5.4.10 HURRICANE

This section provides a profile and vulnerability assessment of the hurricane hazard.

Hazard Profile

This section presents the hurricane description, extent, location, previous occurrences and losses, and probability of future occurrences.

Description

Hurricanes and tropical storms are the major types of storm events generally impact the New York State coastline and adjacent inland areas. These storms typically impact the State from June to November, which is the official eastern U.S. hurricane season. Late July to early October is the period of time that a hurricane or tropical storm is most likely to impact New York State (NYS DHSES 2019).

Extra-tropical storms (Nor'Easters) typically occur during winter months. These storms are usually less intense but can have localized wind velocities that generally reach hurricane strength (NYS DHSES 2019). Nor'Easters are discussed in Section 5.4.12 of this HMP.

A tropical cyclone is characterized by a low-pressure center and numerous thunderstorms that produce strong winds and heavy rain. Tropical depressions, tropical storms, and hurricanes are all considered tropical cyclones. Tropical cyclones strengthen when water evaporated from the ocean is released as the saturated air rises, resulting in condensation of water vapor contained in the moist air. These storms rotate counterclockwise in the northern hemisphere around the center and are accompanied by heavy rain and strong winds. Almost all tropical storms and hurricanes in the Atlantic basin, which includes the Gulf of Mexico and Caribbean Sea, form between June 1 and November 30 (hurricane season). August and September are peak months for hurricane development (NOAA 2013).

Storm surges inundate coastal floodplains by dune overwash, tidal elevation rise in inland bays and harbors, and backwater flooding through coastal river mouths. Strong winds can increase in tide levels and water-surface elevations. Storm systems generate large waves that run up and flood coastal beaches. The combined effects create storm surges that affect the beach, dunes, and adjacent low-lying floodplains. Shallow, offshore depths can cause storm-driven waves and tides to pile up against the shoreline and inside bays.

Extent

The extent of a hurricane is categorized by the Saffir-Simpson Hurricane Scale. The Saffir-Simpson Hurricane Wind Scale is a 1 to 5 rating based on a hurricane's sustained wind speed. This scale estimates potential property damage. Hurricanes reaching Category 3 and higher are considered major hurricanes because of their potential for significant loss of life and damage. Category 1 and 2 storms are still dangerous and require preventative measures (NHC 2014). Table 5.4.10-1 presents this scale, which is used to estimate the potential property damage and flooding expected when a hurricane makes landfall.

Table 5.4.10-1. The Saffir-Simpson Scale

Category	Wind Speed (mph)	Expected Damage
1	74-95 mph	Very dangerous winds will produce some damage: Homes with well-constructed frames could have damage to roof, shingles, vinyl siding, and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.

Category	Wind Speed (mph)	Expected Damage
2	96-110 mph	Extremely dangerous winds will cause extensive damage: Homes with well-constructed frames could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks.
3 (major)	111-129 mph	Devastating damage will occur: Homes with well-built frames may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes.
4 (major)	130-156 mph	Catastrophic damage will occur: Homes with well-built frames can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted, and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months.
5 (major)	>157 mph	Catastrophic damage will occur: A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

Source: NHC 2013
mph Miles per hour
> Greater than

Mean Return Period

In evaluating the potential for hazard events of a given magnitude, a mean return period (MRP) is often used. The MRP provides an estimate of the magnitude of an event that may occur within any given year based on past recorded events. The MRP is the average period, in years, between occurrences of a particular hazard event, equal to the inverse of the annual frequency of exceedance (Dinicola 2009).

Figure 5.4.10-1 through Figure 5.4.10-6 show the estimated maximum 3-second gust wind speeds that can be anticipated in the study area associated with the 100- and 500-year MRP Hazus probabilistic models. The estimated hurricane track for the 100- and 500-year event is also shown. For the 100-year MRP event, the maximum 3-second wind speeds range from 73 to 104 miles per hour (mph), characteristic of a Tropical Storm up to a Category 2 hurricane. For the 500-year MRP event, the maximum 3-second gust wind speeds range from 89 to 127 mph, characteristic of a Category 1 through Category 3 hurricane. The associated impacts and losses from the 100-year and 500-year MRP hurricane events are reported in the Vulnerability Assessment later in this section.

Warning Time

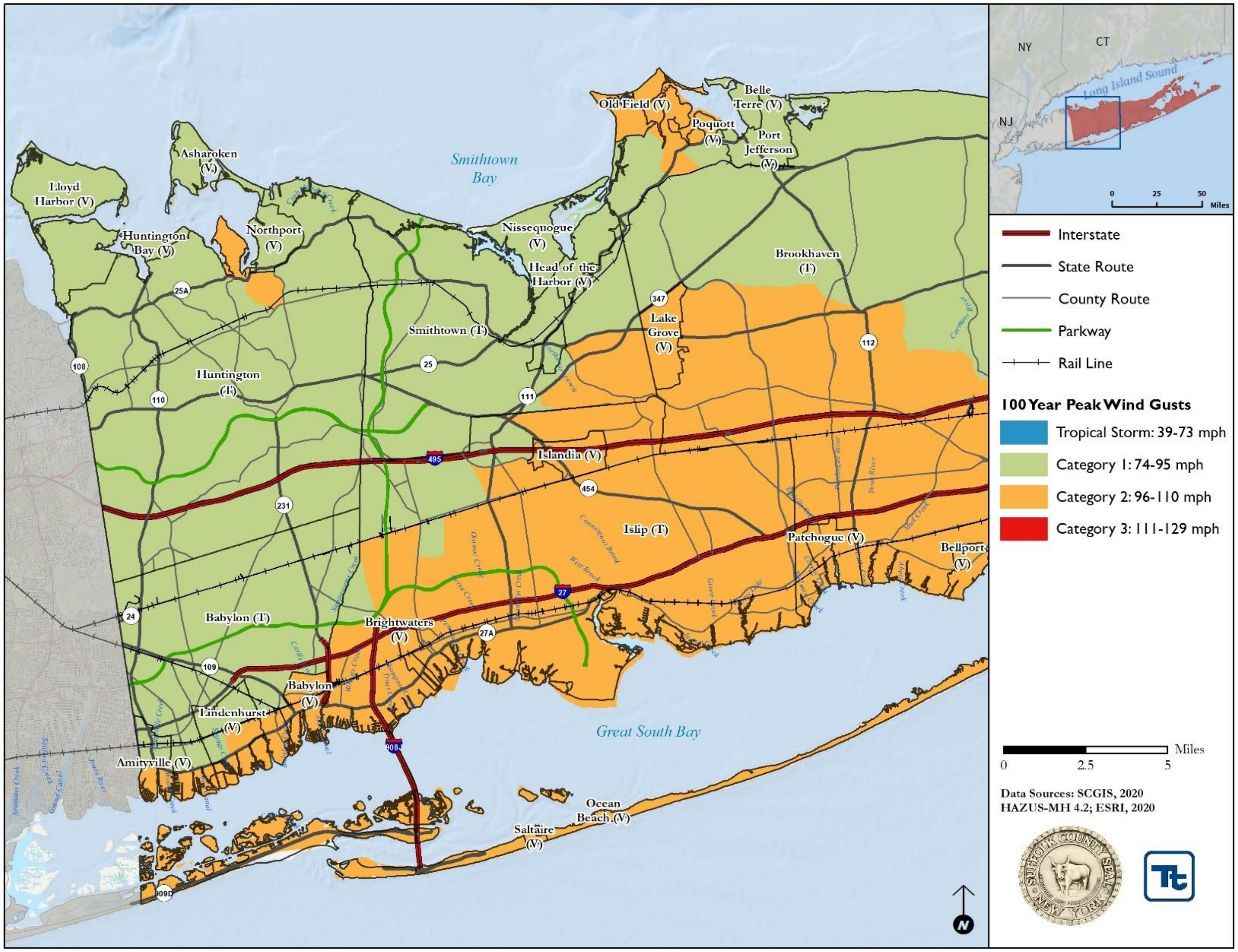
The National Weather Service (NWS) issues hurricane and tropical storm watches and warnings. These watches and warnings are issued or will remain in effect after a tropical cyclone becomes post-tropical, when such a storm poses a significant threat to life and property. The NWS allows the National Hurricane Center (NHC) to issue advisories during the post-tropical stage. The following are the definitions of the watches and warnings:

- *Hurricane/Typhoon Warning* is issued when sustained winds of 74 mph or higher are expected somewhere within the specified area in association with a tropical, subtropical, or post-tropical cyclone. Because hurricane preparedness activities become difficult once winds reach tropical storm force, the warning is issued 36 hours in advance of the anticipated onset of tropical storm force winds (24 hours in the western north Pacific). The warning can remain in effect when dangerously high water or combination of dangerously high water and waves continue, even though winds may be less than hurricane force.

- *Hurricane Watch* is issued when sustained winds of 74 mph or higher are possible within the specified area in association with a tropical, subtropical, or post-tropical cyclone. Because hurricane preparedness activities become difficult once winds reach tropical storm force, the hurricane watch is issued 48 hours prior to the anticipated onset of tropical storm force winds.

