of 27,277 tons of tree debris will be generated. **Table 3.12k** estimates the debris produced for the 500-year MRP event per municipality.

Please note that the Hazus-MH Hurricane Model Technical Manual and User Manual recommend that the estimated debris volume be treated as a low estimate. There may be other sources of vegetative and non-vegetative debris (i.e., flooding) not being modeled in Hazus-MH in combination with the wind. Therefore, this is likely a conservative estimate and may be higher if multiple impacts occur.

Table 3.11k: Debris Production for 500-Year MRP Event Winds

Municipality	Brick and Wood (tons)	Concrete (tons)	Tree (tons)
Bleecker (T)	0	0	0
Broadalbin (T)	8	0	1,969
Broadalbin (V)	4	0	62
Caroga (T)	1	0	0
Dolgeville (V)*	6	0	27
Ephratah (T)	0	0	3,757
Gloversville (C)	115	0	22
Johnstown (C)	70	0	54
Johnstown (T)	0	0	4,483
Mayfield (T)	9	0	1,313
Mayfield (V)	0	0	6
Northampton (T)	3	0	1,270
Northville (V)	2	0	62
Oppenheim (T)	0	0	5,377
Perth (T)	7	0	1,665
Stratford (T)	0	0	7,210
Fulton County	**225**	**0**	**27,277**

Source: Hazus-MH MR4. Note: * These values represent the entire Village of Dolgeville (both portions in Fulton and Herkimer Counties).

Impact on General Building Stock

After considering the population exposed to the severe storm hazard, the value of general building stock exposed to and damaged by 100- and 500-year MRP events was evaluated. Potential damage is the modeled loss that could occur to the exposed inventory. Hazus-MH MR4 estimates there is a total building replacement value (structure only) of greater than $4 billion in Fulton County. Greater than 75-percent of the building stock value is associated with residential housing. The analysis below uses the replacement value (building structure and does not include building contents) with the valuation of general building stock and the loss estimates determined in Fulton County based on the default general building stock database provided in Hazus-MH MR4. The general building stock valuations provided in Hazus-MH MR4 are Replacement Cost Value from RSMeans as of 2006.

Table 3.11l presents the total exposure value for general building stock by occupancy class for the County.

Table 3.12l: Building Stock Replacement Value (Structure Only) by Occupancy Class

Municipality	Total Replacement Value	Residential Replacement Value	Commercial Replacement Value	Industrial Replacement Value
Bleecker (T)	$56,230,000	$53,315,000	$2,010,000	$508,000
Broadalbin (T)	$256,461,000	$226,108,000	$14,830,000	$3,500,000
Broadalbin (V)	$90,402,000	$58,644,000	$14,958,000	$5,649,000
Caroga (T)	$234,377,000	$219,551,000	$8,990,000	$1,273,000
Dolgeville (V)	$149,722,000	$108,123,000	$22,202,000	$10,818,000
Ephratah (T)	$78,484,000	$72,610,000	$3,946,000	$1,738,000
Gloversville (C)	$1,105,210,000	$807,907,000	$174,348,000	$81,231,000
Johnstown (C)	$776,521,000	$471,419,000	$174,731,000	$86,356,000
Johnstown (T)	$479,387,000	$361,025,000	$60,335,000	$19,783,000
Mayfield (T)	$353,165,000	$295,984,000	$40,031,000	$8,052,000
Mayfield (V)	$57,057,000	$43,949,000	$5,349,000	$1,163,000
Northampton (T)	$168,935,000	$157,963,000	$8,998,000	$1,053,000
Northville (V)	$92,066,000	$74,175,000	$11,183,000	$1,202,000
Oppenheim (T)	$87,130,000	$65,088,000	$7,338,000	$10,003,000
Perth (T)	$206,155,000	$176,770,000	$19,140,000	$8,210,000
Stratford (T)	$51,148,000	$47,348,000	$1,570,000	$122,000
Fulton County	**$4,242,450,000**	**$3,239,979,000**	**$569,959,000**	**$240,661,000**

Source: Hazus-MH MR4

Notes:

1. Replacement value reflects the building structure and does not include building contents. The valuation of general building stock and the loss estimates determined in Fulton Coutny were based on the default general building stock database provided in Hazus-MH MR4. The general building stock valuations provided in Hazus-MH MR4 are Replacement Cost Value from RSMeans as of 2006
2. Total RV is the sum of all building classes (Residential, Commercial, Industrial, Agricultural, Religious, Government and Education)
3. The total RV for the agricultural occupancy class is $10,979,000, the total RV for the religious occupancy class is $68,539,000, the total RV for the government occupancy class is $52,742,000, and the total RV for the education occupancy class $59,591,000.
4. The building stock replacement value represents the entire Village of Dolgeville (portions in both Fulton and Herkimer Counties).

