



Appendix D. Recent FEMA Disaster Declarations



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Between 1954 and 2012, New Jersey has been included in 49 FEMA major disaster declarations (DR), emergency declarations (EM), or fire management assistance declarations (FMA). The 2011 State Plan discussed FEMA declarations in New Jersey that occurred between September 1999 and December 2010. For this Plan update, FEMA declarations for New Jersey that occurred between January 1, 2011 and December 31, 2012 will be described further in this Appendix. With documentation being so extensive, not all sources have been identified or researched. Therefore, not all information may be included in the descriptions below.

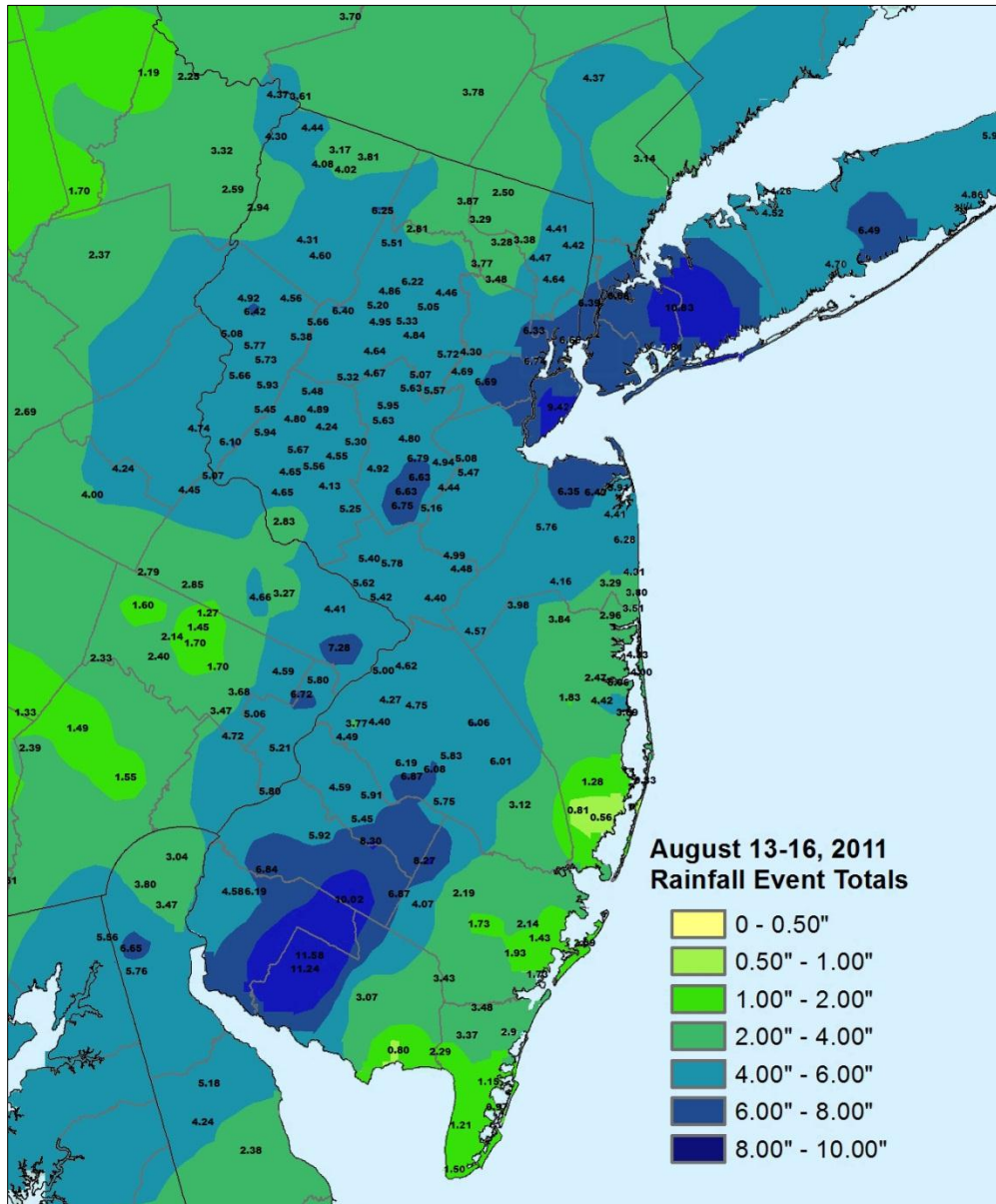
DR-4033 – Severe Storm and Flooding – August 2011

Between August 13 and 14, 2011, heavy rains brought flash flooding and flooding of several moderate-sized rivers in southwest and central New Jersey. Eastern Salem, western Cumberland, eastern Gloucester, eastern Camden, and western Atlantic Counties were especially hit hard. Roads and several dams were overtopped or destroyed in these counties. Rainfall totals in these counties included 10.82 inches in Upper Deerfield Township (Cumberland County), 8.53 inches in Franklin Township (Gloucester County), 8.04 inches in Winslow Township (Camden County), and 7.51 inches at Hammonton (Atlantic County). Wind gusts downed trees and wires in some locations. A wind gust of 40 miles per hour (mph) was observed at Seaside Heights (Ocean County).

Storms continued in New Jersey on August 15 and impacted those areas that were not damaged from the storms on August 13 and 14, 2011. Rainfall totals included 3.63 inches at Hardyston Township (Sussex County), 3.12 inches in Rockaway Township (Morris County), and 3.40 inches in Upper Township (Cape May County). Pea size hail was reported in Bridgewater Township (Somerset County). Moderate flooding was observed in Sussex and Somerset Counties. On August 16, nearly an inch of rain fell at Buena Vista Township (Atlantic County) and 0.68 inches fell in Rumson (Monmouth County). Figure D-1 shows the rainfall totals for this event.



Figure D-1. August 13-16, 2011 Rainfall Event Totals



Source: Office of the New Jersey State Climatologist (ONJSC) 2011

As a result of the heavy rains, many rivers, creeks and streams crested, reaching near-record flood stage. The Great Egg Harbor at Folsom crested at 8.2 feet on August 16 and the Maurice River at Norma, which drains both Cumberland and Salem Counties, crested at 6.3 feet on August 16, 2011.

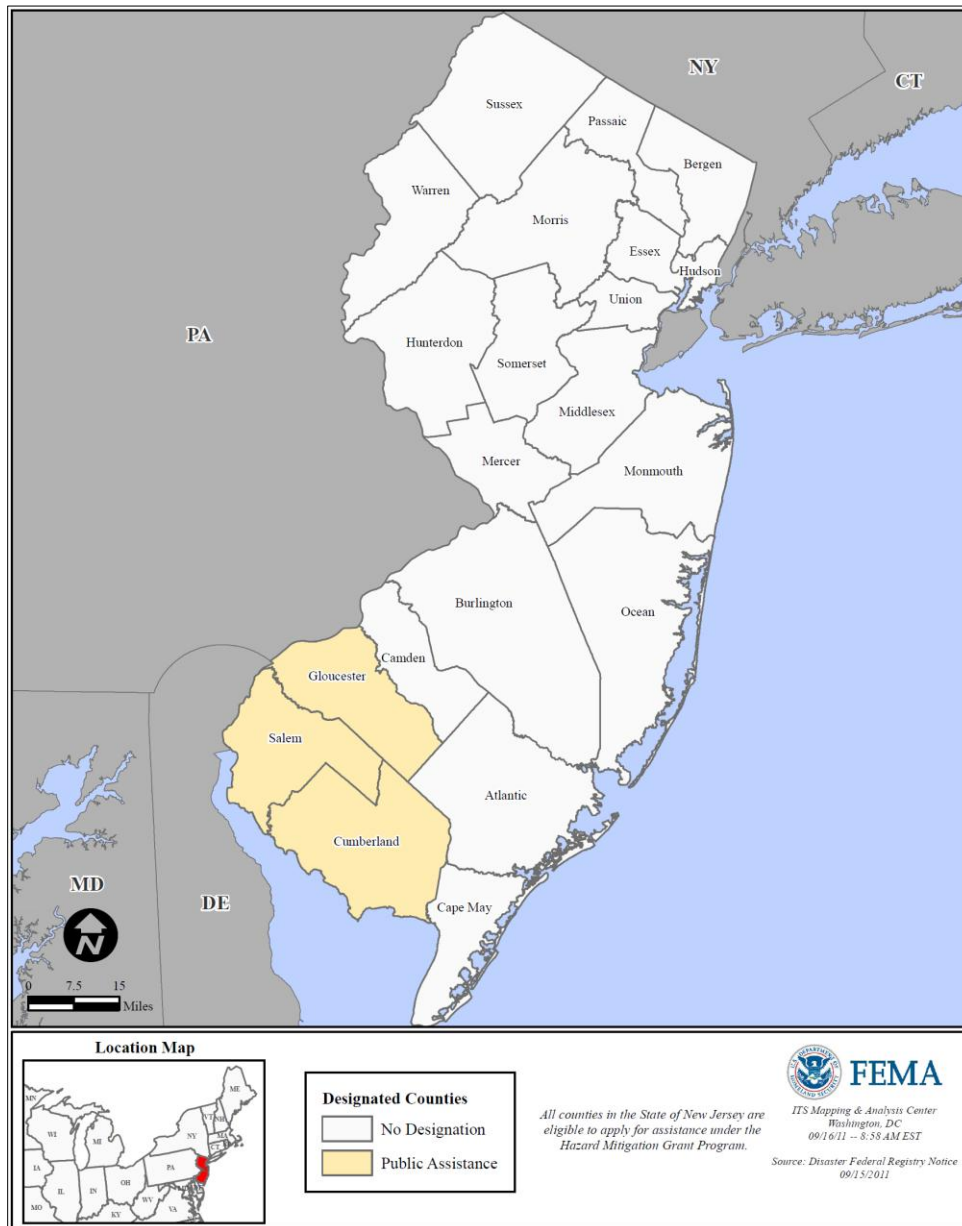
Several dams were affected by this event. In Cumberland County, the Sunset Lake and Raceway Dams in Bridgeton City either breached or failed. The Seelys Mill Pond Dam and Bostwick Dam in Upper Deerfield Township remained intact; however, created significant hazards due to roadways located above the dams. In Salem County, the Elmer Dam in Elmer Borough and the Palatine, Centeron Lake, Parvins Mill and Rainbow Lake dams in Pittsgrove Township, were either breached or held, but presented significant hazard levels because of the roadways above.



In Cumberland, Gloucester, and Salem Counties, more than 181 homes were damaged. Specifically, 33 homes received major damage, 116 homes received minor damage, and 32 homes were considered affected. Many bridges, dams, and roadways were washed away in these counties and Rowan University in Gloucester County sustained substantial water damage.

Overall, this severe storm event resulted in 1 death and over \$25 million in property damages in New Jersey (NOAA-NCDC 2013). FEMA declared a major disaster declaration (DR-4033) for New Jersey, which included Cumberland, Gloucester, and Salem Counties. Figure D-2 shows the designated areas for the FEMA disaster. FEMA obligated a total of \$4,513,243.21 in public assistance (PA) grants.