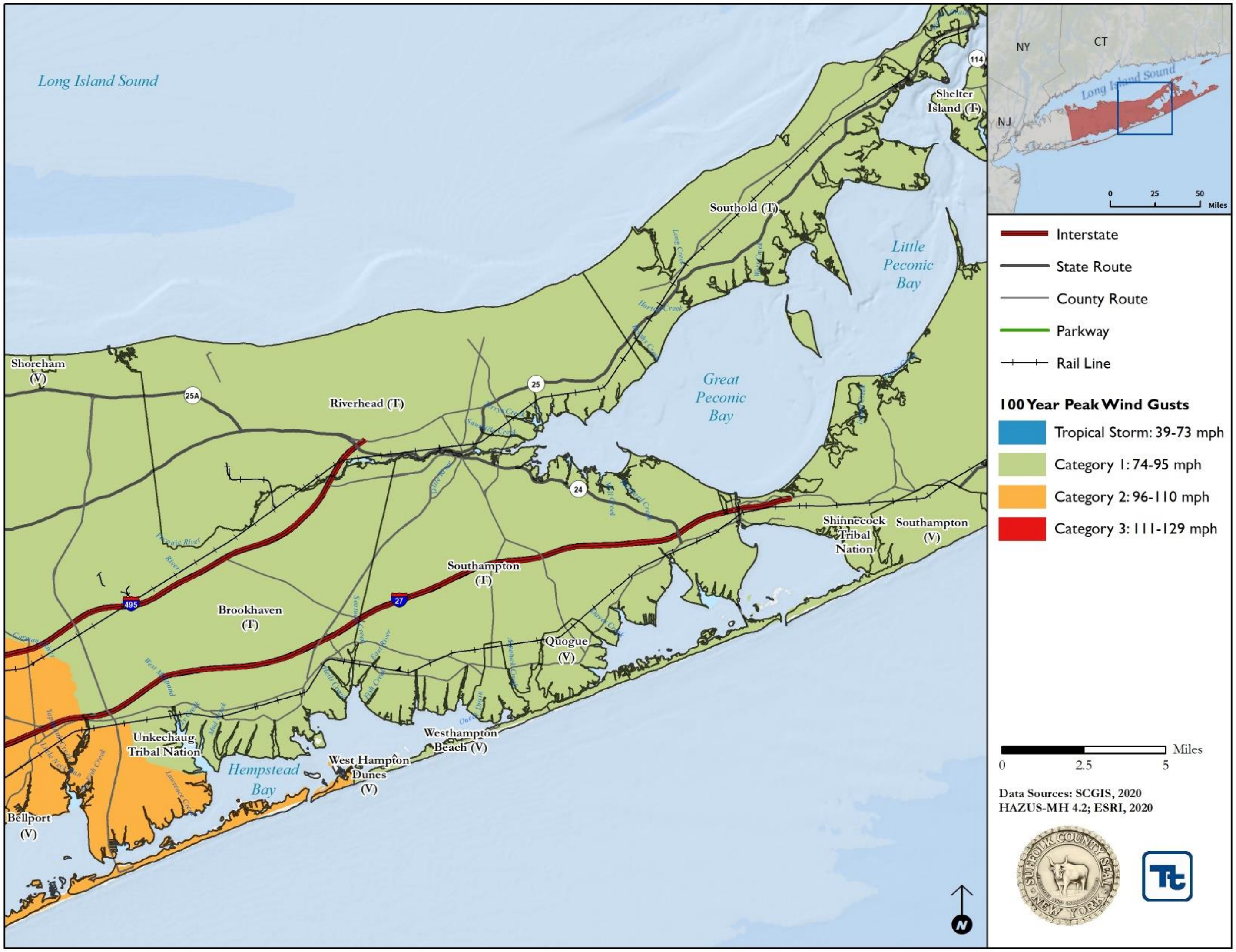
- *Tropical Storm Warning* is issued when sustained winds of 39 to 73 mph are expected somewhere within the specified area within 36 hours (24 hours for the western north Pacific) in association with a tropical, subtropical, or post-tropical storm.
- *Tropical Storm Watch* is issued when sustained winds of 39 to 73 mph are possible within the specified area within 48 hours in association with a tropical, sub-tropical, or post-tropical storm (NWS 2013).

Figure 5.4.10-1. Wind Speeds and Storm Track for the 100-Year Mean Return Period Event in Suffolk County -West



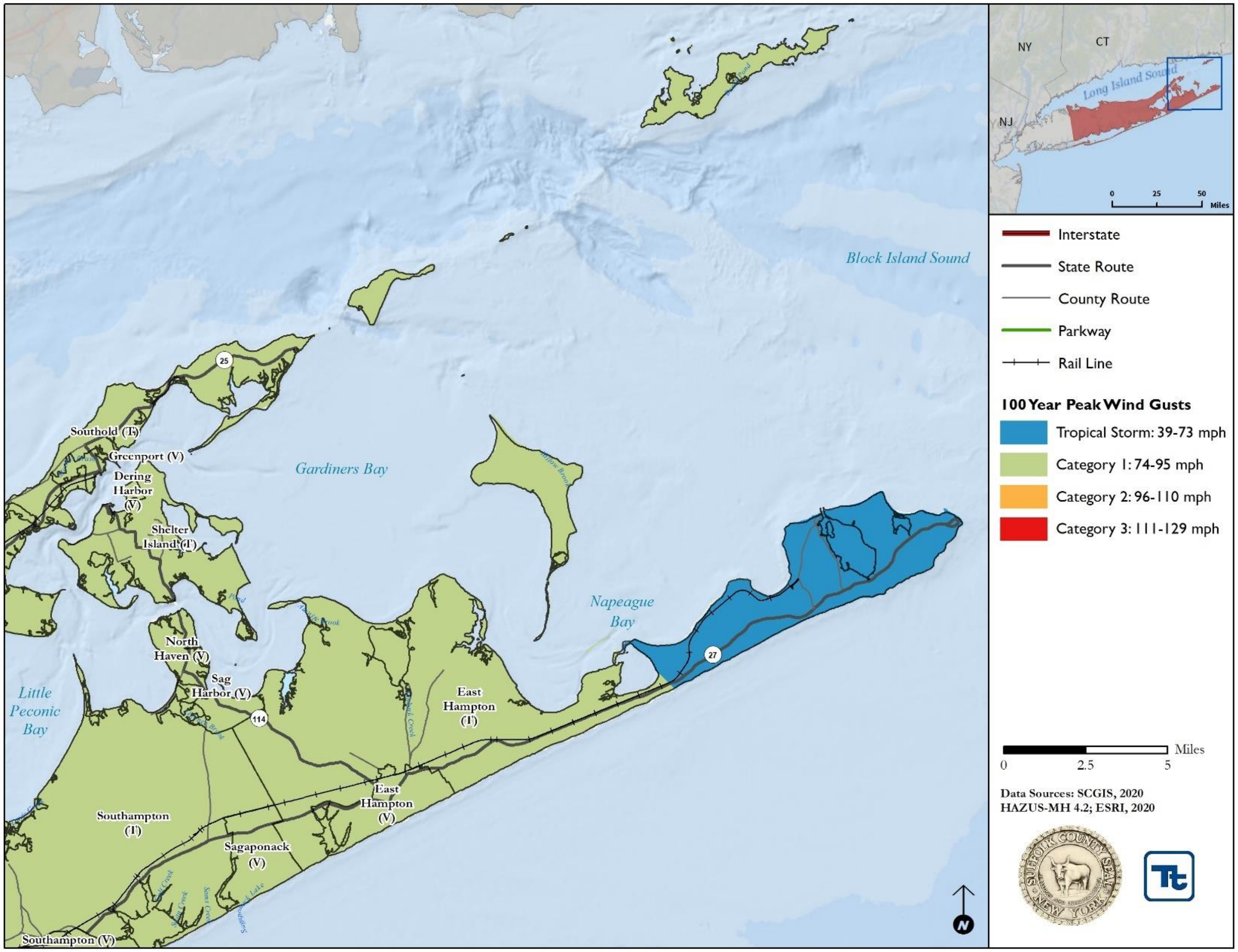
Note: *For the 100-year MRP event, the maximum 3-second wind speeds range from 73 to 104 miles per hour (mph), characteristic of a Tropical Storm up to a Category 2 hurricane. Hazus did not provide the storm track for the 100-year MRP event.*

Figure 5.4.10-2. Wind Speeds and Storm Track for the 100-Year Mean Return Period Event in Suffolk County - Central



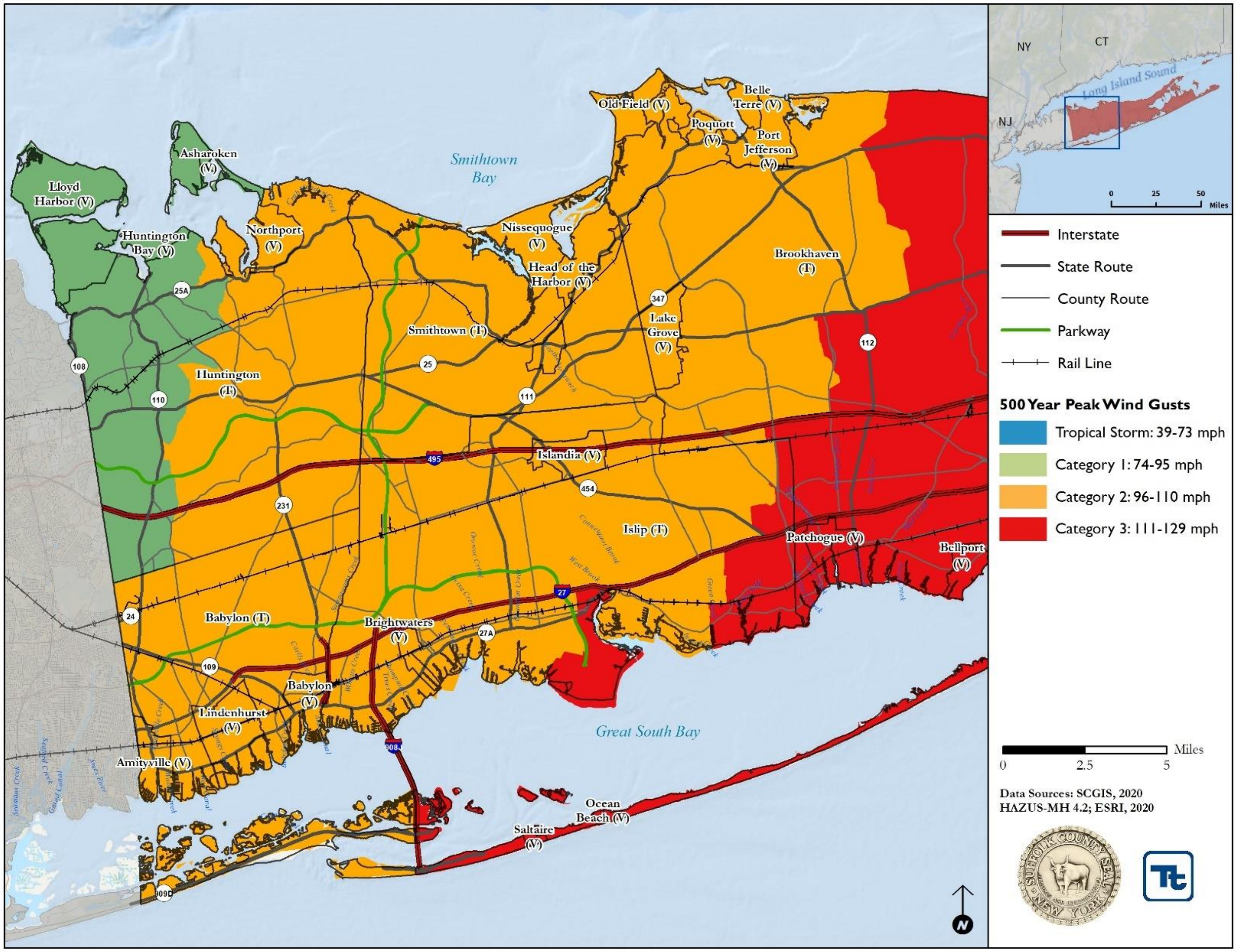
Note: For the 100-year MRP event, the maximum 3-second wind speeds range from 73 to 104 miles per hour (mph), characteristic of a Tropical Storm up to a Category 2 hurricane. Hazus did not provide the storm track for the 100-year MRP event.