The Hazus-MH hurricane analysis considers damage associated with significant winds. Such wind impacts also could occur as a result of the severe wind storms or tornadoes and therefore, are considered relevant to the severe storm hazard. Rain often is associated with severe storms and heavy rains could result in flooding. Flooding is addressed under the flood hazard (Section 5.4.3).

The entire study area is considered at risk for the severe storm wind hazard. Expected building damage was evaluated by Hazus-MH across the following damage categories: no damage/very minor damage, minor damage, moderate damage, severe damage, and total destruction. **Table 3.11m** summarizes the definition of the damage categories.

Table 3.11m: Description of Damage Categories

Qualitative Damage Description	Roof Cover Failure	Window Door Failures	Roof Deck	Missile Impacts on Walls	Roof Structure Failure	Wall Structure Failure
1. No Damage or Very Minor Damage Little or no visible damage from the outside. No broken windows, or failed roof deck. Minimal loss of roof over, with no or very Limited water penetration.	≤2%	No	No	No	No	No
2. Minor Damage Maximum of one broken window, door or garage door. Moderate roof cover loss that can be Covered to prevent additional water Entering the building. Marks or dents on walls requiring painting or patching for repair.	>2% and ≤15%	One window, door, or garage door failure	No	<5 impacts	No	No
3. Moderate Damage Major roof cover damage, moderate window breakage. Minor roof sheathing failure. Some resulting damage to interior of building from water.	>15% and ≤50%	> one and ≤ the larger of 20% & 3	1 to 3 panels	Typically 5 to 10 impacts	No	No
4. Severe Damage Major window damage or roof sheathing loss. Major roof cover loss. Extensive damage to interior from water.	>50%	> the larger of 20% & 3 and ≤50%	>3 and ≤25%	Typically 10 to 20 impacts	No	No
5. Destruction Complete roof failure and/or, failure of wall frame. Loss of more than 50% of roof sheathing.	Typically >50%	>50%	>25%	Typically >20 impacts	Yes	Yes

Source Hazus-MH Hurricane Technical Manual

As noted earlier in this profile, wind speeds associated with the 100-year MRP event are less than 50 mph, characteristic of a tropical cyclone or tropical storm. Peak gust wind speeds for the 500-year MRP range from 67 to 71 mph; wind speeds characteristic of a tropical storm and nearly a Category 1 hurricane. Because the estimated wind risk is low, there are mainly minor structural damages estimated.

In summary, Hazus-MH MR4 does not estimate any structural damage as a result of the 100-year MRP event. Hazus-MH MR4 only estimates minor building damage to the residential occupancy class as a result of the 500-year event. Because of differences in building construction, residential structures are generally more susceptible to wind damage than commercial and industrial structures. Mobile homes are particularly vulnerable to severe storms and wind damage. According to Hazus-MH MR4, there are a total of 3,126 mobile homes in the study area with a structural replacement value of approximately $37,000 each. Of the nearly $2.5 million in structural damage estimated as a result of the 500-year event, approximately $120,561 is estimated damage to manufactured homes (mobile homes) in Fulton County.

Table 3.11n summarizes the general building stock damage estimated by Hazus-MH MR4 for the 100- and 500-year MRP hurricane events for the County as a whole. **Table 3.11o** summarizes the general building stock damage estimated for the 100- and 500-year MRP

hurricane events for each participating municipality. The data shown in both tables indicate total losses associated with wind damage to building structure only. The damage estimates include buildings damaged at all severity levels from minor damage to total destruction and the total dollar damage reflects the overall impact to buildings at an aggregate level. In addition, the annualized losses were examined for Fulton County; see **Table 3.11p**. Please note that annualized loss does not predict what losses will occur in any particular year.