Figure D-2. Designated Areas for Severe Storm and Flooding, FEMA-DR-4033



Source: FEMA 2011

Note: The yellow indicate the counties that received Public Assistance



FEMA DR-4021 - Hurricane Irene – August 2011

Hurricane Irene struck the State of New Jersey between August 27 and 28, 2011 and moved up the coast, bringing hurricane-force winds and torrential rainfall. Irene was reclassified as a tropical storm prior to making landfall in New Jersey. The storm caused the largest coastal evacuation in State history, record flooding on many rivers, power outages over 700,000 residents, and at least 12 fatalities.

At least one million residents and visitors were evacuated from coastal counties, from Cape May County to Monmouth County. During the storm, rainfall rates exceeded over one inch per hour, with flash flooding becoming a dangerous hazard. Tropical storm force winds throughout New Jersey brought down numerous trees and power lines, resulting in power outages and structural damages. Along the coast, winds gusted at near hurricane force, reaching 69 mph at Harvey Cedars (Ocean County), 66 mph at the Atlantic City Marina (Atlantic County), and 65 mph at Point Pleasant (Ocean County). Inland, gusts ranged between 40 and 60 mph (ONJSC 2011).

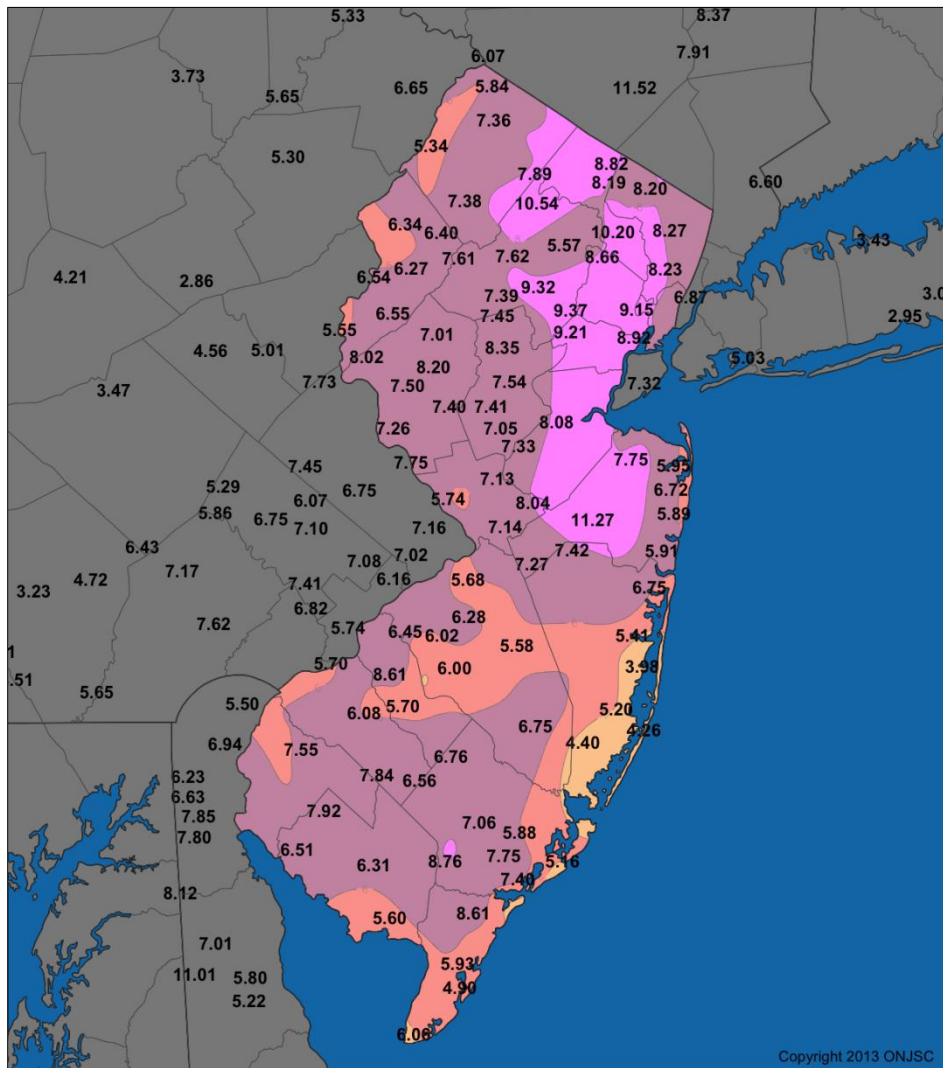
Rainfall totals ranged between 2.13 inches in York Haven and 11.52 inches in Monroe (Figure D-3), which caused major flooding and beach erosion. The statewide rainfall average was approximately 7 inches. Irene was New Jersey's largest rainstorm in over a century. Six weather stations had their highest one-day rainfall totals on August 28, 2011 (ONJSC 2011).

- Canistear Reservoir (Sussex County) – 6.98 inches
- Lambertville (Hunterdon County) – 7.5 inches
- Oak Ridge Reservoir (Morris County) – 7.58 inches
- Hightstown (Mercer County) – 7.89 inches
- New Brunswick (Middlesex County) – 7.96 inches
- Freehold/Marlboro (Monmouth County) – 8.23 inches (ONJSC 2011)

The rain resulted in streams and rivers rising to record or near-record stages. Homes, businesses, and roadways were inundated throughout New Jersey. The Passaic River at Little Falls (Passaic County) crested at approximately 14.2 feet. This is the second highest level on record, only behind the October 10, 1903 crest of 17.5 feet and surpassing 12.9 feet on April 7, 1984. At Bound Brook (Somerset County), the Raritan River crested at 41.9 feet, just behind the 42.1 feet reached on September 17, 1999 following Hurricane Floyd (ONJSC 2011).



Figure D-3. Tropical Storm Irene Storm Total Precipitation, 2011



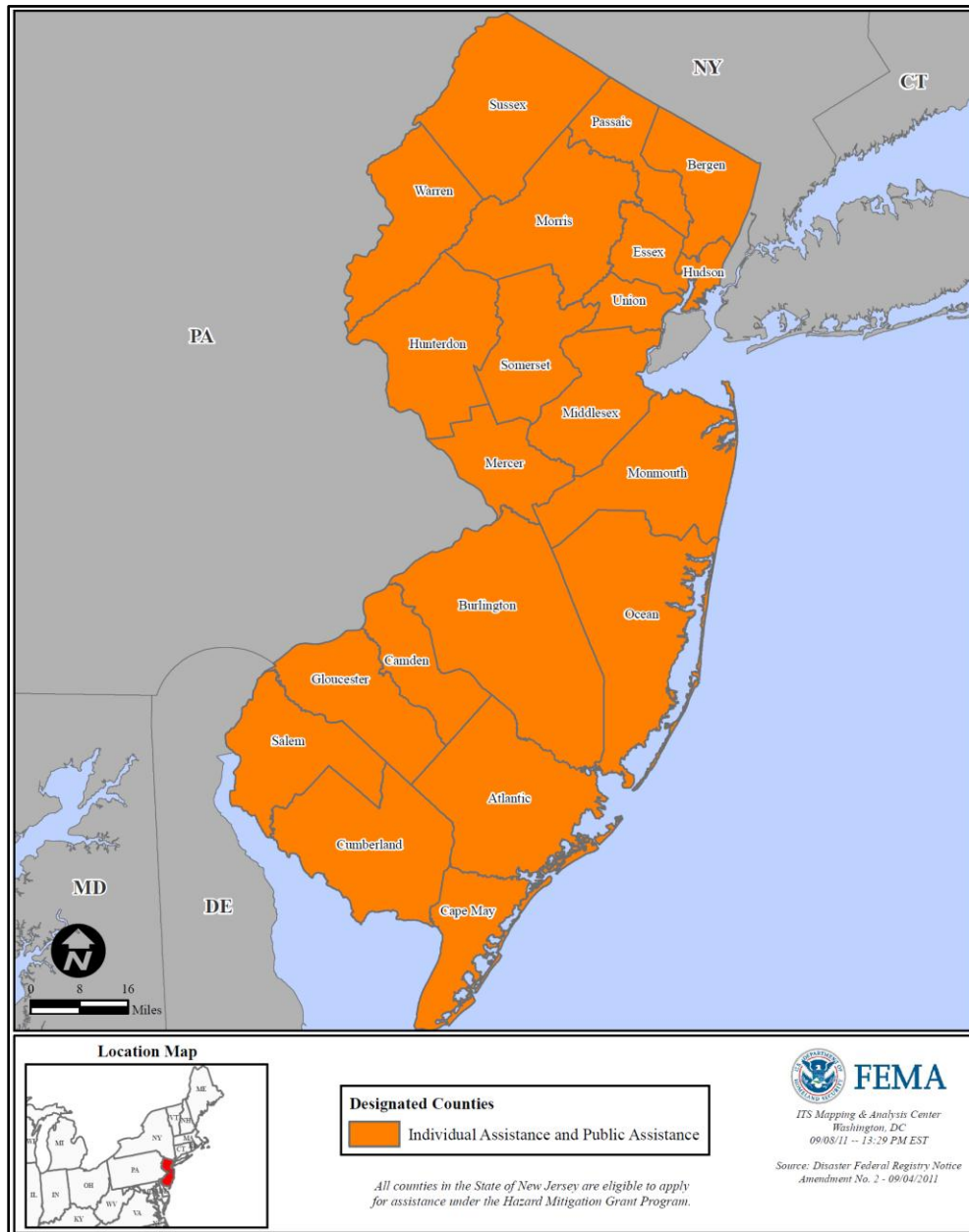
Source: ONJSC 2013

The torrential rains flooded both major and local roadways, causing hundreds of road closures and impeded travel. Portions of State Route 3 in Bergen County; U.S. 46 in Essex County; and I-80, State Route 20, State Route 23, U.S. 202 and U.S. 64 in Passaic County, all remained flooded into early September. In Morris County, a portion of I-287 collapsed. An aerial survey of Bergen, Essex, Morris, Passaic, and Somerset Counties was performed on August 30, 2011. This survey found that at least 2,080 homes suffered major damage, including damage to homes in areas not impacted by past flood events. This damage made it impossible for individuals to return to their homes for an extended period of time.

Overall, Hurricane Irene resulted in 7 deaths and over \$760 million in property damages (ONJSC 2013). FEMA declared a major disaster declaration (DR-4021) for New Jersey, which included all 21 counties in the State. Figure D-4 shows the designated areas for the FEMA disaster. FEMA received a total of 49,280 individual assistance (IA) applications and approved a total of \$176,949,241.27 for IA. FEMA obligated a total of \$114,498,277.19 in public assistance (PA) grants.



