3.8 – Hail Storm Hazard Profile

The information below was obtained through the following sources:

- http://www.nws.noaa.gov/
- www.fema.gov
- www.nssl.noaa.gov

The following chart provides a few terms to know regarding a hailstorm

Term	Definition
Hail	Showery precipitation in the form of irregular pellets or balls of ice more than 5 mm in diameter, falling from a cumulonimbus cloud.
Hail Index	An indication of whether the thunderstorm structure of each storm identified is conducive to the production of hail.
Hail Size	Typically refers to the diameter of the hailstones. Warnings and reports may report hail size through comparisons with real-world objects that correspond to certain diameters

Hail can be produced from many different storm types. Typically hail is a cascading effect of a thunderstorm event. The following excerpt from the NOAA National Severe Storms Laboratory provides background information on the development of Hail.

> There are two ideas about hail formation. In the past, the prevailing thought was that hailstones grow by colliding with supercooled water drops. Supercooled water will freeze on contact with ice crystals, frozen rain drops, dust or some other nuclei. Thunderstorms that have a strong updraft that lifts hailstones to the top of the cloud where they encounter more supercooled water and continue to grow. The hail falls when the thunderstorm's updraft can no longer support the weight of the ice or when the updraft weakens. The stronger the updraft the larger the hailstone can grow.
>
> Recent studies suggest that supercooled water may accumulate on frozen particles near the back-side of the storm as they are pushed forward across and above the updraft by the prevailing winds near the top of the storm. Eventually, the hailstones encounter downdraft air and fall to the ground.
>
> Hailstones grow two ways: by wet growth or dry growth processes. In wet growth, a tiny piece of ice is in an area where the air temperature is below freezing, but not super cold. When the tiny piece of ice collides with a supercooled drop, the water does not freeze on the ice immediately; instead, liquid water spreads across tumbling hailstones and slowly freezes. Since the process is slow, air bubbles can escape, resulting in a layer of clear ice.
>
> Dry growth hailstones grow when the air temperature is well below freezing and the water droplet freezes immediately as it collides with the ice particle. The air bubbles are "frozen" in place, leaving cloudy ice.

Hailstones can have layers like an onion if they travel up and down in an updraft, or they can have few or no layers if they are "balanced" in an updraft. One can tell how many times a hailstone traveled to the top of the storm by counting the layers. Hailstones can begin to melt and then re-freeze together - forming large and very irregularly shaped hail. (NOAA/NSSL)

Location:

Hail storms can occur anywhere within New York State. They are typically part of a larger storm system such as a Severe Thunderstorm or Tornado event.

Extent:

The following chart provides the typical description: diameter ratio regarding hail. Warnings and reports may report hail size through comparisons with real-world objects that correspond to certain diameters:

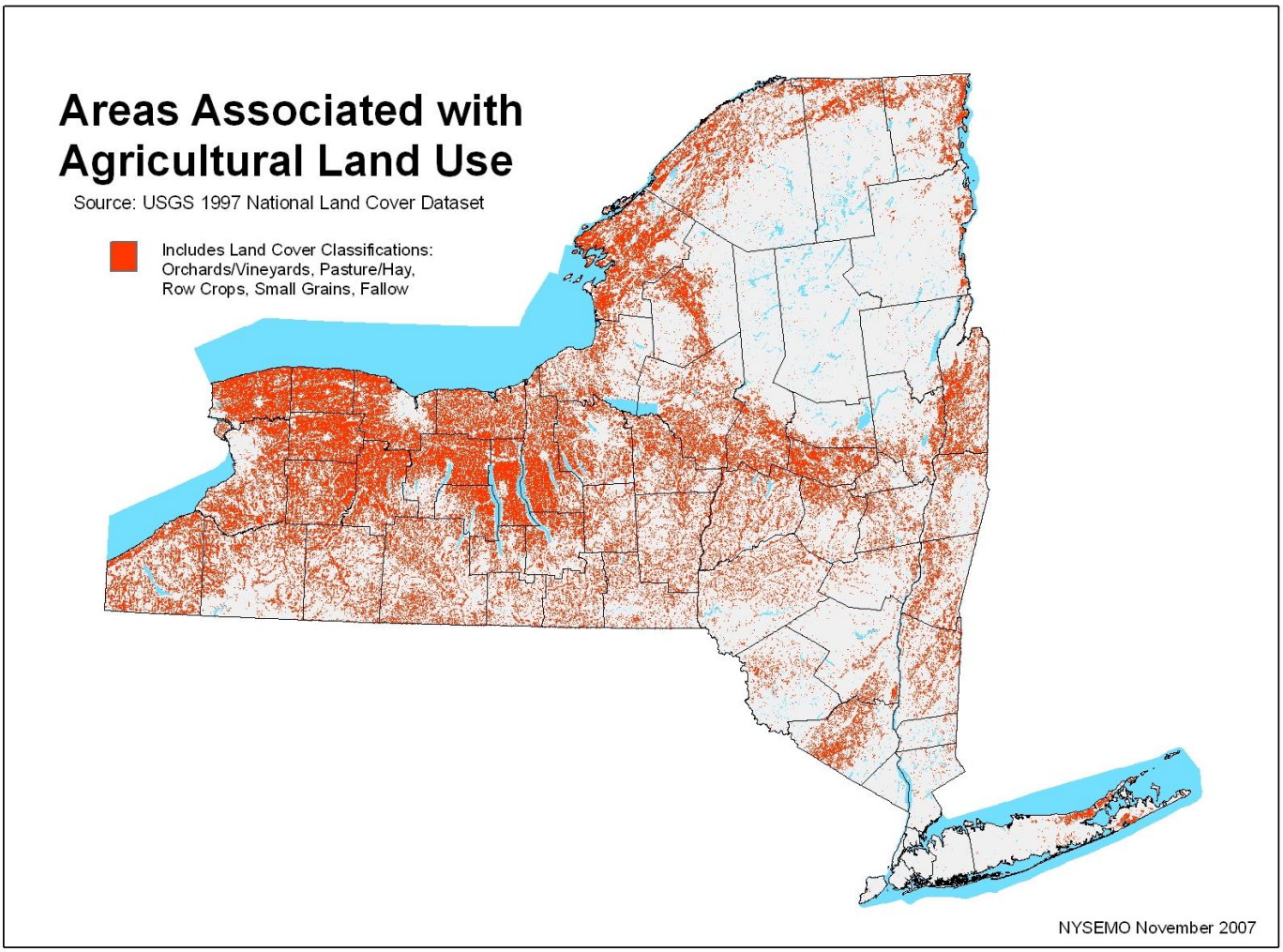
Table 3-39

Description	Diameter (inches)
Pea	0.25
Marble or Mothball	0.50
Penny or Dime	0.75
Nickel	0.88
Quarter	1.00
Half Dollar	1.25
Walnut or Ping Pong Ball	1.50
Golf ball	1.75
Hen's Egg	2.00
Tennis Ball	2.50
Baseball	2.75
Tea Cup	3.00
Grapefruit	4.00
Softball	4.50

Effects of Hail

It is estimated that damage from hail approaches $1 billion in the U.S. annually. U.S. Agriculture is typically the most affected by such hail storms because it causes severe crop damage and even a minor storm with relatively small size Hailstones can have a devastating effect. As well, damage to vehicles, roofs (residential/commercial), and landscaping are the other things most commonly damaged by hail. **Figure 3-109** portrays the agricultural land use across New York State. It is recommended that jurisdictions that have agricultural markets and industries take into account the vulnerability of the jurisdiction in regards to the affects of hail. Hail has also been known to cause injuries and occasionally has been fatal. The most deadly hailstorm on record occurred in India on April 30, 1988, killing 246 people and 1600 domesticated animals.

Figure 3-109



<u>Previous Occurrence:</u>

Hail Storm Events within New York State

The following chart provides a detailed description of previous occurrences of Hail throughout New York State between 2007 and 2010. Note that the chart is limited to the time period, to Hail size which is that of at least 1 inch, and to recorded property damages of at least one dollar. For more detailed information regarding Hail storms within New York State, please visit the following website: http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms . The NOAA National Climatic Data Center provides information on Hail events throughout New York State dating back to 1950. The Data Center has information on almost 3,000 Hail events that have taken place within the State. Since 1993 there have been approximately $3.2 million in recorded property damage as the result of Hail storms and roughly $60.1 million in crop damage since 1994. As well, since 1987 there have been roughly 89 reported injuries as the result of Hail events.