Table 3.11n: Estimated Fulton County Building Replacement Value (Structure Only) Damaged by the 100-Year and 500-Year MRP Winds

Occupancy Category	Building Value Damage (Structure Only)	
	100-Year	500-Year
Residential	$0	$2,287,762
Commercial	$0	$56,996
Industrial	$0	$24,066
Agricultural, Religious Government , Education	$0	$24,941

Source: Hazus-MH MR4/ Note: These totals include Fulton County and the entire Village of Dolgeville

Table 3.11o: Estimated Building Value (Structure Only) Damaged by the 100-Year and 500-Year MRP Winds

Municipality	Total (All Occupancy Classes)		Percentage of Total Building Value		Residential Buildings		Commercial Buildings		Industrial Buildings	
	100 Yr	500 Yr	100 Yr	500 Yr	100 Yr	500 Yr	100 Yr	500 Yr	100 Yr	500 Yr
Bleecker (T)	$0	$32,793	0	0.1	$0	$32,501	$0	$201	$0	$51
Broadalbin (T)	$0	$161,007	0	0.1	$0	$157,972	$0	$1,483	$0	$350
Broadalbin (V)	$0	$40,379	0	0.0	$0	$37,203	$0	$1,496	$0	$565
Caroga (T)	$0	$130,892	0	0.1	$0	$129,431	$0	$899	$0	$127
Dolgeville (V)[3]	$0	$73,082	0	0.0	$0	$68,922	$0	$2,220	$0	$1,082
Ephratah (T)	$0	$51,763	0	0.1	$0	$51,194	$0	$395	$0	$174
Gloversville (C)	$0	$561,542	0	0.1	$0	$531,812	$0	$17,435	$0	$8,123
Johnstown (C)	$0	$411,809	0	0.1	$0	$381,299	$0	$17,473	$0	$8,636
Johnstown (T)	$0	$309,665	0	0.1	$0	$298,035	$0	$6,034	$0	$1,978
Mayfield (T)	$0	$223,123	0	0.1	$0	$217,506	$0	$4,003	$0	$805
Mayfield (V)	$0	$26,211	0	0.0	$0	$24,912	$0	$535	$0	$116
Northampton (T)	$0	$109,185	0	0.1	$0	$108,088	$0	$900	$0	$105
Northville (V)	$0	$50,115	0	0.1	$0	$48,326	$0	$1,118	$0	$120
Oppenheim (T)	$0	$47,425	0	0.1	$0	$45,321	$0	$734	$0	$1,000
Perth (T)	$0	$125,317	0	0.1	$0	$122,379	$0	$1,914	$0	$821
Stratford (T)	$0	$33,222	0	0.1	$0	$32,860	$0	$157	$0	$12
Fulton County	**$0**	**$2,387,530**	**0**	**0.1**	**$0**	**$2,287,762**	**$0**	**$56,996**	**$0**	**$24,066**

Source: Hazus-MH MR4

Notes:

1. Values represent values (RV) for building structure only (does not include contents).
2. The valuation of general building stock and the loss estimates determined in Fulton County were based on the default general building stock database provided in Hazus-MH MR4. The general building stock valuations provide in HAZUS-MH MR4 are Replacement Cost Value from RSMeans as of 2006.
3. These values represent the entire Village of Dolgeville.

Table 3.11p: Summary of Estimated Annualized Wind General Building Stock Losses for Fulton County

Municipality	Total (Buildings + Contents)	Buildings	Contents
Bleecker (T)	$341	$297	$22
Broadalbin (T)	$2,699	$2,356	$146
Broadalbin (V)	$783	$633	$54
Caroga (T)	$1,381	$1,197	$89
Dolgeville (V)(2)	$650	$520	$60
Ephratah (T)	$410	$347	$31
Gloversville (C)	$9,559	$7,349	$1,025
Johnstown (C)	$6,608	$4,951	$824
Johnstown (T)	$3,750	$3,037	$381
Mayfield (T)	$3,117	$2,668	$207
Mayfield (V)	$364	$309	$22
Northampton (T)	$1,699	$1,467	$109
Northville (V)	$828	$699	$59
Oppenheim (T)	$417	$336	$40
Perth (T)	$2,045	$1,752	$130
Stratford (T)	$266	$223	$20
Fulton County	**$34,917**	**$28,141**	**$3,217**

Source: Hazus-MH MR4
Notes:
(1) The valuation of general building stock and the loss estimates determined in Fulton County were based on the default general building stock database provided in Hazus-MH MR4. The general building stock valuations provided in Hazus-MH MR4 are Replacement Cost Value from RSMeans as of 2006.
(2) These values represent the entire Village of Dolgeville.