Figure D-4. Designated Areas for Hurricane Irene, FEMA-DR-4021



Source: FEMA 2013

DR-4039 – Remnants of Tropical Storm Lee – September 2011

The remnants of Tropical Storm Lee arrived in New Jersey on September 5, 2011, bringing heavy rains throughout the State. A flood watch for several counties (Hunterdon, Mercer and Sussex Counties) was in effected from September 5 through September 7. On September 6, the NWS issued an alert on the increased threat of moderate to major flooding.

By September 7, 2011, three to five inches of rain fell across the State. Continued flood warnings were issued for rivers in Hunterdon and Passaic Counties. Evacuations and sheltering activities were ongoing in several



counties. As a result of the heavy rains, major flooding of the Passaic River occurred in Little Falls and Pine Brook, the Pompton River at Pompton Plains, and moderate flooding along parts of the Delaware River.

The flooding caused road closures across New Jersey, including:

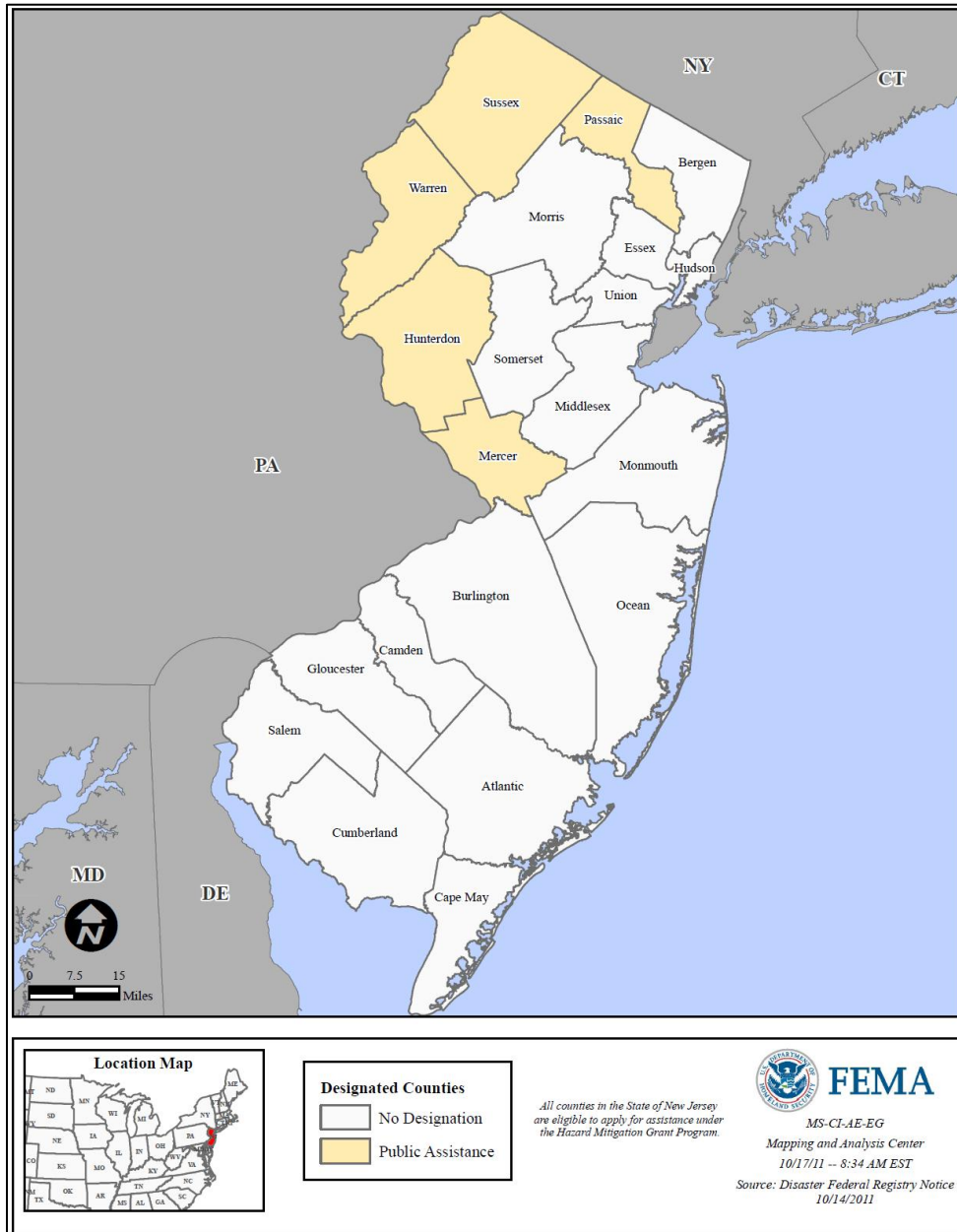
- Hunterdon County – I-78, U.S. 22, and State Routes 29 and 179
- Mercer County – I-95, U.S. 1 and State Routes 175 and 29
- Passaic County – State Routes 20 and 23
- Warren County – State Route 57 and U.S. 46
- Sussex County – State Routes 15, 182, and 57

The Delaware River Joint Toll Bridge Commission closed four bridges into Pennsylvania on September 8: New Hope-Lambertville Bridge, the Centre Bridge-Stockton Bridge, the Uhlerstown-Frenchtown Bridge, and the Lumberville-Raven Rock Pedestrian Bridge. The City of Trenton evacuated approximately 1,200 residents in the area of Riverside Drive and Lee Avenue. The Rivers Edge Apartments in Ewing Township had approximately 300 residents displaced. The New Jersey Department of Treasury initiated emergency protective measures to minimize damage at the State House in the City of Trenton.

Overall, New Jersey had approximately \$10 million in property damage from the remnants of Tropical Storm Lee (NOAA-NCDC 2013). FEMA declared a major disaster declaration (DR-4039) for New Jersey, which included five counties (Hunterdon, Mercer, Passaic, Sussex, and Warren Counties). Figure D-4 shows the designated areas for the FEMA disaster. FEMA obligated a total of \$4,152,279.29 in public assistance (PA) grants.



Figure D-5. Designated Areas for Remnants of Tropical Storm Lee, FEMA-DR-4039



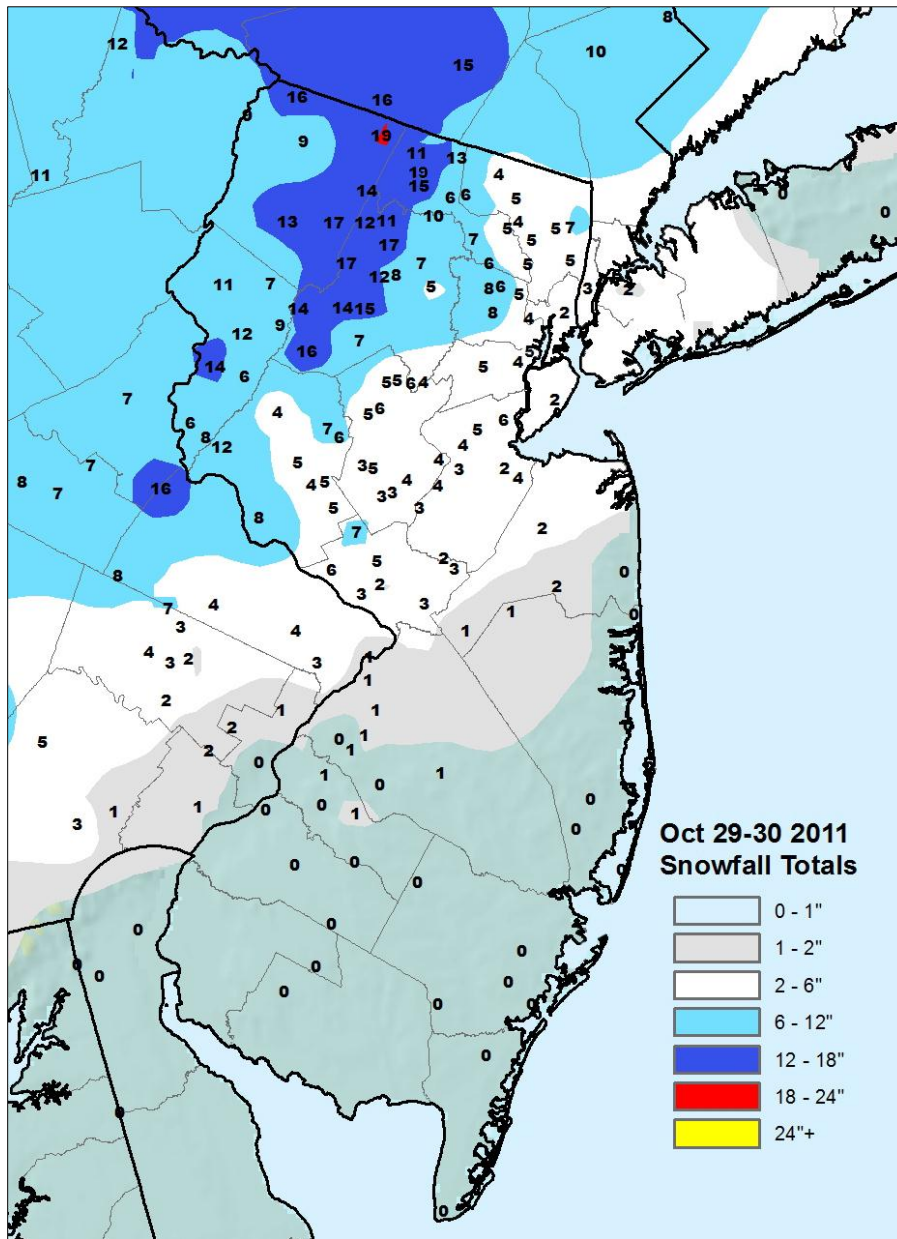
Source: FEMA 2011



DR-4048 – Severe Storms – October 2011

Rain began to fall in southern New Jersey early on October 29, 2011 and spread north. Some northern areas of the State saw the precipitation begin as snow and during the morning, the rain turned to snow in central and northern New Jersey. Moderate to heavy snow continued into the afternoon, mixing with sleet in lower elevations. Once the snow tapered off during the morning of October 30, 2011, New Jersey had experienced its largest October snowstorm since the late 18th century. Snowfall totals ranged from 0.2 inches in several locations to 19.1 inches in Vernon Township (Sussex County) (record storm total). Several other locations broke records for October snowfall totals (ONJSC 2011). Figure D-6 shows the snowfall totals throughout the State.