Figure 5.4.10-3. Wind Speeds and Storm Track for the 100-Year Mean Return Period Event in Suffolk County - East



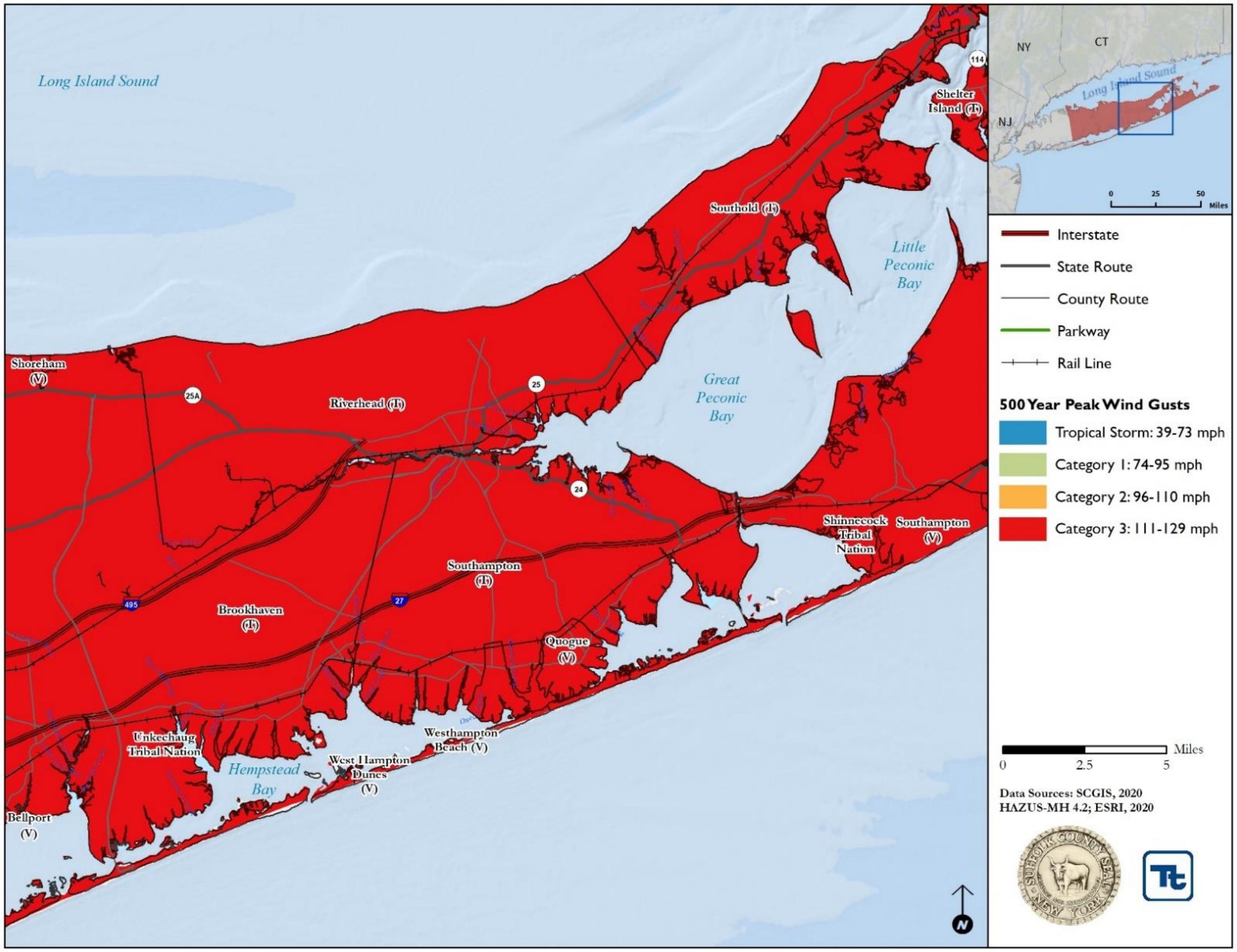
Note: For the 100-year MRP event, the maximum 3-second wind speeds range from 73 to 104 miles per hour (mph), characteristic of a Tropical Storm up to a Category 2 hurricane. Hazus did not provide the storm track for the 100-year MRP event.

Figure 5.4.10-4. Wind Speeds and Storm Track for the 500-Year Mean Return Period Event in Suffolk County - West



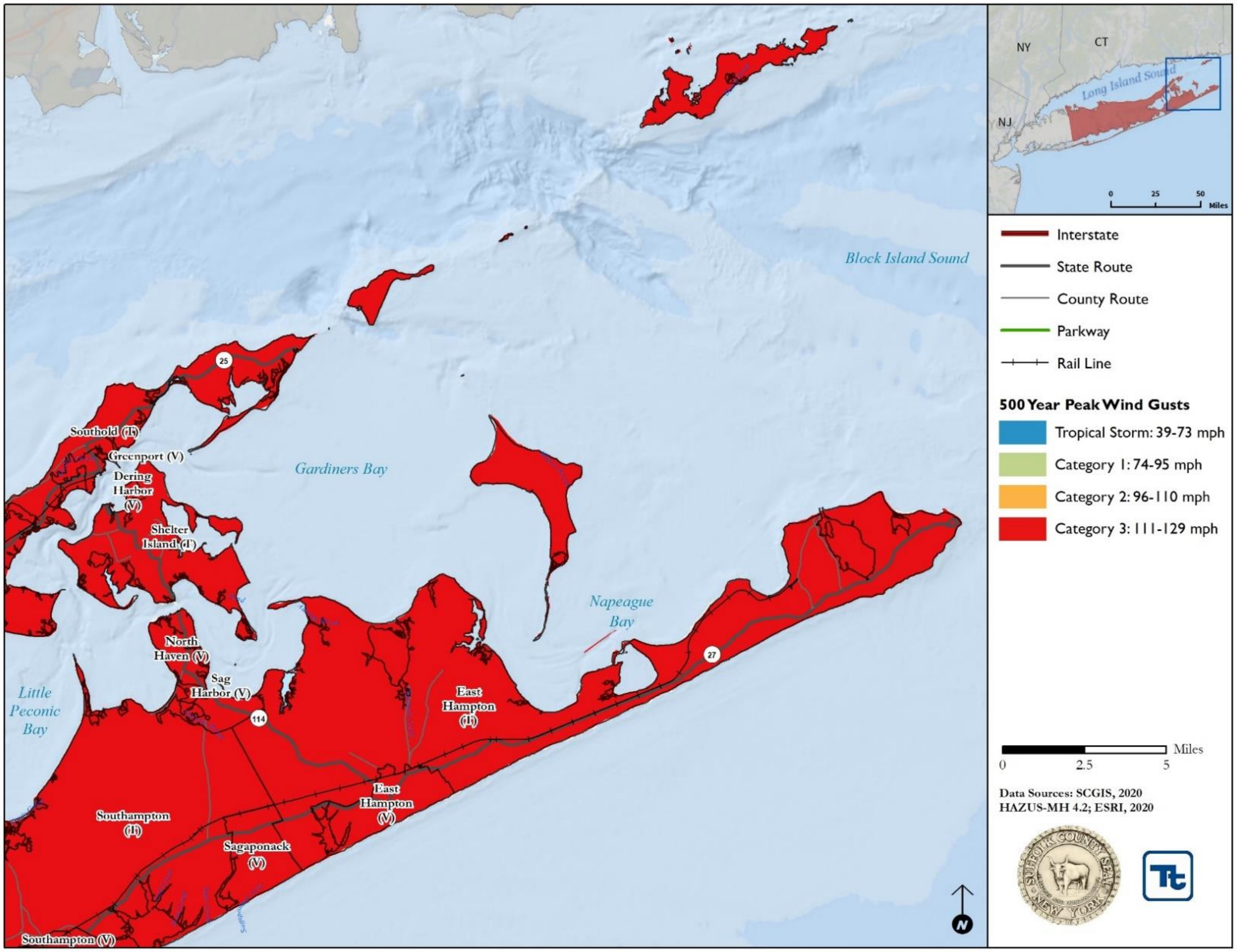
Note: For the 500-year MRP event, the maximum 3-second gust wind speeds range from 89 to 127 mph, characteristic of a Category 1 through Category 3 hurricane. Hazus provides the storm track for the 500-year MRP event, but this storm track falls outside of the extent of this project area.

Figure 5.4.10-5. Wind Speeds and Storm Track for the 500-Year Mean Return Period Event in Suffolk County – Central



Note: For the 500-year MRP event, the maximum 3-second gust wind speeds range from 89 to 127 mph, characteristic of a Category 1 through Category 3 hurricane. Hazus provides the storm track for the 500-year MRP event, but this storm track falls outside of the extent of this project area.

Figure 5.4.10-6. Wind Speeds and Storm Track for the 500-Year Mean Return Period Event in Suffolk County - East



Note: For the 500-year MRP event, the maximum 3-second gust wind speeds range from 89 to 127 mph, characteristic of a Category 1 through Category 3 hurricane. Hazus provides the storm track for the 500-year MRP event, but this storm track falls outside of the extent of this project area.