Residential buildings account for a majority of the building stock damage and also comprise the majority of the building inventory. Because of differences in building construction, residential structures are generally more susceptible to wind damage than commercial and industrial structures**. Figure 3.11j** shows the density of damage estimated for residential structures for the 500-year MRP event. As anticipated, Hazus estimates the most damage within the populated and built environments in the County.

Based on historical events and damages to Fulton County, Hazus appears to be underestimating the damages the County and its municipalities incur as a result of severe storm events.

Impact on Critical Facilities

100-Year MRP Event – Hazus-MH estimates the hospital, police departments, fire stations and schools will not suffer damage during a 100-year event. All facilities are estimated to be fully functional (no loss of use). Hazus-MH MR4 does not estimate damages to utilities or transportation features. **500-Year MRP Event –** Hazus-MH estimates the hospital, police departments, fire stations and schools have less than one-percent chance of suffering minor damage during a 500-year event. All facilities are estimated to be fully functional (no loss of use). Hazus-MH MR4 does not estimate damages to utilities or transportation features.

Impact on Economy

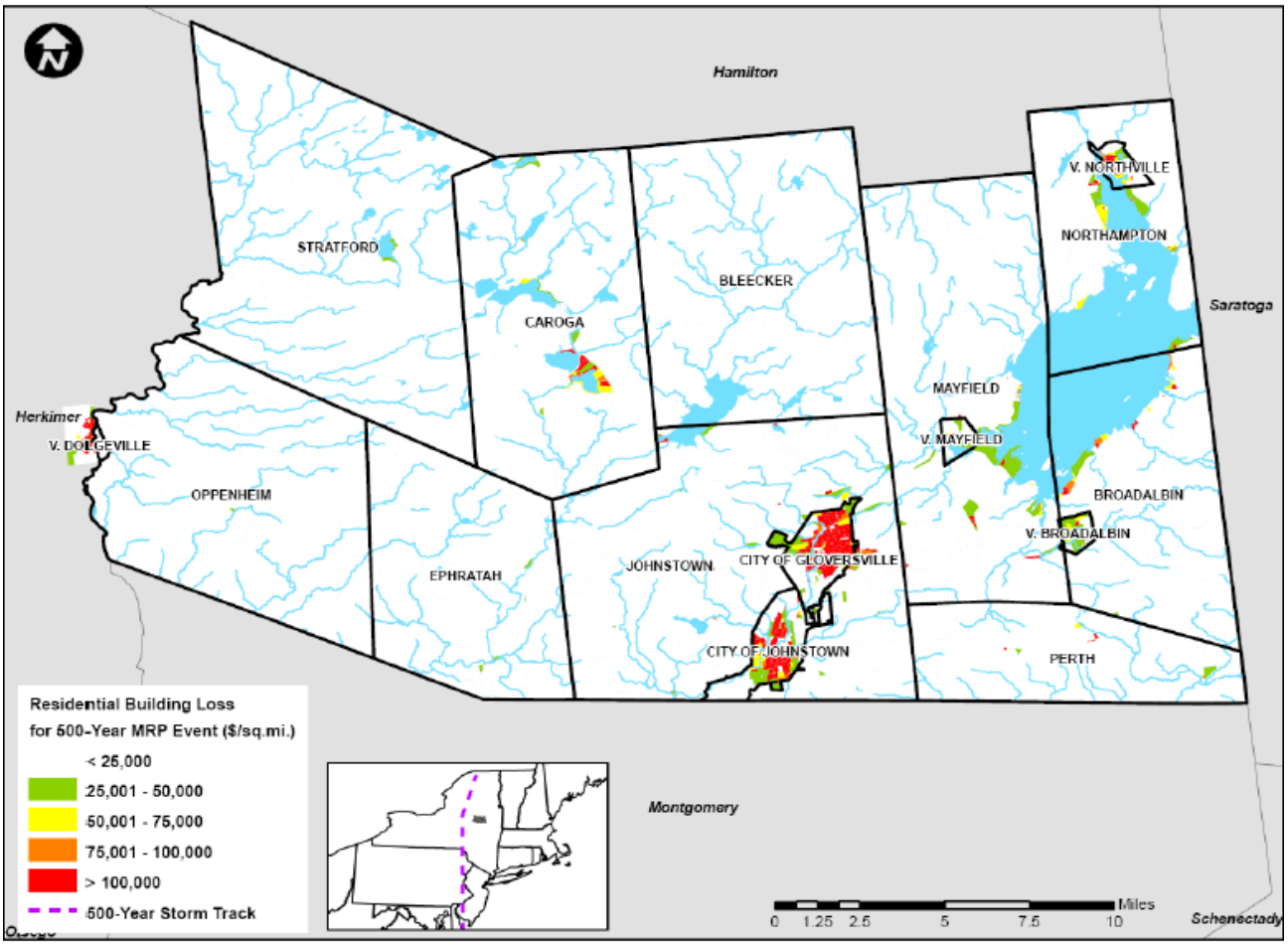
Severe storms also have impacts on the economy, including: loss of business function, damage to inventory, relocation costs, wage loss and rental loss due to the repair/replacement of buildings. Hazus-MH estimates the total economic loss associated with each storm scenario (direct building losses and business interruption losses). Direct building losses are the estimated costs to repair or replace the damage caused to the building. This is reported in the Impact on General Building Stock sub-section discussed earlier ($2,387,530). Business interruption losses are the losses associated with the inability to operate a business because of the damage sustained during the storm.