Figure D-6. October 29-30, 2011 Snowfall Totals



Source: ONJSC 2011

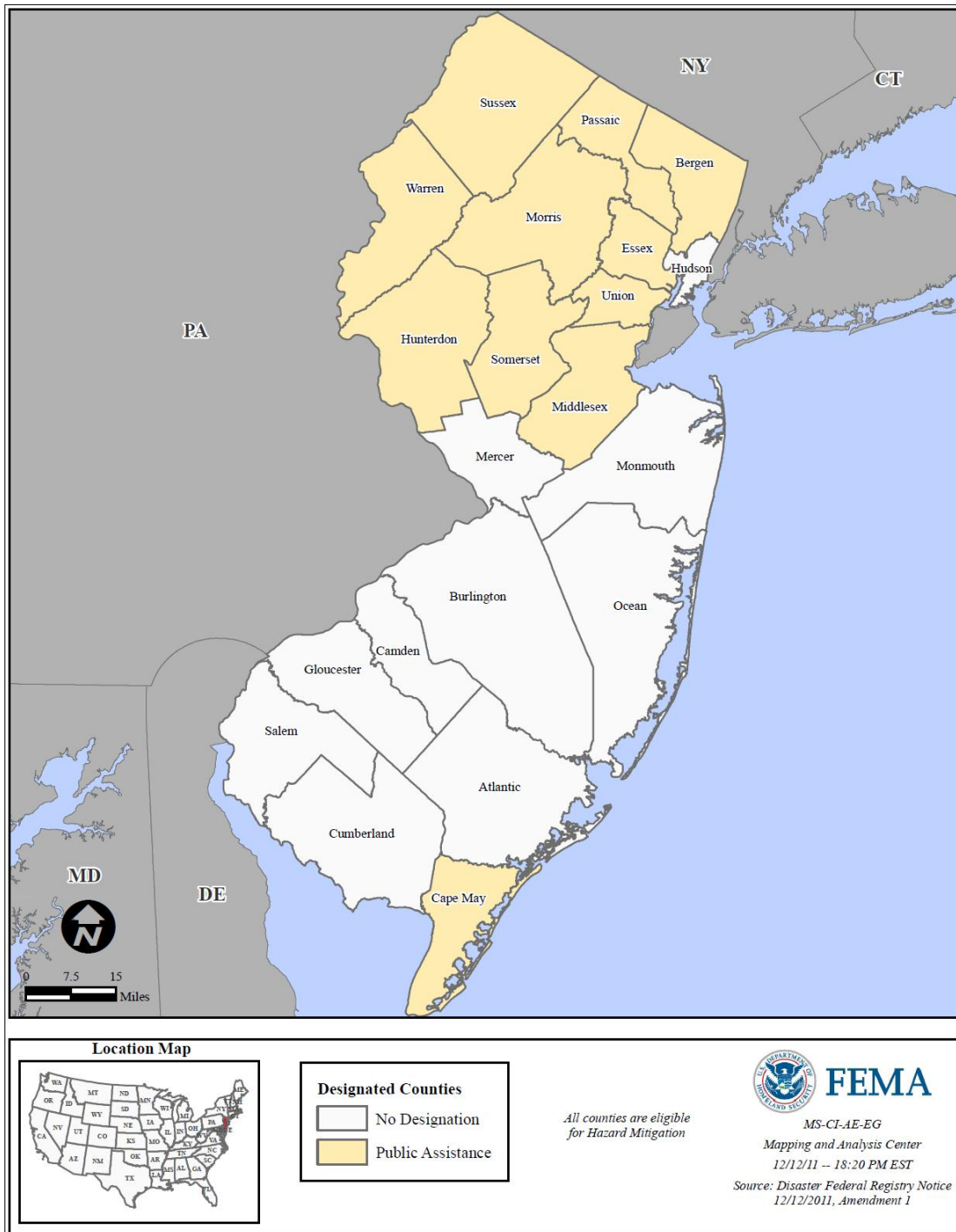


Once several inches of snow had accumulated, tree branches and entire trees began to snap and crash onto homes, power lines and cars. By the end of the storm, over 600,000 customers lost power, with some remaining without power for over a week. The areas impacted by snow did not experience large wind gusts. However, areas along the shore did. Wind gusts of 56 mph were observed at the Atlantic City Marina (Atlantic County), 51 mph at Seaside Heights (Ocean County), 49 mph at Harvey Cedars (Ocean County), 40 mph at Point Pleasant (Ocean County), and 40 mph at Bivalve (Cumberland County) (ONJSC 2011).

Overall, this severe storm event resulted in eight deaths (ONJSC 2011). FEMA declared a major disaster declaration (DR-4048) for New Jersey, which included 11 counties (Bergen, Cape May, Essex, Hunterdon, Middlesex, Morris, Passaic, Somerset, Sussex, Union, and Warren). Figure D-7 shows the designated areas for the FEMA disaster. FEMA obligated a total of \$24,843,185.64 in public assistance (PA) grants.



Figure D-7. Designated Areas for the Severe Storm, FEMA-DR-4048



Source: FEMA 2011

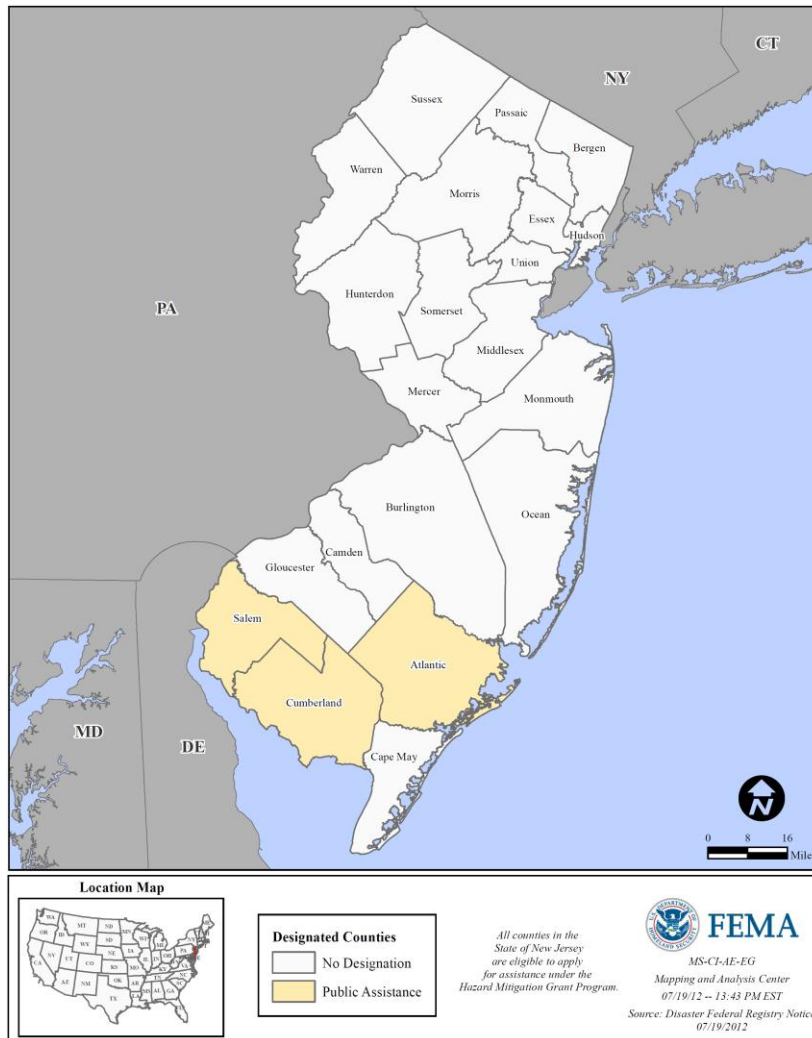


DR-4070 – Severe Storms and Wind - June 2012

On June 30, 2012, a storm traveled through southern New Jersey, bringing widespread wind gusts exceeding 60 mph that downed trees and power lines. A derecho crossed the State that lasted about 10 minutes and brought straight-line winds that caused tremendous damage to those areas impacted. Rainfall totals from this storm included 1.48 inches in Upper Deerfield (Cumberland County) and 1.46 inches in West Creek (Ocean County). Wind gusts were recorded at 81 miles per hour (mph) in Tuckerton (Atlantic County), 74 mph in Absecon (Atlantic County), 67 mph in Bivalve (Cumberland County), 66 mph at the Atlantic City Marina (Atlantic County), 64 mph in Mullica (Atlantic County), and 62 mph in Upper Deerfield (Cumberland County). Hail up to 0.75 inch to 1.25 inches in diameter was reported in Absecon, Tuckerton, and Egg Harbor Townships (Atlantic County) (ONJSC 2012).

Overall, New Jersey had approximately \$20 million in property damage and three storm-related fatalities. FEMA declared a major disaster declaration (DR-4070) for New Jersey, which included three counties (Atlantic, Cumberland, and Salem). Figure D-8 shows the designated areas for the FEMA disaster. FEMA obligated a total of \$9,744,730.09 in public assistance (PA) grants.

Figure D-8. Designated Areas for the Severe Storm and Wind, FEMA-DR-4070



Source: FEMA 2012



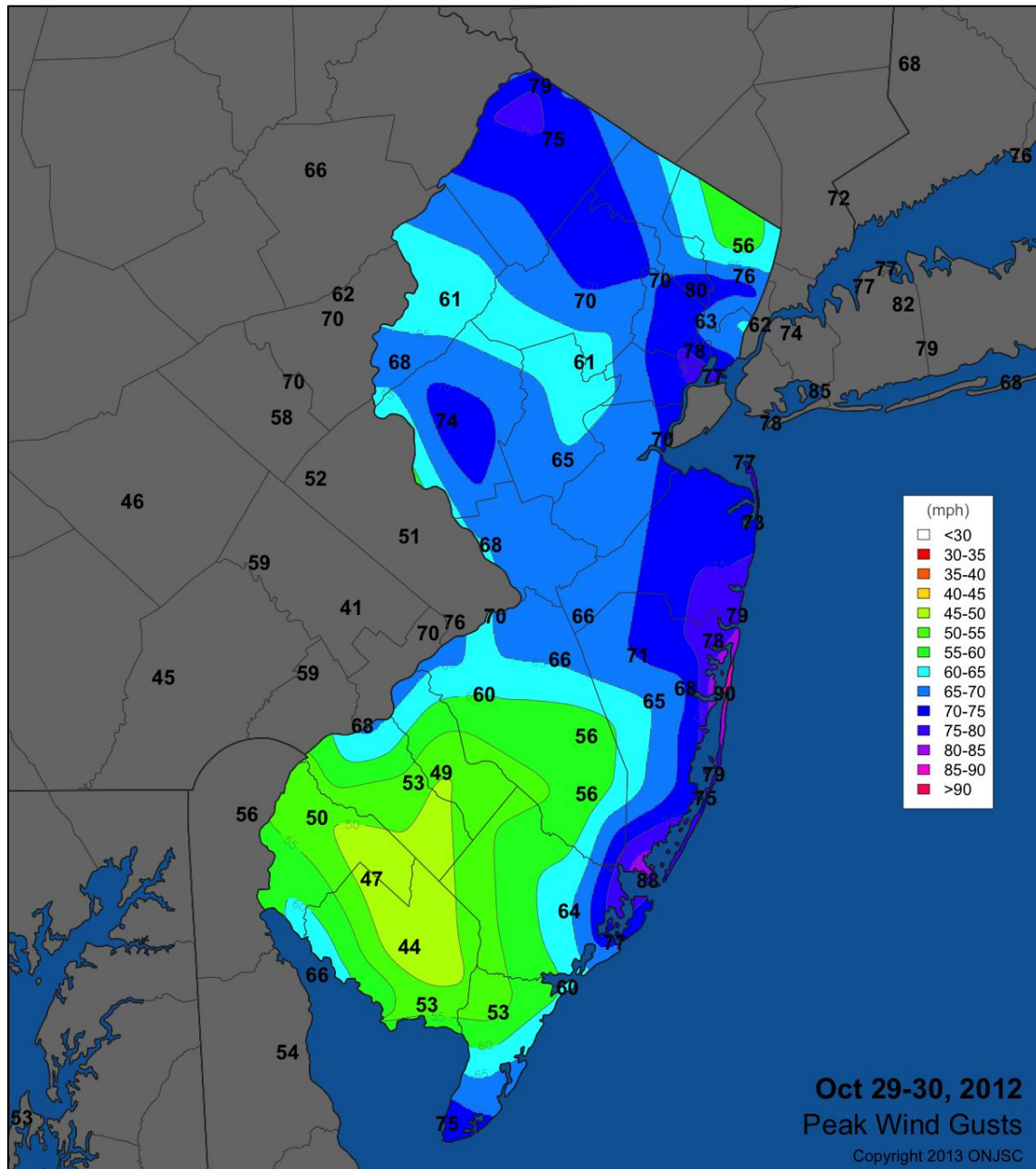
DR-4086 – Hurricane Sandy – October-November 2012