Storm Surge

Typically, storm surge is estimated by subtracting the regular/astrological tide level from the observed storm tide. Typical storm surge heights range from several feet to more than 25 feet. The exact height of the storm surge and which coastal areas will be flooded depends on many factors: strength, intensity, and speed of the hurricane or storm; the direction it is moving relative to the shoreline; how rapidly the sea floor is sloping along the shore; the shape of the shoreline; and the astronomical tide. Storm surge is the most damaging when it occurs along a shallow sloped shoreline, during high tide, in a highly populated, and developed area with little or no natural buffers (for example, barrier islands, coral reefs, and coastal vegetation).

The most common reference to a return period for storm surges has been the elevation of the coastal flood having a 1-percent chance of being equaled or exceeded in any given year, also known as the 100-year flood. Detailed hydraulic analyses include establishing the relationship of tide levels with wave heights and wave run-up. The storm surge inundation limits for the 1-percent annual chance coastal flood event are a function of the combined influence of the water surface elevation rise and accompanying wave heights and wave run-up along the coastline.

A storm surge associated with storms of longer recurrence intervals may result in more storm surge flooding, higher water levels, larger waves, and an increased likelihood of dune overwash, wave damage, and possible breaching of barrier islands.

Storm surge modeling, known as SLOSH (Sea, Lake, and Overland Surges from Hurricanes), computes storm surges based on storm movement in different directions and strengths in combination with topography and bathymetry. SLOSH models analyze storms movement (moving northeast, northwest), changing in strength (from Category 1 to Category 4), and striking during different tidal cycles (NYS DHSES 2019).

SLOSH calculations are based on storm surges reaching above average tides and strong potential winds for each category storm. The error of this model ranges between plus or minus three feet. Figure 5.4.10-7 through Figure 5.4.10-9 illustrate the SLOSH maps for Suffolk County.

Figure 5.4.10-7. Sea Lake Overland Surge from Hurricanes (SLOSH Model) - West

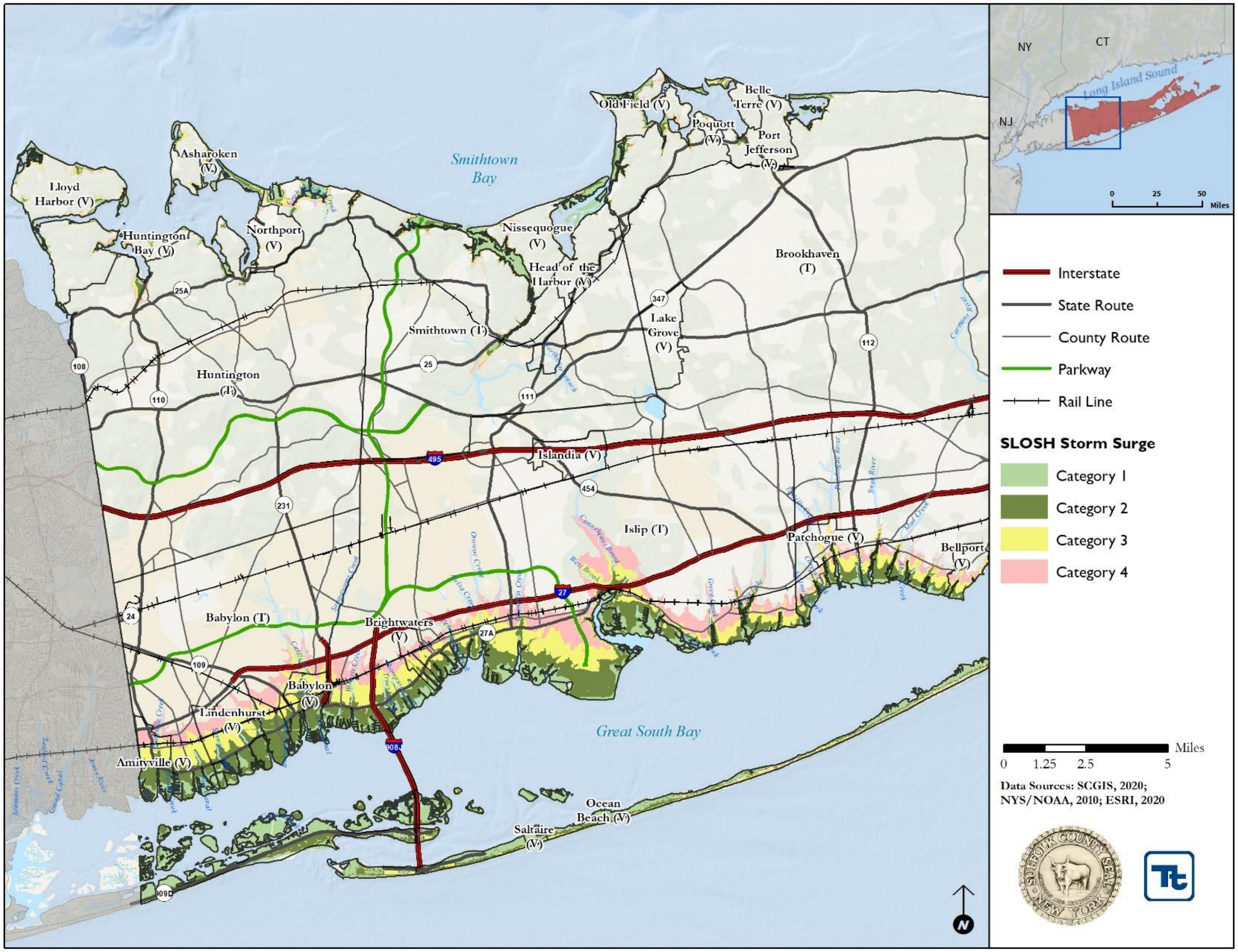


Figure 5.4.10-8. Sea Lake Overland Surge from Hurricanes (SLOSH Model) - Central

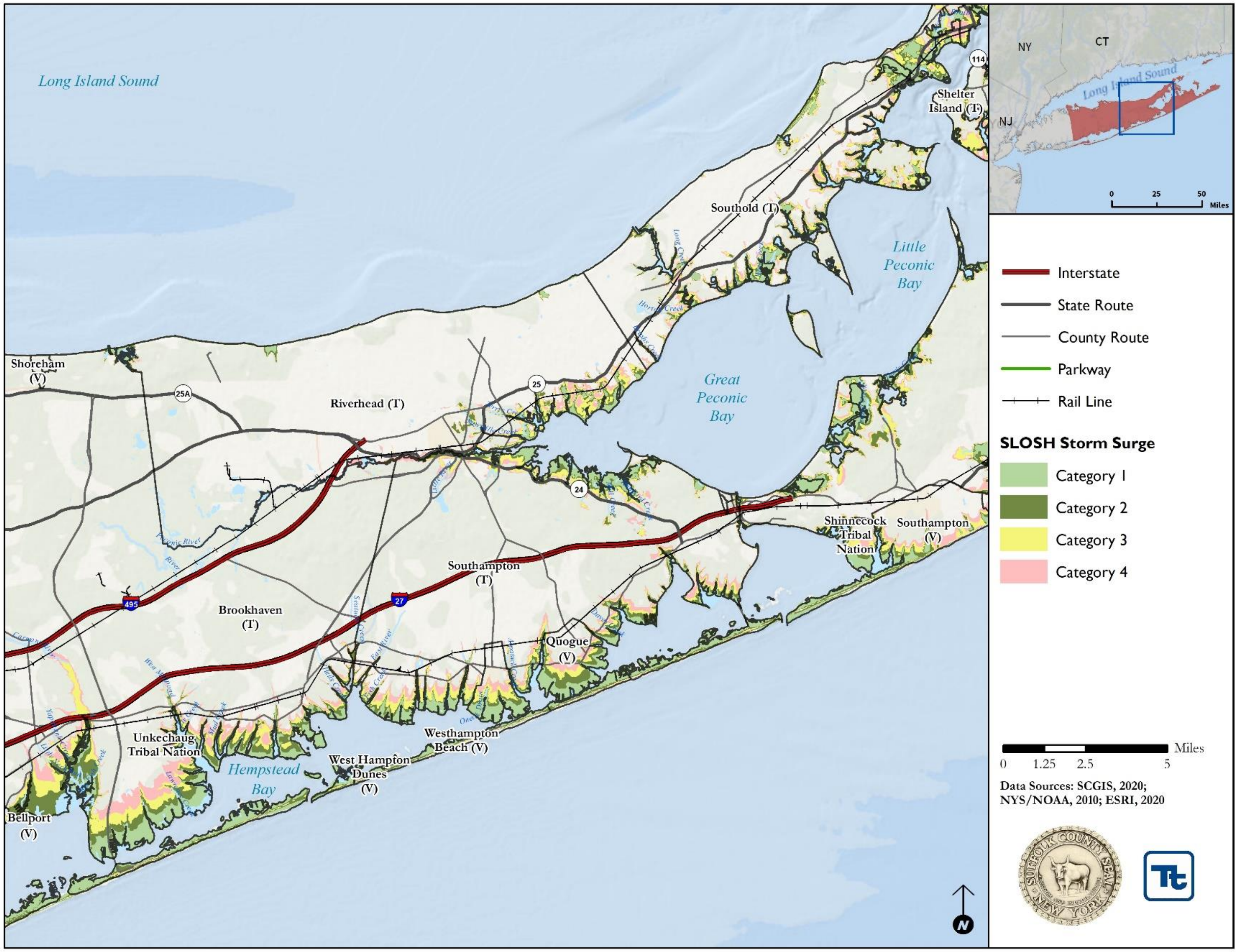
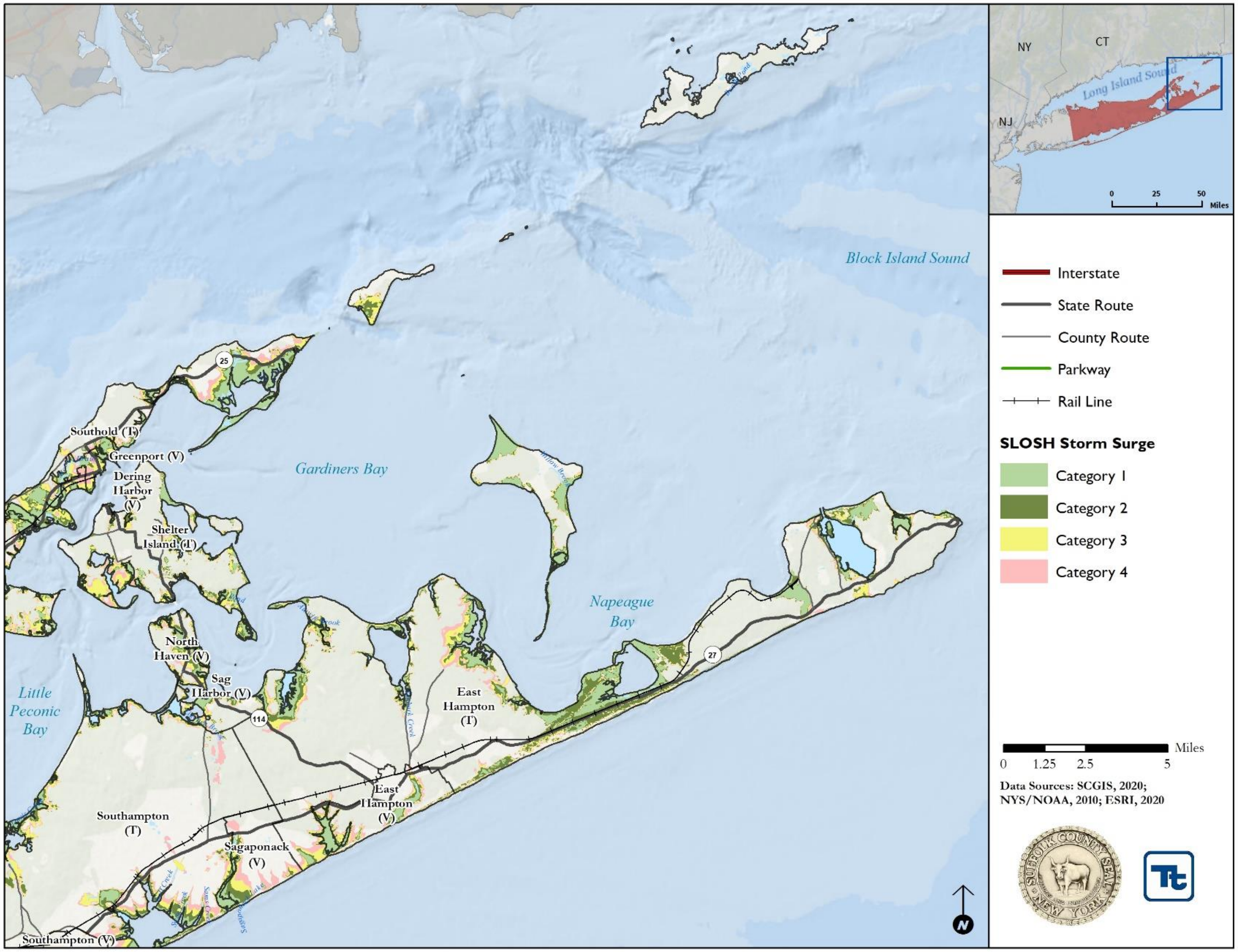