Hazus-MH MR4 does not estimate that any commercial or industrial business interruption loss will occur for the 100-year MRP event. For the 500-year MRP event, Hazus-MH estimates a loss of approximately $24,380 for the study area as a whole; associated with relocation and rental costs for residential and commercial occupancy classes. Therefore, the total building related economic losses to Fulton County is estimated at nearly $2.5 million ($2,387,530 in direct building losses and $24,380 in business interruption losses).

Transportation lifelines are not considered particularly vulnerable to the 100- and 500-year MRP severe storm wind hazard. However, utility structures could suffer damage associated with falling tree limbs or other debris. Such impacts can result in the loss of power, which can impact business operations and can impact heating or cooling provision to citizens (including the young and elderly, who are particularly vulnerable to temperature-related health impacts).

It is estimated that the impact to the economy, as a result of a severe storm event, would be considered “low” in accordance with the risk ranking shown in Section 5.3.

Figure 3.11j: Density of Losses for Residential Structures (Structure Only) for the 500-Year MRP Wind Event



Source: HAZUS-MH MR4

Future Growth and Development

As discussed in Section 4, areas targeted for future growth and development have been identified across the County. Any areas of growth could be potentially impacted by the severe storm hazard because the entire planning area is exposed and vulnerable. For the severe storm hazard, the entire County has been identified as the hazard area. Please refer to Section 4 (County Profile) and each municipality's annex (Section 9) for maps that illustrate where potential new development is located in relation to Fulton County's hazard areas.

Development in hazard prone areas

At the local level, jurisdictions have recognized their susceptibility of the occurrence of a high wind event. Although some counties seem to have higher occurrences than others the mitigating trend appears to be strictly enforcing building codes and instituting new measures that would call for the use of high wind resistant materials, hurricane clips, and wind shutters. For Instance, Nassau County has assessed their risk and exposure and although the likelihood of a tornado hitting Nassau is low their exposure is very high. They plan to limit their exposure to wind damage by strictly enforcing their building codes. Another step they are considering is requiring safe rooms in mobile home parks.

Found below is a sampling from Nassau County's future developments trends-overview from their current risk assessment. As well as an analysis that includes specific details on severe wind events and the future developments for this county.