Table 3-40

National Climatic Data Center: New York State Hail Information 1/01/07 - 2/28/10, 1 Inch or Greater w/ at Least $1 in Property Damage				
Location or County	**Date**	**Mag**	**PrD**	**CrD**
1 Canastota	8/3/2007	2.50 in.	20K	0K
2 Earlville	8/3/2007	1.75 in.	15K	0K
3 Beekmantown	8/16/2007	1.75 in.	50K	0K
4 Oriskany	8/16/2007	1.50 in.	10K	0K
5 Careys Corners	8/16/2007	1.75 in.	10K	0K
6 Careys Corners	8/16/2007	1.75 in.	10K	0K
7 Rome	8/16/2007	1.75 in.	10K	0K
8 Romulus	8/16/2007	1.75 in.	10K	0K
9 Forestville	8/23/2007	1.00 in.	10K	0K
10 Nunda	8/24/2007	1.50 in.	11K	0K
11 Paradox	8/30/2007	2.75 in.	20K	0K
12 Moriah	8/30/2007	1.75 in.	5K	0K
13 Rochester	4/26/2008	1.00 in.	2K	0K
14 Vernon	5/31/2008	1.25 in.	2K	0K
15 North Tonawanda	6/16/2008	1.00 in.	20K	240K
16 Pultneyville	6/16/2008	1.00 in.	25K	4.0M
17 East Williamson	6/16/2008	1.00 in.	25K	4.0M
18 Sodus	6/16/2008	1.00 in.	25K	4.0M
19 Alton	6/16/2008	1.50 in.	25K	4.0M
20 West Shelby	6/16/2008	1.25 in.	50K	8.0M
21 North Tonawanda	6/16/2008	1.00 in.	20K	240K
22 Cato	6/16/2008	1.25 in.	25K	500K
23 Amherst	6/16/2008	1.00 in.	50K	100K
24 Clarence	6/16/2008	1.50 in.	50K	100K
25 Amherst	6/16/2008	1.50 in.	50K	100K
26 Falconwood	6/16/2008	1.50 in.	50K	100K
27 Alden	6/16/2008	1.00 in.	50K	100K
28 South Newstead	6/16/2008	1.00 in.	50K	100K
29 Newark	6/16/2008	1.00 in.	25K	4.0M
30 Port Gibson	6/16/2008	1.50 in.	50K	1.0M
31 Byron	6/16/2008	1.00 in.	60K	3.0M
32 Falconwood	6/16/2008	1.00 in.	50K	100K
33 Snyder	6/16/2008	1.75 in.	50K	100K
34 Falconwood	6/16/2008	1.00 in.	50K	100K
35 Amherst	6/16/2008	1.25 in.	50K	100K
36 Cheektowaga	6/16/2008	1.00 in.	50K	100K
37 Depew	6/16/2008	1.50 in.	50K	100K
38 Alden	6/16/2008	1.00 in.	50K	100K
39 Lyons	6/23/2008	1.00 in.	8K	25K
40 Cheektowaga	6/29/2008	1.00 in.	8K	0K
41 North Ridge	7/16/2008	1.75 in.	10K	5K
42 Gasport	7/16/2008	1.00 in.	10K	5K
43 Palmyra	7/21/2008	1.00 in.	10K	5K
44 Henrietta	7/23/2008	1.00 in.	10K	0K
45 Farmington	7/23/2008	1.50 in.	5K	15K
46 South Wales	7/23/2008	1.00 in.	10K	5K
47 Scriba	7/24/2008	1.00 in.	5K	5K
48 Wolcott	7/26/2008	1.00 in.	5K	5K

49 Cattaraugus	8/2/2008	1.00 in.	8K	10K
50 North Tonawanda	8/7/2008	1.00 in.	10K	0K
51 Sterling	8/10/2008	1.00 in.	15K	0K
52 Victor	8/10/2008	1.75 in.	20K	0K
53 Oswego	8/10/2008	1.00 in.	10K	0K
54 Scriba	8/10/2008	1.25 in.	10K	10K
55 Scriba	8/10/2008	1.25 in.	10K	10K
56 Throggs Neck	8/11/2008	1.75 in.	15K	8K
57 Deer River	8/18/2008	1.00 in.	10K	0K
58 Walworth	5/9/2009	1.00 in.	5K	0K
59 Williamsville	7/25/2009	1.00 in.	15K	0K
60 Strykersville	8/4/2009	1.00 in.	3K	5K
		TOTALS:	1.397M	34.393M

Source: NOAA, National Climatic Data Center

Probability of Future Events:

Forecasting Hail

To forecast hail, deep moist convection is required, in addition to these three basic ingredients (1) adequate updraft to keep the hailstone aloft for an appropriate amount of time, (2) sufficient supercooled water near the hailstone to enable growth as it travels through an updraft, and (3) a piece of ice or snow for it to grow upon. The following probability information was obtained from the National Severe Storms Laboratory (NSSL), http://www.nssl.noaa.gov/cgi-bin/hazgraph3.pl

Time Series of Hail Annual Cycle Probability

The graph below shows the probability of a hail event occurring on any given day for New York State. For example, a y value of 2 would indicate a two percent chance of a hail event on the date indicated by the x-axis value. (Max Scale Values are 0.5%, 2.5%, or 10%)

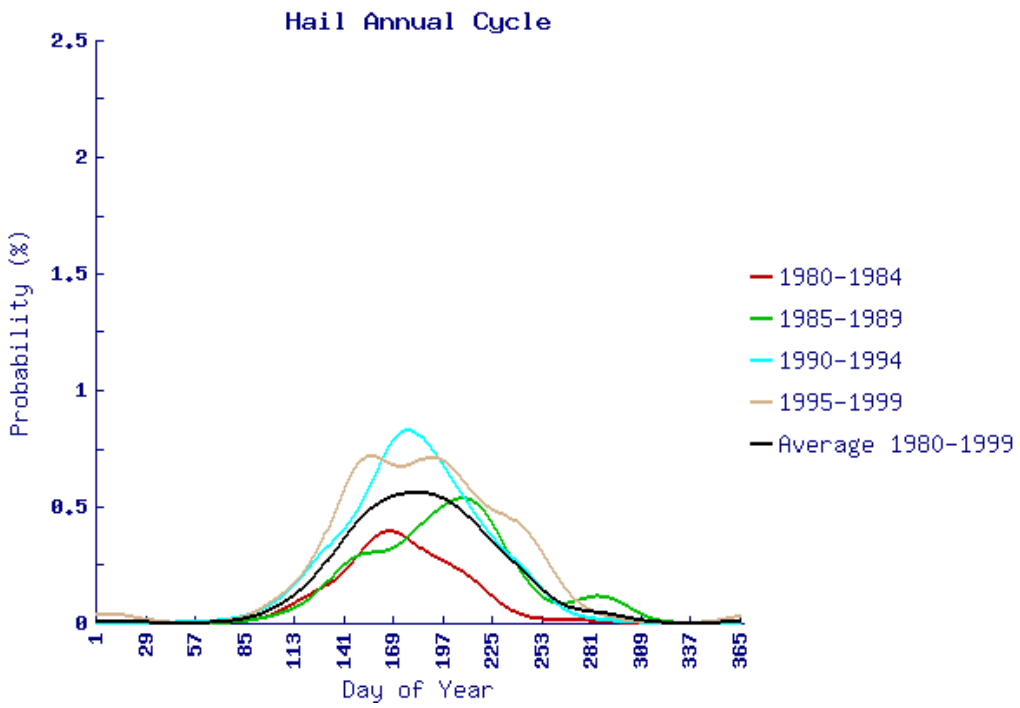
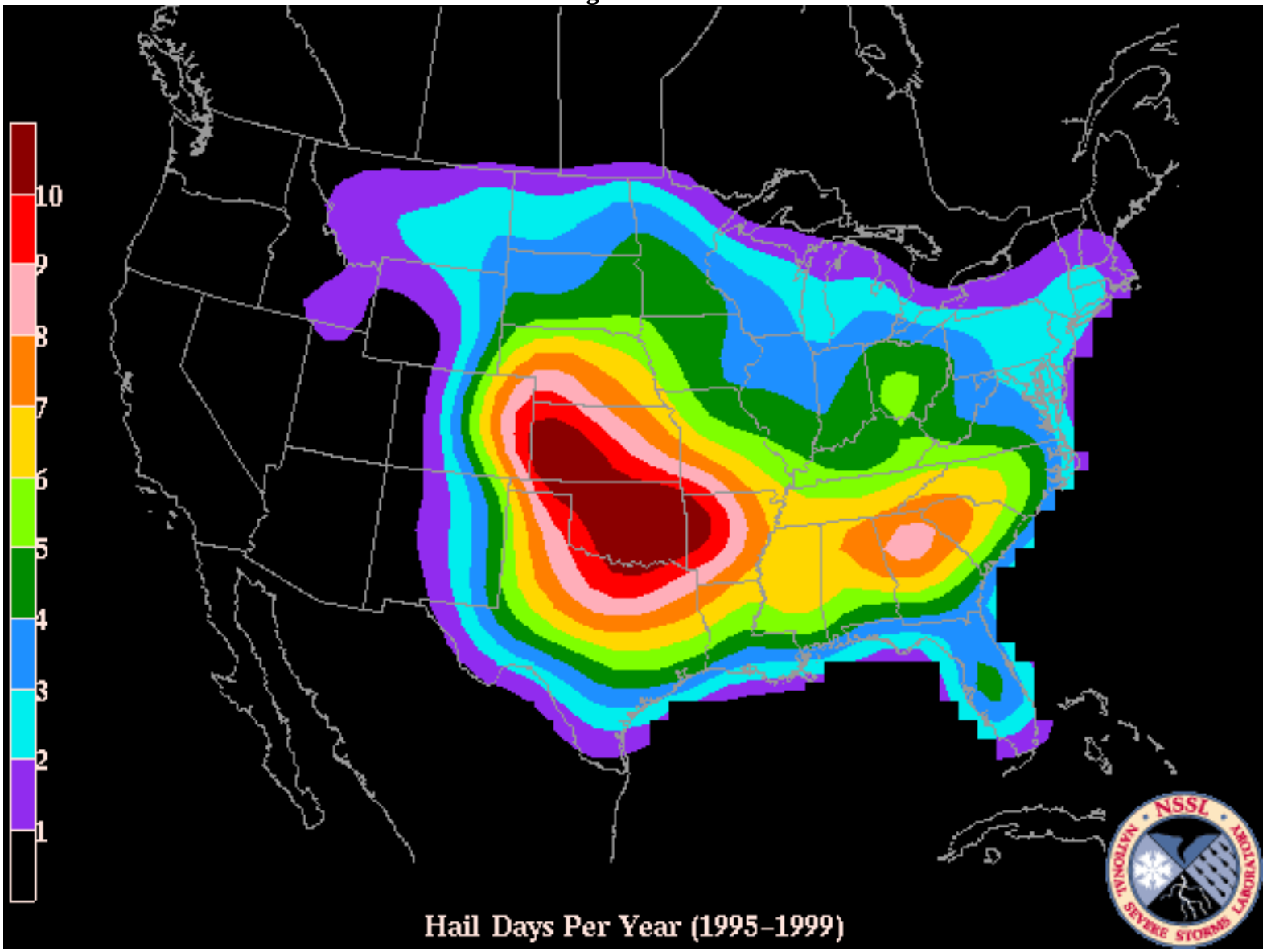