Figure 5.4.10-9. Sea Lake Overland Surge from Hurricanes (SLOSH Model) - East



Location

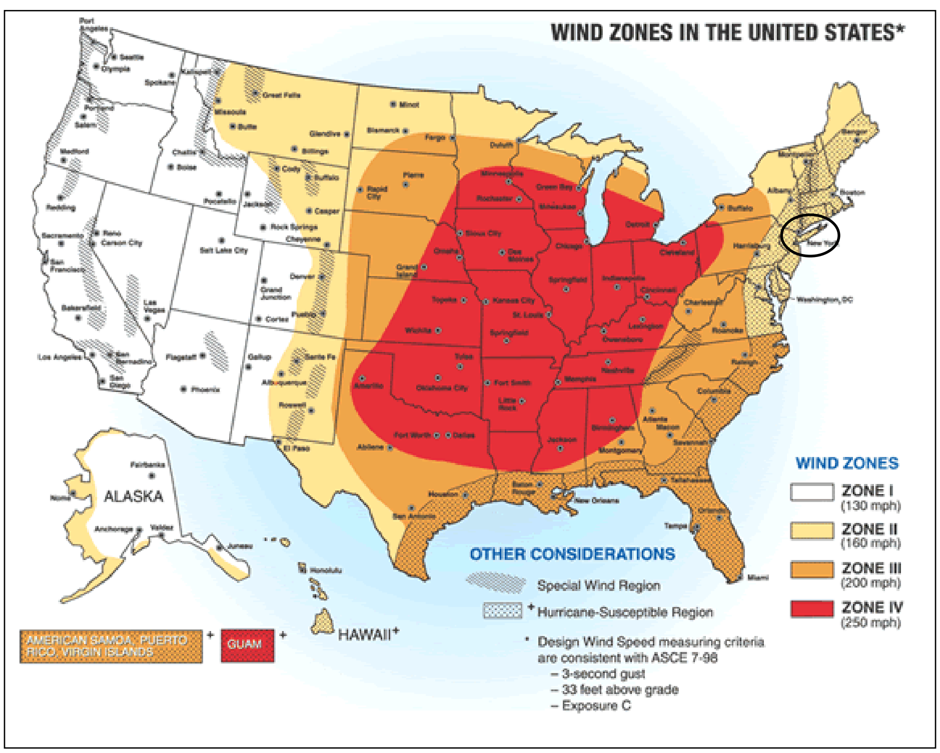
According to computer projections based on SLOSH, large areas of coastal Long Island could be inundated by a storm surge from a major hurricane striking the island at high tide. The southern shore and areas of the North Fork' southern shore are most at risk of inundation during a coastal storm. The entire County is likely to be impacted by heavy rainfall and high winds associated by hurricane and tropical storm events.

Figure 5.4.10-10 illustrates how the frequency and strength of windstorms impacts the U.S. and the general location of the most wind activity. This is based on 40 years of tornado history and 100 years of hurricane history, collected by FEMA. Suffolk County is located in Wind Zone II with speeds up to 160 miles per hour. Suffolk County is also located within the hurricane-susceptible region (FEMA 2020).

According to research by Scott Mandia, Professor of Physical Sciences at SUNY Suffolk, the following observations were made regarding the anticipated effects of a storm surge on Long Island.

- Category 1 hurricanes inundate the majority of the immediate south shore of the Island, including the north side of Great South Bay locations and both sides of the north and south forks. Montauk Highway (Rt. 27A) is completely covered by flood waters during a Category 3 hurricane. Therefore, this road would be considered impassable during the storm.
- A category 4 hurricane inundates the majority of the Villages of: Amityville, Lindenhurst, Babylon, West Islip, East Islip, Bayshore, Gilgo Beach, Cedar Beach, Great South Beach, Fair Harbor, Cherry Grove, Cupsogue, Westhampton Beach, Watermill Beach, Wainscott Beach, Plum Island, Gardiner's Island, Orient, Shelter Island (except for a few high points), Greenport, North Haven, Amagansett Beach, Napeague Beach, Montauk, Woodmere, Valley Stream, Lynbrook, Long Beach, Atlantic Beach, Freeport, Merrick, Wantagh, Lido Beach, Jones Beach, and Tobay Beach (Mandia, n.d.).

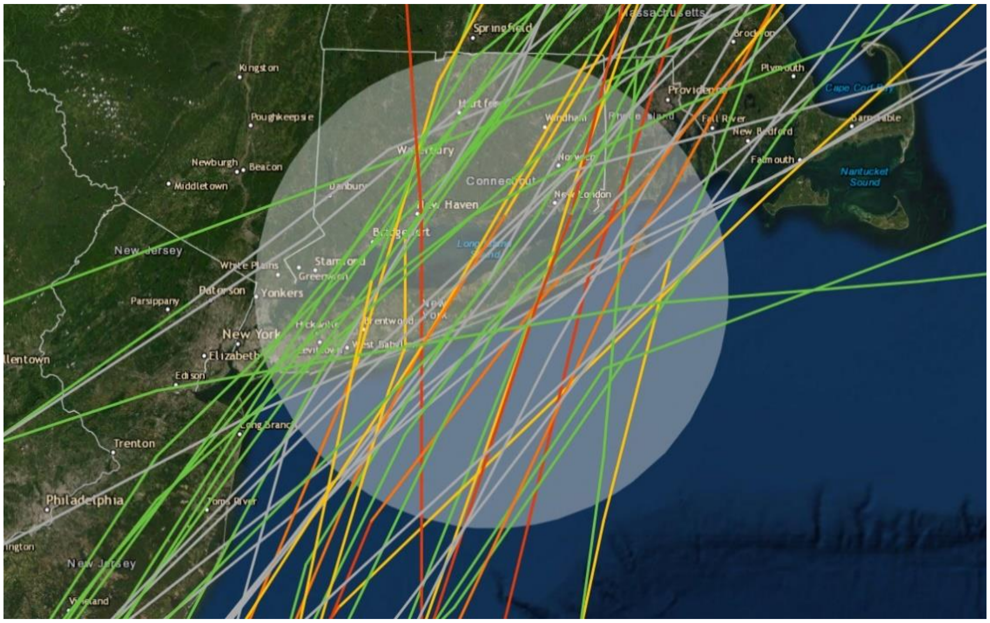
Figure 5.4.10-10. Wind Zones in the U.S.



Source: *FEMA 2020.*
Note: *The black circle indicates the approximate location of Suffolk County.*

The Historical Hurricane Tracks tool is a public interactive mapping application that displays Atlantic Basin and East-Central Pacific Basin tropical cyclone data. This interactive tool tracks tropical cyclones from 1842 to 2012. Figure 5.4.10-11 displays tropical cyclone tracks for Suffolk County; however, the associated names for some of these events are unknown. Between 1842 and 2020, Suffolk County has experienced 36 tropical cyclone events within 50 nautical miles of the county (NOAA 2020).

Figure 5.4.10-11. Historical North Atlantic Tropical Cyclone Tracks (1842-2020)



Source: NOAA 2020

Previous Occurrences and Losses

Between 1954 and 2020, FEMA declared that New York State experienced 12 hurricane-related disasters (DR) or emergencies (EM) classified as one or a combination of the following disaster types: hurricane and tropical storm. Of these 12 events, Suffolk County has been declared as a disaster area as a result of nine hurricane events (FEMA, 2020). One event was in relation to the need for evacuations out of the Gulf Coast during and after Hurricane Katrina but not related to direct hurricane impacts in Suffolk County. Table 5.4.8-2 shows the FEMA disaster declarations (DR) for hurricanes in Suffolk, from 1953 to 2020.