Future Development Trends – Overview

The future land use plan for Nassau County is based on the County's existing and established downtowns and Centers, preferred development patterns, existing and proposed transportation systems and environmental features in the County. For the future, the County Comprehensive Plan recommends, in general:

- Higher intensity development generally located in areas which currently have a more dense or suburbanized character and contain adequate infrastructure, especially where such areas have access to mass transit, major roads, public sanitary sewers and water supply.
- Lower intensity development is recommended for those areas of the County which presently have a low or very low density character and more limited infrastructure capacity.
- Development of vacant parcels
- Redevelopment of currently developed parcels (wherein a site with existing buildings and/or other infrastructure is developed with new uses, new buildings, new infrastructure, or new activities)
- Redevelopment of Brownfields sites
- Transit Oriented Development
- Increased retail development. Households in Nassau County have higher than average disposable incomes, and market research generally supports the need for and sustainability of additional retail development.
- Increased office development. The Comprehensive plan notes a growth in the

County's employment combined with the further expansion of service industries in the economy and relocations of companies from New York City to the suburbs will continue to drive the need for new office space in the future. Demand is expected to be modest and not likely to increase until existing vacant office space has been more fully utilized.

Future Development Trends – Extreme Winds

The wind hazard area encompasses the entire County and is uniform from one jurisdiction to the next. Therefore, future development trends for the wind hazard area would be the same as those county-wide, as discussed under "Overview" earlier in this section.

Maximum sustained wind speeds are estimated to be approximately 10-20 miles per hour higher in southern Nassau County than in northern Nassau County. While northern areas of the county have more vacant land, development pressures have tended to be higher along southern areas of the County so it is likely that future development in the wind hazard area will increase, and will increase to the greatest extent in areas in southern Nassau County. However, new development will be built to a code which provides some degree of protection from the effects of high winds.

3.11.3 Assessing Vulnerability and Losses of State Facilities

Although state agencies maintain internal databases that identify location and value of properties within their areas of responsibility, New York State does not currently have a comprehensive data set of state-owned and operated assets that can be integrated into the GIS methodology for analysis. However, a state facilities inventory project was initiated in August 2013, which will gather information that can be used to building a comprehensive data set. The pilot phase, which will look at a specific critical facility category and develop the methodology for the project, is expected to be complete in mid-2014. At that time, the next phase of the project will be developed for what is anticipated to be a multi-year project. Found in **Section 3.1.6** is a full description of the current status and data limitations to state-owned facilities and critical infrastructures for New York State.

Tables 3.11q and **3.11r** presents the result of the wind hazard vulnerability assessment and loss analysis for State facilities. The results present a gross estimate of potential wind losses to those identified vulnerable State facilities in terms of dollar value of exposed property. The wind hazard vulnerability analysis and loss estimation methodology was supported by GIS technology and involved collaboration with key State agencies that resulted in the identification of two State databases that provide key facility information. The NYS Offices of General Services (OGS) fixed asset database and Office of Cyber Security (OCS) database included fields that provide coordinate location information and building replacement value in dollars.

The analysis process involved creation of a GIS mapping layer showing facility location using the coordinate information and overlaid on a wind hazard layer developed using the FEMA Wind-Zone map data. The Mitigation Planning Committee acknowledges its applicability may not be appropriate beyond a general indication and believes the analysis results may best be used to help target those facilities that might benefit from further analysis. Future analysis may include expressing potential loss based on historical wind loss events; continued application of GIS technology; use of Hazus-MH 2.0 wind loss estimation software created by FEMA; and continued collaboration among state agency

representatives in order to collect site and facility specific information that may improve the integrity of the wind vulnerability analysis.

Table 3.11q: Wind Hazard Exposure – FEMA Wind Zone 2 (up to 160mph) New York

Zone 2 (up to 160 mph)		
State Agency	**No. of Buildings**	**Replacement Cost**
Office of General Services (OGS)	168	$3,056,099,149
Department of Health (DOH)	61	$132,907,384
Department of Corrections and Community Supervision (DOCCS)	2,875	$1,671,012,105
Office of Parks, Recreation and Historic Preservation (OPRHP)	3,188	$727,259,801
Department of Environmental Conservation (DEC)	1,630	$141,507,005
Office of Mental Health (OMH)	543	$1,198,167,513
Office of People with Developmentally Disabilities (OPWDD)	839	$571,205,643
Division of State Police (DSP)	28	$40,112,676
Department of Military and Naval Affairs (DMNA)	79	$166,232,880
Department of Transportation (DOT)	627	$188,791,740
Office of Child and Family Services (OCFS)	162	$85,210,294
Dormitory Authority DASAS	4	$9,663,947
New York State Unified Court System (COURTS)	1	$5,132,214
Department of Labor (DOL)	3	$42,742,595
Department of Education (EDU)	11	$220,871,235
Adirondack Park Agency (APA)	1	$550,696
Total	**10,220**	**$8,257,466,877**