On Monday, October 29, 2012, Superstorm Sandy made landfall near Atlantic City, New Jersey. High winds and precipitation, as well as overflowing rivers and bays, caused direct damage to homes, businesses and town facilities, including fallen trees, blown off roofs, and flooding of critical infrastructure. Tidal surges caused flooding and excessive damage to coastal protective barriers (dunes, bulk heads, and jetties). The storm surge, which measured 8.9 feet at its highpoint in Sandy Hook, inundated and severely affected regions of the State's shore from Cape May to Raritan Bay, including the barrier islands and many areas along the Hudson River. Other overland flooding, wind damage, and an ensuing snowstorm further damaged these communities as well as other communities throughout the State (Rutgers University 2013; NJDCA 2013). Superstorm Sandy was the most disruptive natural disaster to hit New Jersey in recent history (Rutgers University 2013).

Superstorm Sandy brought strong wind gusts and heavy rains to New Jersey. Wind gusts and rainfall totals were gathered from a variety of sources and evaluated by the Office of the New Jersey State Climatologist (ONJSC). Wind gusts ranged from 44 miles per hour (mph) in Cumberland County to 90 mph in Ocean County. Rainfall totals ranged from less than one inch in northern New Jersey to over 12 inches in Cape May County. Figure D-9 shows the peak wind gusts during Sandy and Figure D-10 shows the total rainfall from the storm throughout the State.



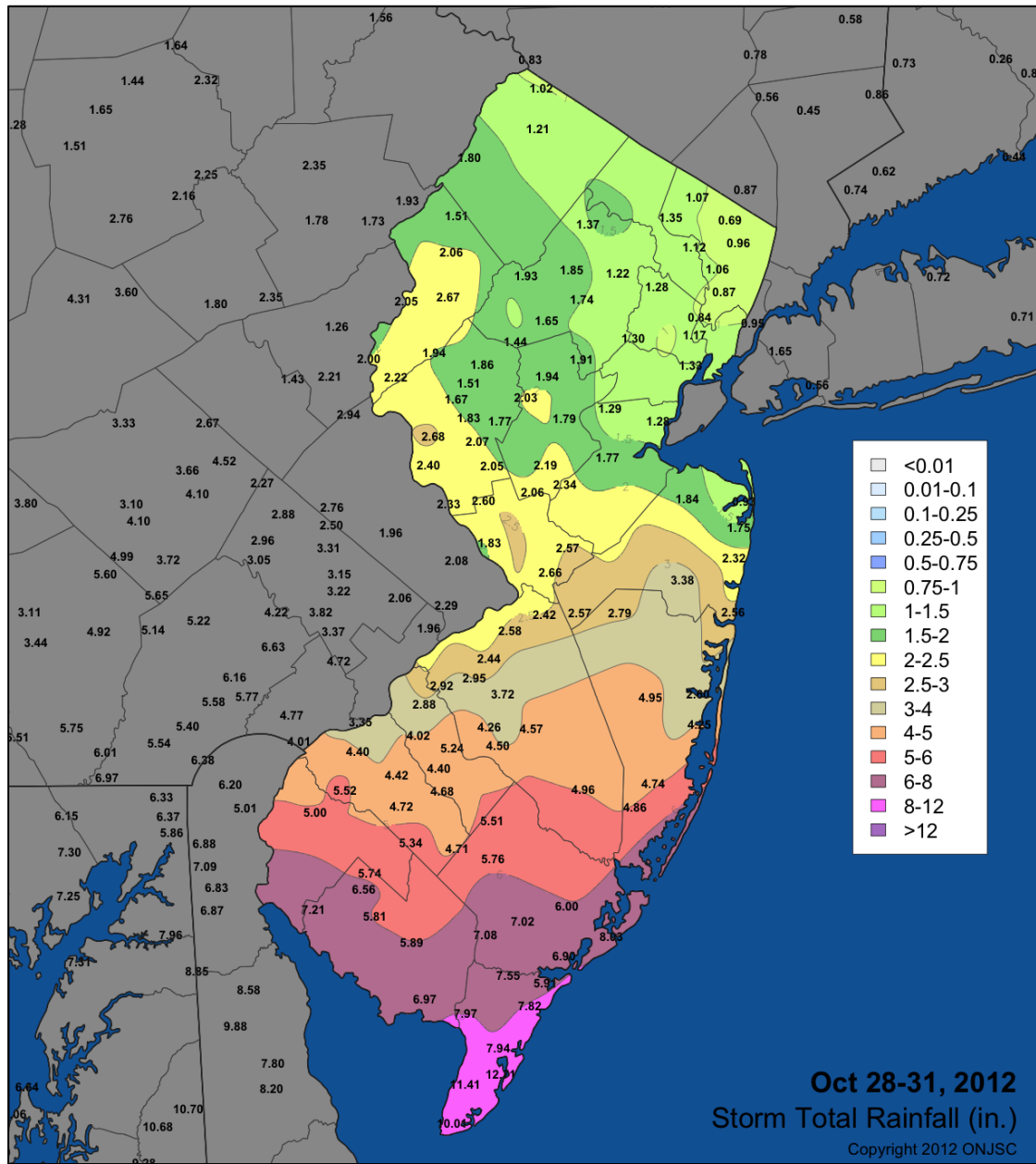
Figure D-9. Peak Wind Gusts in New Jersey



Source: ONJSC 2013



Figure D-10. Superstorm Sandy Total Rainfall

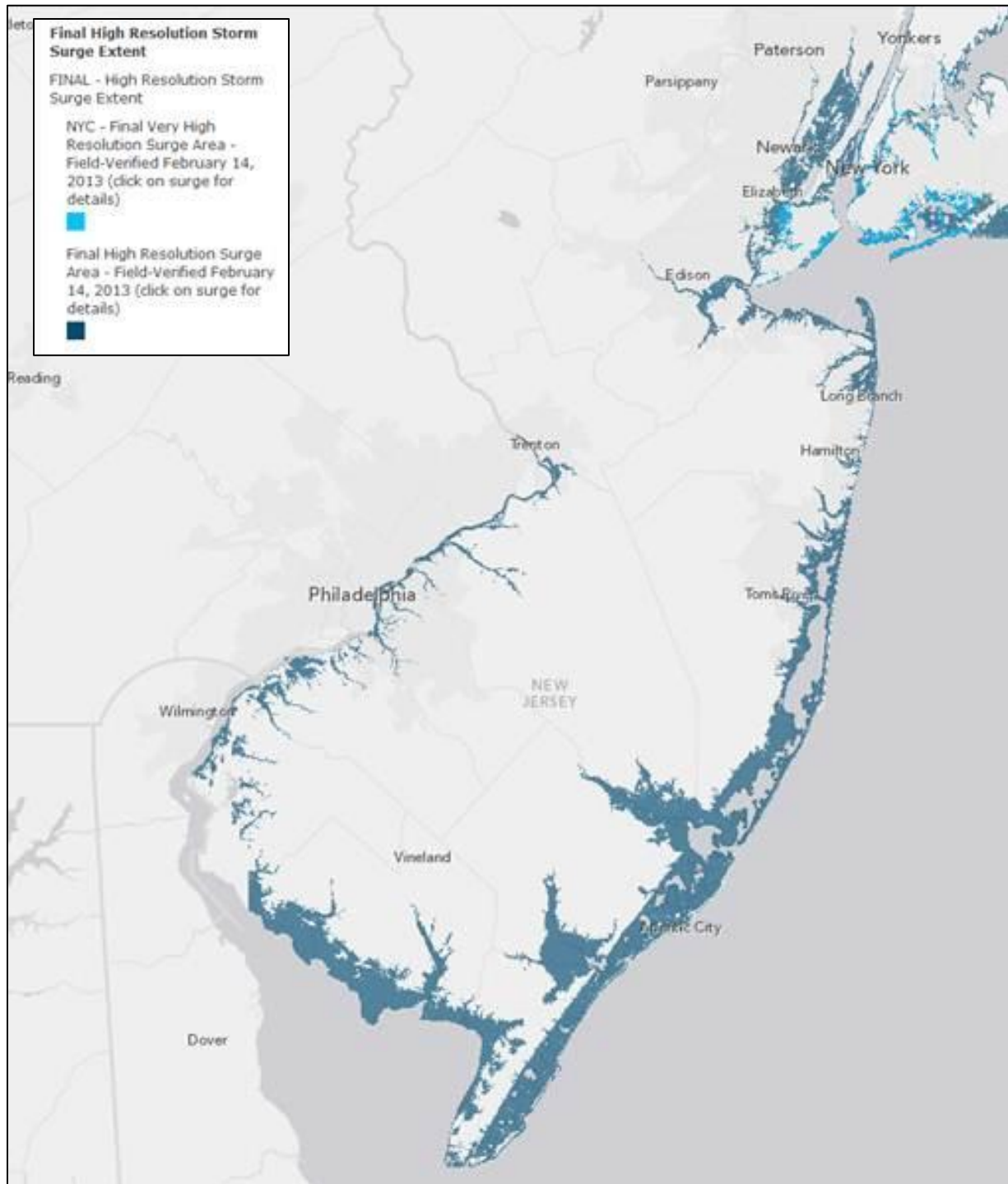


Source: ONJSC 2013

Figure D-11 shows the storm surge from Superstorm Sandy. The highest storm surge measured by a tide gauge in New Jersey was 8.57 feet above normal tide levels at the northern end of Sandy Hook. Farther south, tide gauges in Atlantic City and Cape May measured storm surges of 5.82 feet and 5.16 feet. The deepest water occurred in areas that border Lower New York Bay, Raritan Bay, and the Raritan River. A high-water mark of 8.01 feet above mean higher high water (MHHW) was reported in Sandy Hook. In other locations, a high-water mark of 7.9 feet above ground level was measured in Keyport on the southern side of Raritan Bay and 7.7 feet above ground level was measured in Sayreville near the Raritan River. Water levels were highest along the northern portion of the Jersey Shore in Monmouth and Ocean Counties (Blake et al. 2013).