Table 5.4.10-2. Hurricane-Related FEMA Declarations for Suffolk County, 1954 to 2020

Date(s) of Event	FEMA Declaration Number	Event Type
September 3, 1976	DR-520	Hurricane Belle
September 27, 1985	DR-750	Hurricane Gloria
August 19, 1991	DR-918	Hurricane Bob
September 16-18, 1999	DR-1296	Hurricane Floyd Major Disaster Declaration
August 29-October 1, 2005	EM-3262	Hurricane Katrina Evacuation
August 25-September 5, 2011	EM-3328	Hurricane Irene
August 25-September 5, 2011	DR-4020	Hurricane Irene
October 27-November 8, 2012	EM-3351	Hurricane Sandy

Date(s) of Event	FEMA Declaration Number	Event Type
October 27-November 8, 2012	DR-4085	Hurricane Sandy

Source: FEMA 2020

Hurricane and tropical storms events that have impacted Suffolk County between 2013 and 2020 are listed in Table 5.4.10-3. Please note Nor'Easter hazard events will be addressed specifically in Section 5.4.12. Events identified in the 2014 HMP are included in Appendix E.

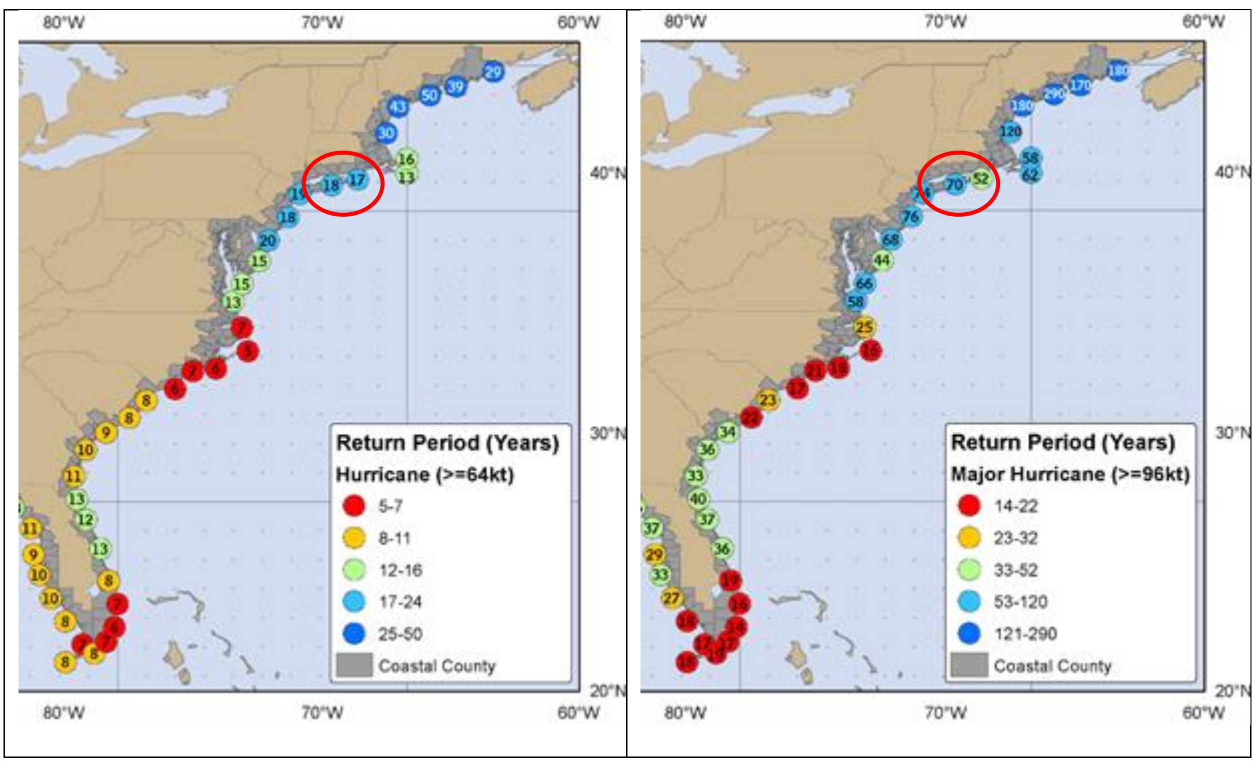
Probability of Future Occurrences

In Section 5.3, the identified hazards of concern for Suffolk County were ranked. The probability of occurrence, or likelihood of the event, is one parameter used for ranking hazards. Based on historical records and input from the Planning Committee, the probability of occurrence for hurricanes and tropical storms in the Planning Area is considered 'occasional' (not likely to occur within 100 years) in Table 5.3-3).

It is estimated that Suffolk County will continue to experience direct and indirect impacts of hurricanes and tropical storms annually that may induce secondary hazards such as flooding, infrastructure deterioration or failure, utility failures, power outages, water quality and supply concerns, and transportation delays, accidents and inconveniences.

Figure 5.4.10-12 illustrates the return period for hurricanes and major hurricanes along the eastern seaboard. According to these maps, western Suffolk County can expect a hurricane ever 18 years and a major hurricane ever 70 years. Eastern Suffolk County can expect a hurricane ever 17 years and a major hurricane every 52 years.

Figure 5.4.10-12. Return Period in Years for Hurricanes and Major Hurricanes



Source: NHC 2011
Note: The return period of hurricanes based on historical data. Suffolk County circled in red. The information on return period is generated with the 1987 HURISK program but uses data through 2010.

Table 5.4.10-3. Hurricane and Tropical Storm Events Between 2013 and 2020

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Location	Description
June 7, 2013	Extratropical Storm Andrea, Flash Flood	N/A	N/A	Wyandanch, Amityville Airport, Babylon, Melville, Deerfield, Halesite	The remnants of Tropical Storm Andrea tracked up the eastern seaboard in early June, resulting in a prolonged period of heavy rain, which caused flash flooding in portions of Southeast New York. Twenty to thirty cars became submerged in water up to their roofs in the Wyandanch Long Island Railroad parking lot. Four feet of standing water accumulated at the intersection of Scutter Ave. and Hawkins Blvd. in Copiague. In East Farmingdale, portions of Route 110, Wellwood Ave. and New Highway were closed due to flooding. The ASOS at Republic Airport in Farmingdale reported 1.03 inches of rainfall in one hour. Total rainfall amounts in Suffolk County ranged from 2.73 inches in West Islip to 5.65 inches in Centereach. Several cars were stuck in flood waters at the end of Rt. 231 between Udall Rd. and Montauk Hwy. in Babylon. The three westbound lanes of the Long Island Expressway were closed at Rt. 110 in Melville due to flooding. Deerfield Rd. was closed between Head of Pond/Scuttle Hole Rd. and Edge of Woods Rd. in Water Mill due to flooding. In Huntington, the intersections of Rt. 110 at Pulaski Rd. and Mill Dam Rd. at Park Ave. were closed due to flooding.
May 12, 2015	Tropical Depression Ana	N/A	N/A	Suffolk County	Tropical Depression Ana passed within 50 nautical miles of the southeast coast of Suffolk County.
September 3-6, 2016	Tropical Storm Hermine, High Surf	N/A	N/A	Southeast Suffolk, Northeast Suffolk, Southwest Suffolk	Slow moving tropical cyclone Hermine caused several days of 8 to 12 feet of surf breaking on Atlantic Ocean shorelines. The surf on top of storm tide September 3rd through the 6th caused significant beach erosion on Long Island ocean beaches. Hither Hills State Park had a significant amount of erosion, with an initial estimate of 30 feet of shoreline lost. At Orient Point State Park, moderate erosion was experienced along the Gardiners Bay Shoreline, with some loss of boulders. Otherwise only minor flooding occurred at the park. Moderate beach erosion was also reported at Wildwood State Park on the north shore of the Town of Riverhead. Robert Moses State Park sustained substantial erosion mostly beginning September 3rd Saturday night and continuing until Monday night. The worst erosion came Sunday night into Monday on the fifth of September. During that time, beach flooding, in some cases up to the dune lines, was experienced throughout the length of the ocean front. Specifically, significant beach erosion occurred at Robert Moses State Park on the west side from the Water Tower towards Field 2. An initial rough estimate of 60-90 feet of shoreline was lost.

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Location	Description
					Additionally, Gilgo Beach within the Town of Babylon jurisdiction, suffered substantial beach erosion. There was a moderate loss of sand along Gilgo Beach with one area west of the Gilgo underpass experiencing a 6 foot scarp along 200 feet of beach, leaving little beach.
September 19-20, 2017	Tropical Storm Jose, High Surf	N/A	N/A	Southeast Suffolk, Southwest Suffolk,	Tropical cyclone Jose tracked north and east along the Mid Atlantic coast Tuesday September 19th, eventually passing about 150 to 200 miles southeast of Montauk Point Tuesday night into Wednesday morning. Generally, 1 to 2 feet of surge was observed during the Tuesday Night and Wednesday morning high tides, resulting in minor to isolated moderate flooding thresholds being exceeded along the southern bays and Atlantic shore front communities of NYC and Long Island. The elevated water levels combined with incoming energetic swells from Jose, also brought surf of 7 to 13 feet. This caused widespread beachfront flooding, dune erosion, and localized wash overs. At Hither Hills in Montauk, the entire beachfront experienced minor to moderate flooding with waves eroding the base of the dunes during the Tuesday morning through Wednesday morning high tides. At Robert Moses, minor to moderate flooding and beach erosion were observed during the Tuesday morning to Wednesday morning high tides. Gilgo Beach had water up to the dunes during the Tuesday morning to Wednesday morning high tides, causing moderate erosion with a strong littoral drift. A wash over cutting from ocean to bay occurred through the Otis Pike High Dune Wilderness Area just west of Smith Point on Fire Island during the Tuesday Night and Wednesday morning high tides. Orient Point State Park had moderate erosion along the Gardiners Bay shoreline due to high wave action during times of high tide Sunday Night and Monday Morning.