Figure 3-110



(The mean number of days per year with one or more events within 25 miles of a point is shown here. The fill interval is 1, with the purple starting at 1. For the significant (violent), its 5 days per century (millennium), Source: NSSL)

After reviewing and evaluating the information from the Nation Severe Storms Laboratory and referencing past event histories, it can be said that New York State can expect to receive a minimum of two damaging Hail storms per year.

Vulnerability:

Vulnerability to Hail storm events can vary greatly. The effects of such storms have proven to have detrimental affects on urban to rural communities. The NOAA database first records damages dating to May 1993. Total recorded property damages to occur since then have totaled $9.4 million and total recorded crop damages as $60.5 million. Using this information, annualized losses are determined to be $555,647 for Property and $3,539,058 for Crops.

Methodology: Damage Totals/Years, $9,446,000/17

A Vulnerability Assessment for property can be quite difficult for Hail Storms. Annualized Crop Loss estimates were used given the data on previously recorded events and the availability of New York State Crop related information.

To provide County Annualized Loss Estimates the 2007 All Crops Cash Receipts from Farm Marketings was obtained from the United States Department of Agriculture National Agricultural Statistics Service.

Table 3-41
Annualized Crop Losses from Hail by County

County	Cash Receipts from Farm Marketing's 2007 (All Crops)	Annualized Loss (Total x Annualized Loss % (.2%))
Albany County	$13,940,000	$27,880
Allegany County	$15,972,000	$31,944
Bronx County	N/A	N/A
Broome County	$9,429,000	$18,858
Cattaraugus County	$24,615,000	$49,230
Cayuga County	$53,516,000	$107,032
Chautauqua County	$54,400,000	$108,800
Chemung County	$6,047,000	$12,094
Chenango County	$9,891,000	$19,782
Clinton County	$27,527,000	$55,054
Columbia County	$27,266,000	$54,532
Cortland County	$6,841,000	$13,682
Delaware County	$12,590,000	$25,180
Dutchess County	$30,838,000	$61,676
Erie County	$8,700,000	$17,400
Essex County	$5,592,000	$11,184
Franklin County	$11,059,000	$22,118

Fulton County	$2,237,000	$4,474
Genesee County	$72,247,000	$144,494
Greene County	N/A	N/A
Hamilton County	N/A	N/A
Herkimer County	$11,795,000	$23,590
Jefferson County	$19,345,000	$38,690
Kings County	N/A	
Lewis County	$13,429,000	$26,858
Livingston County	$44,139,000	$88,278
Madison County	$13,398,000	$26,796
Monroe County	$65,784,000	$131,568
Montgomery County	$16,578,000	$33,156
Nassau County	N/A	N/A
New York County	$557,000	$1,114
Niagara County	$58,005,000	$116,010
Oneida County	$35,250,000	$70,500
Onondaga County	$38,160,000	$76,320
Ontario County	$56,467,000	$112,934
Orange County	$59,803,000	$119,606
Orleans County	$87,972,000	$175,944
Oswego County	$26,143,000	$52,286
Otsego County	$11,687,000	$23,374
Putnam County	$3,360,000	$6,720
Queens County	N/A	N/A
Rensselaer County	$18,031,000	$36,062
Richmond County	N/A	N/A
Rockland County	$4,317,000	$8,634
St. Lawrence County	$17,342,000	$34,684
Saratoga County	$15,480,000	$30,960
Schenectady County	$3,526,000	$7,052
Schoharie County	$11,693,000	$23,386
Schuyler County	$7,189,000	$14,378
Seneca County	$27,831,000	$55,662
Steuben County	$42,353,000	$84,706
Suffolk County	$255,862,000	$511,724
Sullivan County	$5,626,000	$11,252
Tioga County	$9,954,000	$19,908
Tompkins County	$14,371,000	$28,742
Ulster County	$41,489,000	$82,978

Warren County	N/A	N/A
Washington County	$20,549,000	$41,098
Wayne County	$105,346,000	$210,692
Westchester County	$12,123,000	$24,246
Wyoming County	$50,845,000	$101,690
Yates County	$31,635,000	$63,270
Other Counties	$14,593,000	$29,186
Total	$1,664,734,000	$3,329,468

The Annualized Loss percentage is gathered by dividing the Annualized Loss Value calculated using the NOAA database information by the total Cash Receipts
Annualized Loss % = (Damage Totals (Crops)/Years) / Total State Cash Receipts (Crops)
Source: USDA NASS and NOAA

Mitigation Activities

FEMA recommends the following mitigation approaches regarding Hail, which are very similar to those of a thunderstorm or windstorm. They include:

1. Building Codes
2. Public Awareness
3. Weather warning system improvements and modernization

It is recommended that Local Jurisdictions do ample research into the effects a Hail storm may have on their residents and property to determine whether any of the mitigation approaches might be effective. Additionally, the following excerpt taken from the Colorado Department of Local Affairs website, http://www.dola.state.co.us/dem/public_information/hail.htm, provides recommended Safety Tips.

Hail Safety Tips

If you are in an automobile:

- Stop driving. If you can see a safe place close by (e.g., inside a garage, under a highway overpass, or under a service station awning), drive there as soon as you can. Make sure you pull completely off the highway.
- Do NOT leave the vehicle until it stops hailing. Your car will furnish reasonable protection.
- Stay away from car windows. Cover your eyes with something (like a piece of clothing). If possible, get onto the floor face down, or lie down on the seat with your back to the windows. Put very small children under you, and cover their eyes.

If you are in a building:

- Stay inside until the hail stops.
- Stay away from the windows, especially those being struck by hail.
- Account for all family members, building occupants, pets, etc.
- Do not go outside for any reason. Large hail can cause serious or even fatal injuries.
- Avoid using phones and electrical appliances during a severe storm to avoid the danger of electrocution from lightning.

If you are outdoors:

- If you are caught outdoors, seek shelter immediately. If you can't find something to protect your entire body, at least find something to protect your head.
- Stay out of culverts and lowland areas that might fill suddenly with water.
- Trees are a last resort. It is common during severe storms for trees to lose branches. Also, large isolated trees attract lightning.