Figure D-11. Superstorm Sandy Storm Surge in New Jersey



Source: FEMA 2014

Note (1): Based on Nov. 11, 2012 interim data from the FEMA Modeling Task Force Hurricane Sandy Impact Analysis, which combines detailed elevation data with U.S. Geological Survey inspections of high water marks.

Note (2): Coastline inundation zones calculated by the U.S. Army Corps of Engineers using worst-case storm, wave and tide calculations together with elevation data. View the New Jersey hurricane evacuation studies, and the New York state evacuation studies. In New York City, the state zones are superseded by the city's own evacuation zones, which draw from the USACE surveys.



Figure D-12 identifies estimated inundation (feet above ground level) calculated from USGS high-water marks and NOS tide gauges along the east coast of the United States. Values are rounded to the nearest half-foot. Figure D-13 identifies estimated inundation (feet above ground level) calculated from USGS high-water marks and NOS tide gauges in New Jersey, New York, and Connecticut.

Figure D-12. Inundation Values Along East Coast of the United States

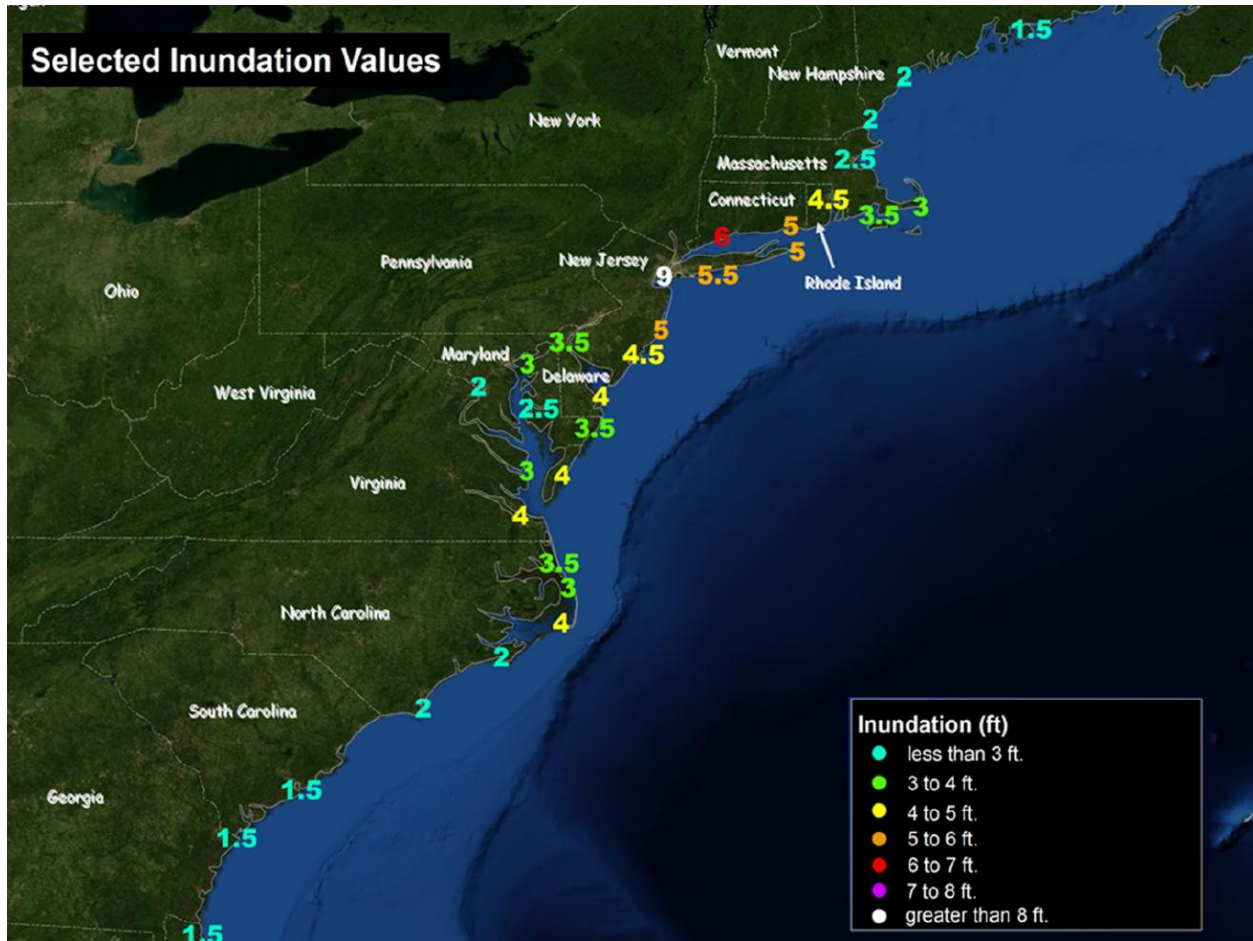
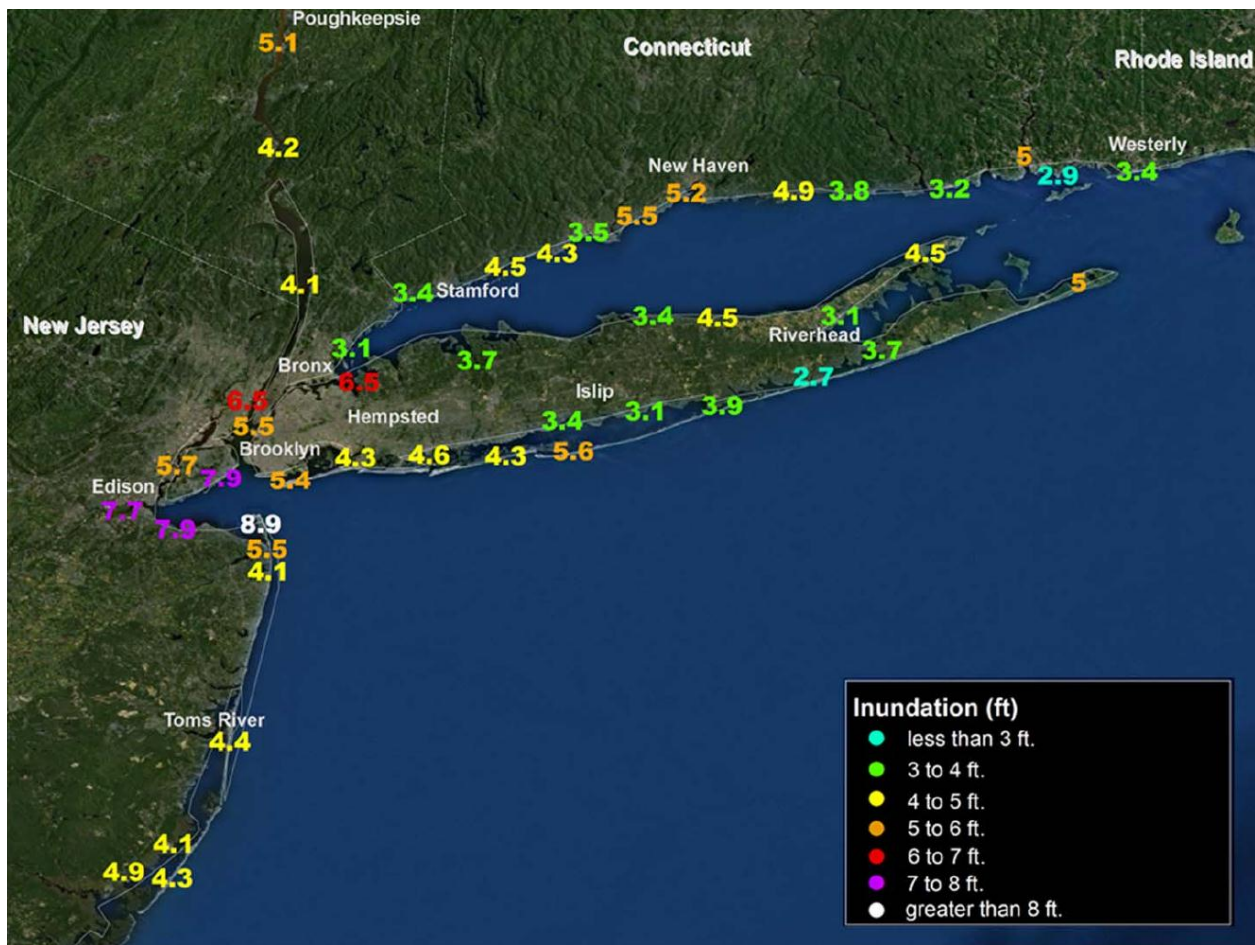




Figure D-13. Inundation Values Along East Coast of New Jersey, New York, and Connecticut



Superstorm Sandy caused unprecedented damage to New Jersey’s housing, business, infrastructure, health, social service and environmental sectors. President Obama’s October 30th disaster declaration designated all twenty-one New Jersey counties major disaster areas. Yet storm damage was particularly concentrated in communities bordering or near the Atlantic Ocean or the Hudson River, many of which were flooded by Sandy’s storm surge. Atlantic, Bergen, Cape May, Essex, Hudson, Middlesex, Monmouth, Ocean and Union Counties have been identified by the U.S. Department of Housing and Urban Development (HUD) as New Jersey’s most impacted areas (NJDC 2013).

There was significant variation in degree and types of impact on the residential, commercial, and municipal sectors across New Jersey. The most common challenge was lack of power; the U.S. Department of Energy estimated that 2.6 million customers were without power throughout the State (Rutgers University 2013).

As a result of Superstorm Sandy, over 325,000 housing units were damaged, totaling \$5.9 billion in damages (Rutgers University 2013). Housing units within New Jersey counties that sustained severe or major damage, as defined by HUD, are summarized below:

- 9% of Atlantic County households sustained severe or major damage
- 1% of Bergen County households sustained severe or major damage, with damages largely concentrated in communities along the Hackensack River in Little Ferry, Monnachie, and



Hackensack. The homes with major or severe damage in Bergen County accounted for almost 5% of all major and severe damage across New Jersey.