Sources: NOAA-NCEI 2020, FEMA 2020, NHC 2020,

Note: Monetary figures within this table were U.S. Dollar (USD) figures calculated during or within the approximate time of the event. If such an event would occur in the present day, monetary losses would be considerably higher in USDs as a result of inflation. With hurricane and tropical storm documentation for New York State and Suffolk County being so extensive, not all sources have been identified or researched. Therefore, Table 5.4.10-3 may not include all events that have occurred in the County.

DR Federal Disaster Declaration
EM Federal Emergency Declaration
FEMA Federal Emergency Management Agency
HMP Hazard Mitigation Plan
IA Individual Assistance
K Thousand ($)
M Million ($)
Mph Miles Per Hour
NCDC National Climate Data Center
NOAA National Oceanic Atmospheric Administration
NYS New York State
NWS National Weather Service
PA Public Assistance
SHELDUS Spatial Hazard Events and Losses Database for the U.S.

Climate Change Impacts

Climate change is beginning to affect both people and resources in New York State, and these impacts are projected to continue growing. Impacts related to increasing temperatures and sea level rise are already being felt in the State. ClimAID: the Integrated Assessment for Effective Climate Change in New York State (ClimAID) was undertaken to provide decision-makers with information on the State's vulnerability to climate change and to facilitate the development of adaptation strategies informed by both local experience and scientific knowledge (New York State Energy Research and Development Authority [NYSERDA] 2011).

Each region in New York State, as defined by ClimAID, has attributes that will be affected by climate change. Suffolk County is part of Region 4, New York City and Long Island. Some of the issues in this region, affected by climate change, include: the area contains the highest population density in the State; sea level rise and storm surge increase coastal flooding, erosion, and wetland loss; challenges for water supply and wastewater treatment; increase in heat-related deaths; illnesses related to air quality increase; and higher summer energy demand stresses the energy system (NYSERDA 2011).

In Region 4, it is estimated that temperatures will increase by 4.1ºF to 5.7ºF by the 2050s and 5.3ºF to 8.8ºF by the 2080s (baseline of 54.6 ºF, mid-range projection). Precipitation totals will increase between 4 and 11% by the 2050s and 5 to 13% by the 2080s (baseline of 49.7 inches, mid-range projection) (NYSERDA 2014). The heaviest 1% of daily rainfalls have increased by approximately 70% between 1958 and 2011 in the Northeast (Horton et al. 2015). Average annual precipitation is projected to increase in the region by four to 11-percent by the 2050s and five to 13-percent by the 2080s (New York City Panel on Climate Change [NPCC] 2015). Increased rainfall and heavy rainfalls increase the chances of standing water where mosquitos breed.

Sea level rise projections for Montauk Point in the middle range estimate (25^{th} to 75^{th} percentile) suggest four to eight inches of rise by the 2020s; 11 to 21 inches by the 2050s; and 18 to 39 inches by the 2080s (based on the 2000-2004 baseline). Scenarios in the high estimate suggest 10 inches by the 2020s; 30 inches by the 2050s; and 58 inches by the 2080s. As decades progress, the expansion of the range is driven by uncertainty in land-based ice mass change, ocean thermal expansion, and regional ocean dynamics (NYSERDA 2014).

The projected increase in sea level rise has the potential to increase risk of storm surge-related flooding along the coast; expand areas at-risk of coastal flooding; increase vulnerability of energy facilities located in coastal areas; flood transportation and telecommunication facilities; and cause saltwater intrusion into some freshwater supplies near the coasts. High water levels, strong winds, and heavy precipitation resulting from severe coastal storms already cause billions of dollars in damages and disrupt transportation and utility distribution systems. Sea level rise will lead to more frequent and extensive coastal flooding. Warming ocean waters raise sea level through thermal expansion and have the potential to strengthen the most power storms (NYSERDA, 2011).

Table 5.4.10-4 displays the projected seasonal precipitation change for the New York City and Long Island ClimAID Region (NYSERDA 2011).

Table 5.4.10-4. Projected Seasonal Precipitation Change in Region 4, 2050s (% change)

Winter	Spring	Summer	Fall
0 to +15	0 to +10	-5 to +10	-5 to +10

Source: NYSERDA 2011

The projected increase in precipitation is expected to fall in heavy downpours and less in light rains. The increase in heavy downpours has the potential to affect drinking water; heighten the risk of riverine and urban flooding;

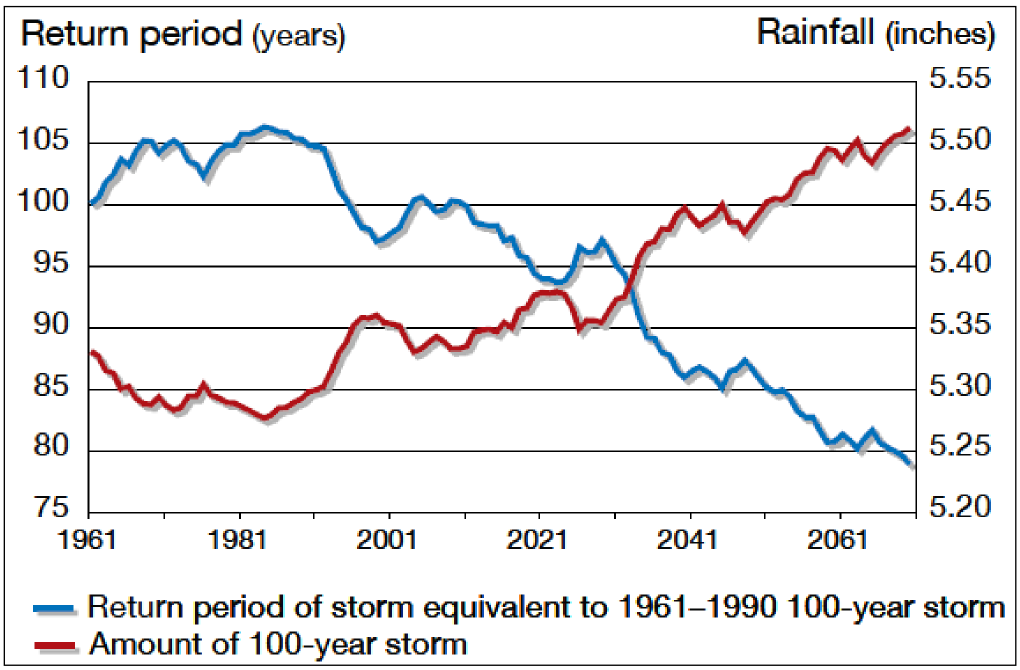
flood key rail lines, roadways and transportation hugs; and increase delays and hazards related to extreme weather events (NYSERDA 2011).

Increasing air temperatures intensify the water cycle by increasing evaporation and precipitation. This can cause an increase in rain totals during events with longer dry periods in between those events. These changes can have a variety of effects on the State's water resources (NYSERDA 2011).

Over the past 50 years, heavy downpours have increased, and this trend is projected to continue. This can cause an increase in localized flash flooding in urban areas and hilly regions. Flooding has the potential to increase pollutants in the water supply and inundate wastewater treatment plants and other vulnerable facilities located within floodplains. Less frequent rainfall during the summer months may impact the ability of water supply systems. Increasing water temperatures in rivers and streams will affect aquatic health and reduce the capacity of streams to assimilate effluent wastewater treatment plants (NYSERDA 2011).

Figure 5.4.10-13 displays the project rainfall and frequency of extreme storms in New York State. The amount of rain fall in a 100-year event is projected to increase, while the number of years between such storms (return period) is projected to decrease. Rainstorms will become more severe and more frequent (NYSERDA 2011).

Figure 5.4.10-13. Projected Rainfall and Frequency of Extreme Storms



Source: NYSERDA 2011

Total precipitation amounts have slightly increased in the Northeast U.S., by approximately 3.3 inches over the last 100 years. There has also been an increase in the number of two-inch rainfall events over a 48-hour period since the 1950s (a 67-percent increase). The number and intensity of extreme precipitation events are increasing in New York State as well. More rain heightens the danger of localized flash flooding, streambank erosion and storm damage (DeGaetano et al [Cornell University] 2010).

As oceans warm, the length of hurricane season may expand. The past five hurricane seasons have featured a tropical system occurring before the official start of the season. In 2016, a very rare winter hurricane named Alex developed in the middle of January (BBC 2019). According to NOAA's database, 39 storms formed in the Atlantic Basin before June 1 from 1851 through 2020, a long-term average of one such early storm every four to five years. The 2010s had the most such storms, and there has been a steady increase since the 1990s. However, the 1950s had six such storms, the 1930s had four and there was another four preseason storm streak from 1887 through 1890. It is possible there were other such storms in the era before satellites – before the mid-1960s – that were missed by ship observations or reports from areas impacted. It remains to be seen if expansion of the traditional hurricane season is a long-term trend or a common occurrence (Weather.com 2020).

Impacts of climate change can lead to shoreline erosion, coastal flooding, and water pollution; affecting man-made coastal infrastructures and coastal ecosystems. Coastal areas may be impacted by climate change in different ways. These areas are sensitive to sea level rise, changes in the frequency and intensity of storms, increase in precipitation, and warmer ocean temperatures (USEPA 2017). Temperatures are predicted to increase in Suffolk County and ocean temperatures are forecast to continue to increase, which may lead to an increase in intensity and frequency of hurricanes. It remains to be seen if other factors such as steering currents, atmospheric sheer, and the presence of Saharan dust will be impacted in ways which increase or decrease the risk of hurricanes in Suffolk County.

Vulnerability Assessment

A probabilistic assessment was conducted for the 100- and 500-year MRPs through a Level 2 analysis in Hazus to analyze the hurricane hazard and provide a range of loss estimates due to wind impacts. Storm surge impacts were assessed using SLOSH data from NOAA's National Hurricane Center. Refer to Section 5.2 (Methodology and Tools) for additional details on the methodology used to assess coastal storm risk.

Impact on Life, Health and Safety

The impact of a coastal storm on life, health and safety is dependent upon several factors including the severity of the event and whether adequate warning time was provided to residents. Approximately 17.8-percent of Suffolk County's residents (or 264,571 people) live in Category 4 hurricane storm surge inundation area (2014-2018 ACS 5-year Estimate). Further, approximately 3-percent of the population is exposed to Category 1 storm surge impacts. The coastal storm events can displace population and/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. Please refer to Section 4 (County Profile) for more information about Suffolk County's demographics to gain more insight about persons vulnerable to this hazard.