Source: FEMA, OGS

Table 3.11r: Wind Hazard Exposure – FEMA wind Zone 3 (up to 200mph) New York State Agency Facilities

Zone 3 (up to 200 mph)		
State Agency	**No. of Buildings**	**Replacement Cost**
Office of General Services (OGS)	7	$47,515,267
Department of Health (DOH)	2	$4,018,999
Department of Corrections and Community Supervision (DOCCS)	1,287	$943,517,798
Office of Parks, Recreation and Historic Preservation (OPRHP)	1,884	$183,611,265
Department of Environmental Conservation (DEC)	247	$24,896,945
Office of Mental Health (OMH)	82	$200,251,446
Office of People with Developmentally Disabilities (OPWDD)	605	$304,824,365
Division of State Police (DSP)	10	$7,037,269
Department of Military and Naval Affairs (DMNA)	36	$62,667,227
Department of Transportation (DOT)	322	$138,353,454
Office of Child and Family Services (OCFS)	81	$47,866,025
Other Agencies*	1	$1,308,551
Department of Education (EDU)	9	$15,740,648
Department of Agriculture and Markets (AG&MKTS)	94	$70,624,039
Department of State (DOS)	4	$6,308,976
Total	**4,671**	**$2,058,542,274**

Source: FEMA, OGS

3.11.4 Data Limitations and Other Key Documents

The Mitigation Planning Team researched the tornado hazard and its effects on New York State. Contents of this section resulted from research and outreach including the following sources:

- The National Oceanic and Atmospheric Administration (NOAA), National Climatic Data Center, http://www.outlook.noaa.gov/tornadoes/
- The National Climatic Data Center, Storm Events Database, http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms
- TornadoProject.com, http://www.tornadoproject.com/
- Spatial Hazard Events and Losses Database for the United States (SHELDUS™)
- Fulton County Local Hazard Mitigation Plan http://www.fultoncountyny.gov/hazard/hazmit.html

Please note: *data obtained from the Spatial Hazard Events and Losses Database for the United States (SHELDUS™) is a county-level hazard data set for the U.S. for 18 different natural hazard event types such thunderstorms, hurricanes, floods, and tornados. For each event the database includes the beginning date, location (county and state), property losses, crop losses, injuries, and fatalities that affected each county. The data derives from the national data source, National Climatic Data Center's monthly Storm Data publications. Using the latest release of SHELDUS™ 12.0, the database includes every loss causing and/or deadly event between 1960 through 1992 and from 1995 onward. Between 1993 and 1995, SHELDUS™ reflects only events that caused at least one fatality or more than $50,000 in property or crop damages.*

Additional Data and Next Steps for Fulton County

Over time, Fulton County will obtain additional data to support the analysis of this hazard. Data that will support the analysis would include additional detail on past hazard events and impacts, additional information on estimated frequency of these events, and future data regarding events and damages as they occur. In addition, information on particular buildings or infrastructure and their value will support updates regarding the particular assets in the County that are most vulnerable to severe storm (wind related) events. Additional utility data would support an improved assessment of potential damage for this infrastructure category.

For the severe storm events that cannot currently be directly modeled in Hazus-MH (tornado, thunderstorm, etc.), additional detailed loss data from past and future events will assist in assessing potential future losses. Based on these values and a sufficient number of data points, future losses could be modeled. Alternately, percent of damage estimates could be made and multiplied by the inventory value to estimate potential losses. This methodology is based on FEMA's How To Series (FEMA 386-2), Understanding Your Risks, Identifying and Estimating Losses (FEMA, 2001) and FEMA's Using Hazus-MH for Risk Assessment (FEMA 433) (FEMA, 2004). Finally, with time, Hazus-MH will be released with modules that address hurricane wind and associated flooding as one model and will include a tornado module. As this version of Hazus-MH is released, the County can run

analyses for the tornado hazard and re-run an analysis for an overall picture of the hurricane-associated wind and flood damages.[2]

[2] http://www.fultoncountyny.gov/hazard/hazmit.html