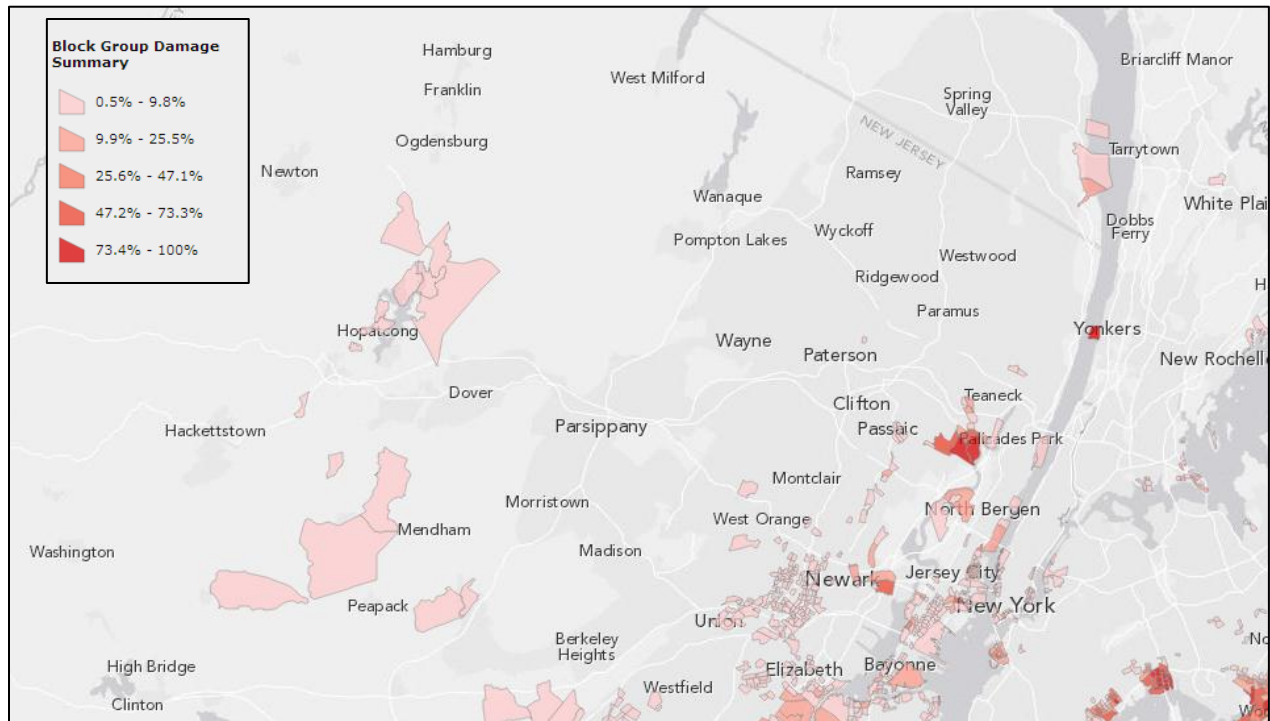
- 5% of Cape May County households sustained severe or major damage, totaling 2,446 units
- Less than 1% of Essex County households sustained severe or major damage, totaling 397 units. While a relatively smaller percentage of units in Essex County experienced severe or major damage, flooding was widespread. Approximately 3,100 units in the County experienced some level of damage.
- 2% of Hudson County households sustained severe or major damage, totaling 4,407 units. Flooding was concentrated in Jersey City, Bayonne, and Hoboken.
- Less than 1% of Middlesex County households sustained severe or major damage, totaling 1,975 units. Flooding occurred along the South River and along the coast facing Staten Island.
- 5% of Monmouth County households sustained severe or major damage, totaling 11,467 units. A large percentage of the housing units were in Keansburg, Highlands, Union Beach, and Sea Bright.
- 10% of Ocean County households sustained severe or major damage
- Less than 1% of Union County households sustained severe or major damage, totaling 643 units. Overall, 2,998 units experienced some level of damage (NJDCA 2013).

Superstorm Sandy also had a widespread and lasting impact on New Jersey's business sector and particularly affected small businesses. The storm caused substantial damage to commercial property and caused short- and long-term business operations losses. Data suggest that businesses in 113 of New Jersey's 565 municipalities incurred a combined \$382,000,000 in commercial property losses and \$63,900,000 in business interruption losses. While most, if not all, New Jersey industries were impacted, the tourism industry has been particularly affected. While some tourism-driven businesses may require significant rebuilding, certain others on the Jersey Shore that were comparatively less affected are expected to suffer under a general misperception that the entire coastline was decimated by Superstorm Sandy. All of these losses also affected the State's labor market, which in the month after the storm saw more than double the historically expected amount of unemployment claims filed (NJDCA 2013).

The following figures provide Superstorm Sandy damage estimates by block group for the State of New Jersey.

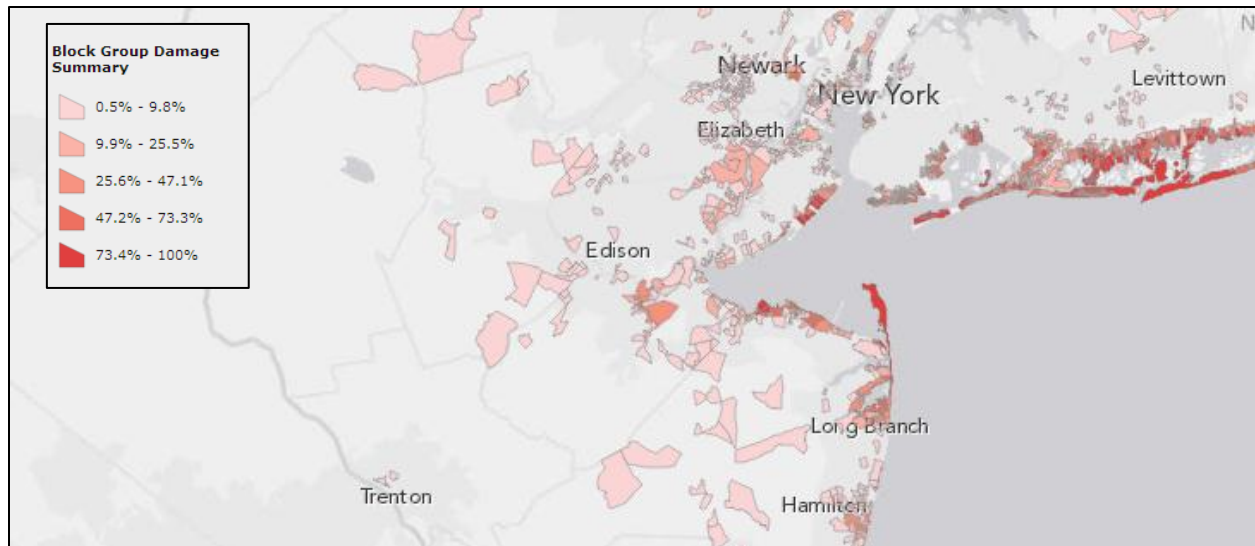


Figure D-14. Damage Estimates, by Block Group, for Northern New Jersey



Source: U.S. Department of Housing and Urban Development 2014

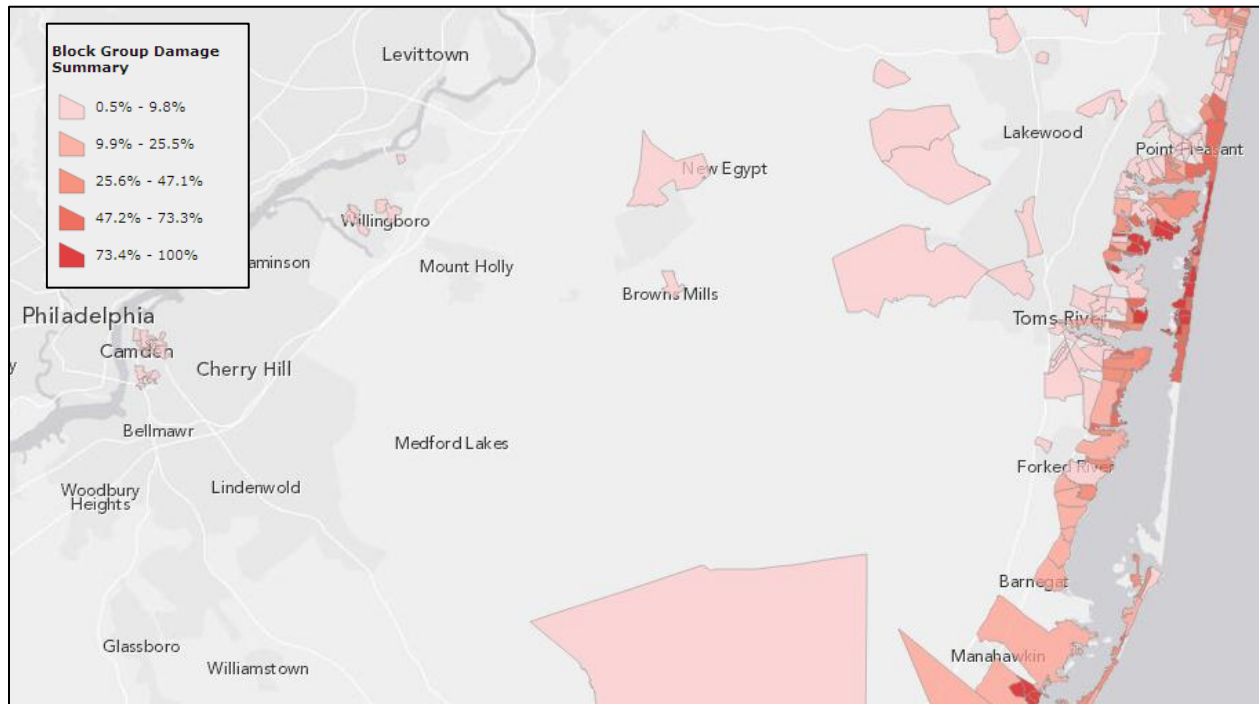
Figure D-15. Damage Estimates, by Block Group, for Central New Jersey



Source: U.S. Department of Housing and Urban Development 2014

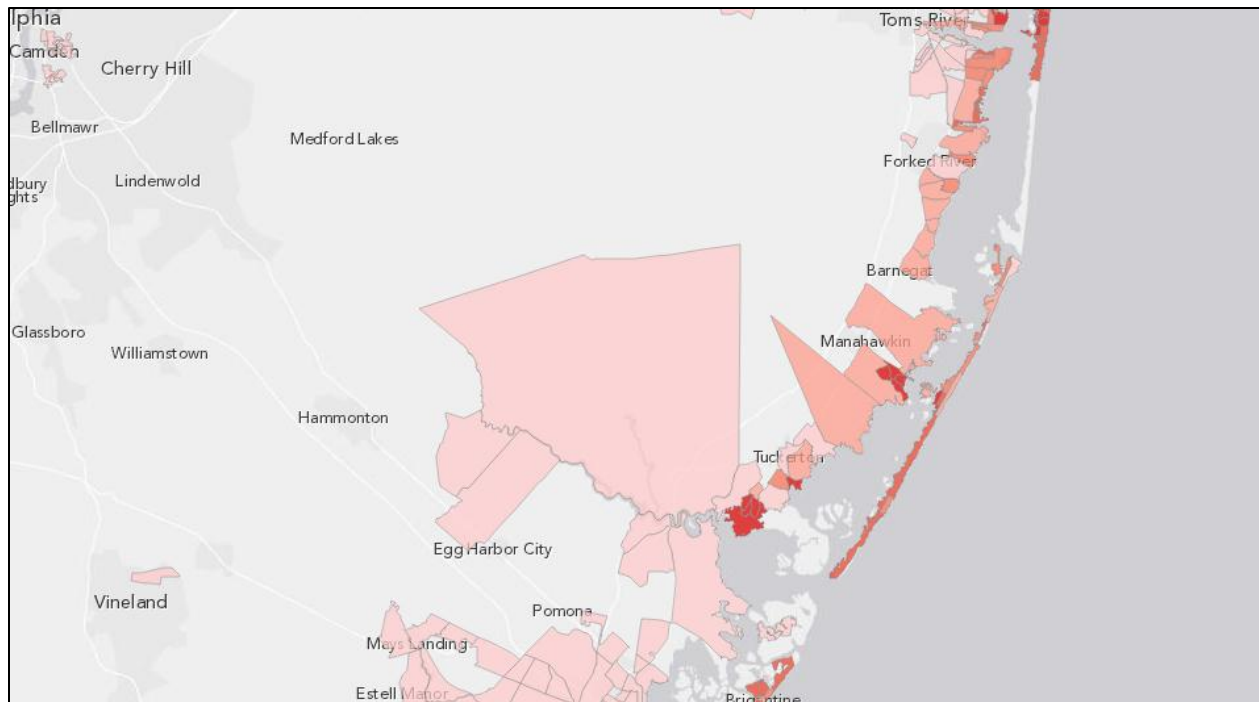


Figure D-16. Damage Estimates, by Block Group, for Southern New Jersey



Source: U.S. Department of Housing and Urban Development 2014

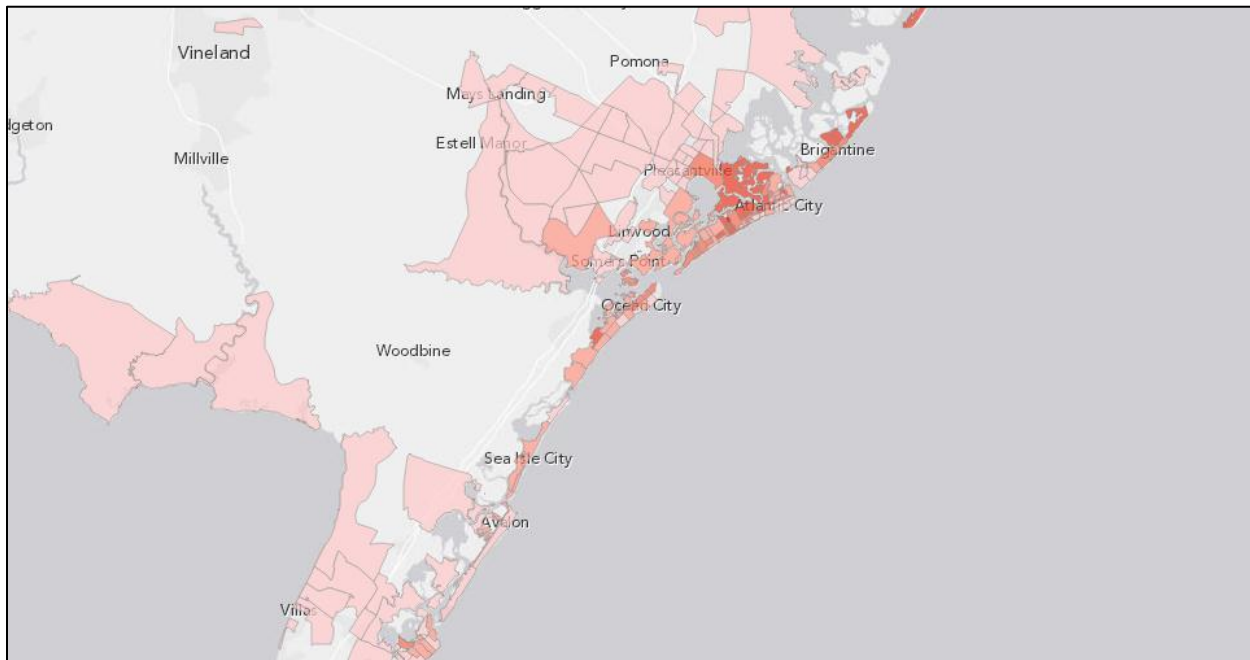
Figure D-17. Damage Estimates, by Block Group, for Southern New Jersey



Source: U.S. Department of Housing and Urban Development 2014



Figure D-18. Damage Estimates, by Block Group, for Southern New Jersey



Source: U.S. Department of Housing and Urban Development 2014

The State's infrastructure was badly damaged by Superstorm Sandy. Many lasting images of the storm show its impact on infrastructure. The State experienced substantial damage to roadways, railways, utilities, and other infrastructure. The storm also increased the need for the State and local governments to provide crucial health and social services. After a natural disaster, the need for health and social services is particularly pronounced. Other sectors were also negatively impacted by Superstorm Sandy. The storm had, and continues to have, adverse impact to New Jersey's environment. Impacts include beach erosion, compromised levees, and debris strewn across natural habitats. Many municipalities are now facing storm-induced budget shortfalls due to decreased revenues, increased expenses and declining property tax bases (NJDC 2013).

New Jersey Transit (NJ Transit) stated that Superstorm Sandy caused major damage throughout New Jersey, leaving behind long-term mechanical and operational challenges that NJ Transit is working to overcome. NJ Transit cancelled all service on Sunday in advance of the storm, which enabled the agency to ensure the safety of customers and employees and also allowed transit personnel to move locomotives, train cars, buses and other equipment to locations where they could be protected as much as possible from the elements. Since the storm subsided on Tuesday morning, crews have worked around the clock to inspect more than 500 miles of track, equipment yards, buses and train sets, making repairs or clean-ups where necessary as the first step toward restoring the NJ Transit network to normal operations. However, storm damage in many areas was severe, and residual impacts from Superstorm Sandy will cause many bus, rail, light rail and Access Link customers to continue to experience service suspensions, delays and cancellations on their lines. The following outlines the damages NJ Transit experienced due to Superstorm Sandy.

NJ Transit Rail System

- NJ Transit's Rail Operations Center-the central nervous system of the railroad-is engulfed in water, which has damaged backup power supply systems, the emergency generator, and the computer system that controls the movement of trains and power supply.



- There are numerous downed trees across the rail system, which have caused damage to overhead wires and signal wires.
- There are rail washouts across the system, including on the North Jersey Coast Line and Atlantic City Rail Line.
- Several rail stations are flooded, including Hoboken Terminal.
- Morgan Drawbridge on the North Jersey Coast Line in South Amboy sustained damage from boats and a trailer that collided into the bridge.

NJ Transit Bus System

- Power outages in local communities have resulted in the loss of traffic control devices critical to safe operation.
- Downed tree limbs and power lines continue to make many roads impassable.
- Nine of NJ Transit's bus garages continue to operate on back-up generator power.

NJ Transit Light Rail System

- Newark Light Rail sustained flooding in Newark Penn Station, as well as major debris damage between Newark Penn and Branch Brook Park stations.
- Hudson-Bergen Light Rail experienced track washouts at Port Imperial and West Side Avenue stations, as well as trees in the overhead wire in Weehawken and flooding in Hoboken.
- River Line sustained no significant damage to equipment or infrastructure; however, due to a loss of commercial power in downtown Camden, there is no power to operate the signals and switches.

NJ Transit continues to inspect facilities, infrastructure and equipment across all regions of New Jersey in the wake of Superstorm Sandy, as part of an intensive effort to restore the state's public transportation network to normal operations.

The Port Authority of New York and New Jersey (PANYNJ) operates five airports, four bridges, two tunnels, a bus terminal, the largest port complex on the east coast, and a bi-state commuter rail system (PATH). Overall, PANYNJ transports nearly 700 million people each year and billions of dollars of goods. Superstorm Sandy brought the PANYNJ to a complete halt, causing widespread damage to all assets (U.S. Senate Commerce, Science and Transportation Committee 2012).

Superstorm Sandy resulted in \$2 billion in damages to Port Authority facilities, including the agency's seaports, tunnels, bridges, and airports. Essential Port Authority assets were victim to unprecedented damages, including the PATH rail system. In the aftermath of Superstorm Sandy, the Port Authority sustained historic damages to all of its facilities, including 100 million gallons of water that inundated Delta's shuttle ramps at LaGuardia Airport, the destruction of LaGuardia's instrument landing system pier, PATH's Caisson 3 signal room, one of the key electrical control systems that helps run the mass transit system. The signal room has been replaced since the damages from Sandy (PANYNJ 2013).

Superstorm Sandy forced PANYNJ to close all facilities except the Lincoln Tunnel and Stewart Airport. Since airports were closed, carriers cancelled more than 10,000 flights. Fifteen to 20% of all U.S. flights pass through the Port Authority's airports, and 18% of the country's international flights use New York as a gateway (U.S. Senate Commerce, Science and Transportation Committee 2012).

The PATH system provides a critical transit link across the Hudson River. Commuters use PATH to travel for work into and out of New York City, moving over 300,000 people each day. Unprecedented flooding to much of the PATH system severely damaged critical signal and switch systems. At the Hoboken and Exchange



Place PATH stations, corrosive seawater rushed in the stations, causing them to become inoperable and forcing them to close to commuters. PATH crews worked to pump out tunnels and stations and to restore power to the substations. One week after the storm, PANYNJ was able to restore limited PATH service (U.S. Senate Commerce, Science and Transportation Committee 2012).

The Holland Tunnel flooded, forcing closure of this essential link between New York and New Jersey for days. Port Authority crews had to pump thousands of gallons of water out of the Holland Tunnel before operations could resume (PANYNJ 2013) (U.S. Senate Commerce, Science and Transportation Committee 2012).

The Port of New York and New Jersey is considered the mega-port of the east coast. It provides 250,000 jobs and over \$25 billion of economic activity. This port suffered widespread damage during Superstorm Sandy, which included extensive flooding, toppled cargo containers, washed-out access roads, twisted rail track, barges and debris tossed on piers, and damaged electrical infrastructure. The flooding at the ports disrupted the region's supply chain and caused significant damage to good, which included the destruction of more than 15,000 cars due to salt water (U.S. Senate Commerce, Science and Transportation Committee 2012).

At the airports, LaGuardia had an estimated 100 million gallons of seawater flood the airfield. Newark, JFK and Teterboro also suffered significant flooding and power outages. The Port Authority bus terminal, which is the primary bus facility for New York City and the region, had to completely stop their services, impacting travel for over 200,000 daily passengers (U.S. Senate Commerce, Science and Transportation Committee 2012).

Ships were unloading during the course of the storm; however, a full recovery from the damage caused at the port will take much longer. More than 700 cargo containers were damaged when the storm surge and high winds toppled the containers onto each other. A Port Authority barge was lifted on a berth in Red Hook (U.S. Senate Commerce, Science and Transportation Committee 2012).