The loss associated with coastal storms can vary across the County. Secondary flooding associated with the torrential downpours during hurricanes/tropical storms are also a concern (refer to Section 5.4.8 - Flood). The estimated population living in the Category 1 through 4 SLOSH inundation zones is summarized in Table 5.4.10-5 by jurisdiction. Overall, the Town of Islip has the greatest number of residents in the SLOSH inundation areas.

Table 5.4.10-5. Approximate Population Residing in the SLOSH Hurricane Inundation Zones

Jurisdiction	Total Population (ACS 2014 - 2018)	Estimated Population in SLOSH Inundation Zones							
		Cat 1	Percent (%) of Total	Cat 2	Percent (%) of Total	Cat 3	Percent (%) of Total	Cat 4	Percent (%) of Total
Amityville (V)	9,452	2,081	22.0%	5,167	54.7%	7,539	79.8%	8,739	92.5%
Asharoken (V)	443	243	54.9%	291	65.7%	318	71.9%	347	78.4%
Babylon (T)	162,968	9,192	5.6%	20,826	12.8%	30,566	18.8%	40,409	24.8%
Babylon (V)	12,089	2,147	17.8%	7,048	58.3%	11,678	96.6%	12,089	100.0%
Belle Terre (V)	681	0	0.0%	2	0.3%	4	0.6%	4	0.6%
Bellport (V)	2,008	24	1.2%	73	3.6%	238	11.9%	415	20.7%

Jurisdiction	Total Population (ACS 2014 - 2018)	Estimated Population in SLOSH Inundation Zones							
		Cat 1	Percent (%) of Total	Cat 2	Percent (%) of Total	Cat 3	Percent (%) of Total	Cat 4	Percent (%) of Total
Brightwaters (V)	3,069	332	10.8%	507	16.5%	1,043	34.0%	1,625	53.0%
Brookhaven (T)	448,342	10,077	2.2%	22,515	5.0%	34,913	7.8%	48,060	10.7%
Dering Harbor (V)	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
East Hampton (T)	18,685	429	2.3%	1,336	7.2%	2,435	13.0%	3,326	17.8%
East Hampton (V)	1,034	5	0.5%	32	3.1%	76	7.4%	144	13.9%
Greenport (V)	1,945	108	5.6%	319	16.4%	1,085	55.8%	1,862	95.7%
Head of the Harbor (V)	1,463	3	0.2%	3	0.2%	3	0.2%	12	0.8%
Huntington (T)	189,840	392	0.2%	706	0.4%	1,152	0.6%	1,783	0.9%
Huntington Bay (V)	1,366	91	6.7%	146	10.7%	239	17.5%	356	26.1%
Islandia (V)	3,345	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Islip (T)	326,416	10,242	3.1%	26,470	8.1%	53,773	16.5%	83,489	25.6%
Lake Grove (V)	11,130	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Lindenhurst (V)	27,053	2,481	9.2%	8,826	32.6%	17,164	63.4%	22,410	82.8%
Lloyd Harbor (V)	3,676	21	0.6%	85	2.3%	174	4.7%	271	7.4%
Nissequogue (V)	1,574	37	2.4%	95	6.1%	122	7.7%	156	9.9%
North Haven (V)	919	31	3.4%	112	12.2%	354	38.6%	458	49.8%
Northport (V)	7,348	38	0.5%	87	1.2%	142	1.9%	263	3.6%
Ocean Beach (V)	24	18	75.2%	23	96.9%	24	100.0%	24	100.0%
Old Field (V)	812	33	4.1%	101	12.5%	157	19.3%	223	27.4%
Patchogue (V)	12,398	362	2.9%	2,645	21.3%	5,591	45.1%	7,100	57.3%
Poquott (V)	992	11	1.1%	24	2.4%	39	4.0%	61	6.1%
Port Jefferson (V)	7,871	31	0.4%	67	0.8%	156	2.0%	192	2.4%
Quogue (V)	803	163	20.3%	321	40.0%	420	52.3%	542	67.5%
Riverhead (T)	33,625	749	2.2%	1,570	4.7%	3,127	9.3%	4,077	12.1%
Sag Harbor (V)	2,184	136	6.2%	271	12.4%	563	25.8%	723	33.1%
Sagaponack (V)	260	4	1.6%	21	8.2%	43	16.6%	70	26.8%
Saltaire (V)	8	6	74.6%	8	96.4%	8	99.5%	8	99.7%
Shelter Island (T)	2,744	47	1.7%	209	7.6%	569	20.7%	783	28.5%
Shoreham (V)	437	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Smithtown (T)	112,224	27	0.0%	108	0.1%	212	0.2%	462	0.4%
Southampton (T)	51,008	3,403	6.7%	6,316	12.4%	10,894	21.4%	14,483	28.4%
Southampton (V)	3,263	82	2.5%	217	6.6%	397	12.2%	612	18.8%
Southold (T)	20,202	899	4.4%	2,310	11.4%	5,006	24.8%	7,172	35.5%
Village of the Branch (V)	1,770	0	0.0%	0	0.0%	0	0.0%	0	0.0%
West Hampton Dunes (V)	69	40	57.6%	68	98.9%	69	100.0%	69	100.0%
Westhampton Beach (V)	1,653	546	33.0%	782	47.3%	968	58.5%	1,121	67.8%
Shinnecock Tribal Nation	662	35	5.3%	121	18.3%	278	42.1%	392	59.3%
Unkechaug Tribal Nation	324	52	16.0%	101	31.3%	162	50.0%	241	74.3%
Suffolk County (Total)	**1,488,179**	**44,616**	**3.0%**	**109,929**	**7.4%**	**191,703**	**12.9%**	**264,571**	**17.8%**

Source: American Community Survey 2018, NYS/NOAA 2010; Suffolk County GIS 2020

Notes: Cat = Category, T = Town, V = Village, % = Percent, SLOSH = Sea, Lake and Overland Surge from Hurricanes

Research has shown that some populations, while they may not have more hazard exposure, may experience exacerbated impacts and prolonged recovery if/when impacted. This is due to many factors including their physical and financial ability to react or respond during a hazard. The population over the age of 65 is more vulnerable and, physically, they may have more difficulty evacuating. They may require extra time or outside assistance during evacuations and are more likely to seek or need medical attention which may not be available due to isolation during a storm event. According to the 5-Year 2018 ACS population estimates, there are 239,284 persons over the age of 65 and 104,660 persons living in poverty in Suffolk County.

The CDC 2016 Social Vulnerability Index (SVI) ranks U.S. Census tracts on socioeconomic status, household composition and disability, minority status and language, and housing and transportation. Suffolk County's overall score is 0.2318, indicating that its communities have low social vulnerability (CDC 2016). The CDC SVI map shows that vulnerability is fairly distributed throughout the County but is generally concentrated in the interior and southern coastal jurisdictions. Coastal jurisdictions ranking higher in their vulnerability scores for CDC's housing and transportation category may be at greater risk during hurricane events because of potential connection issues or lack of access to evacuation routes.

Residents may be displaced or require temporary to long-term sheltering. Hazus estimates that the Town of Southampton will have the greatest number of households displaced and number of persons requiring short-term shelter during a 100-year MRP wind event; 287 households and 63 persons total. Hazus estimates that the Town of Brookhaven will have the greatest number of households displaced and number of persons requiring short-term shelter during a 500-year MRP wind event; 7,651 households and 1,559 persons total. Table 5.4.10-6 summarizes the number of households that will be displaced and number of residents that will require short-term sheltering. There are less people estimated to require short-term sheltering because a portion will temporarily stay with local friends or family instead of relying on public resources. Please note these estimates are based on wind speed only and do not account for sheltering needs associated with flooding and storm surge that may accompany coastal storm events.

Table 5.4.10-6. Sheltering Needs for the 100- and 500-year MRP Hurricane Event

Jurisdiction	100-Year MRP		500-Year MRP	
	Displaced Households	People Requiring Short-Term Shelter	Displaced Households	People Requiring Short-Term Shelter
Amityville (V)	0	0	59	13
Asharoken (V)	0	0	9	2
Babylon (T)	0	0	634	141
Babylon (V)	0	0	75	15
Belle Terre (V)	0	0	37	7
Bellport (V)	2	0	104	21
Brightwaters (V)	0	0	35	7
Brookhaven (T)	108	22	7,651	1,559
Dering Harbor (V)	1	0	0	0
East Hampton (T)	16	3	7	1
East Hampton (V)	1	0	0	0
Greenport (V)	14	4	8	2
Head of the Harbor (V)	0	0	7	1
Huntington (T)	0	0	785	153

Jurisdiction	100-Year MRP		500-Year MRP	
	Displaced Households	People Requiring Short-Term Shelter	Displaced Households	People Requiring Short-Term Shelter
Huntington Bay (V)	0	0	17	3
Islandia (V)	0	0	19	5
Islip (T)	12	2	3,665	748
Lake Grove (V)	0	0	154	29
Lindenhurst (V)	0	0	112	22
Lloyd Harbor (V)	0	0	7	1
Nissequogue (V)	0	0	10	2
North Haven (V)	11	2	2	1
Northport (V)	0	0	66	12
Ocean Beach (V)	0	0	2	0
Old Field (V)	0	0	31	5
Patchogue (V)	14	4	382	100
Poquott (V)	0	0	10	2
Port Jefferson (V)	0	0	147	28
Quogue (V)	40	8	16	3
Riverhead (T)	39	9	263	60
Sag Harbor (V)	5	1	1	0
Sagaponack (V)	2	0	1	0
Saltaire (V)	0	0	2	0
Shelter Island (T)	16	3	2	0
Shoreham (V)	0	0	6	1
Smithtown (T)	0	0	810	150
Southampton (T)	287	63	143	32
Southampton (V)	22	4	7	1
Southold (T)	95	19	71	14
Village of the Branch (V)	0	0	14	3
West Hampton Dunes (V)	1	0	3	1
Westhampton Beach (V)	17	4	17	3
Shinnecock Tribal Nation	6	1	2	0
Unkechaug Tribal Nation	1	0	8	2
Suffolk County (Total)	**710**	**150**	**15,404**	**3,154**

Source: Hazus v 4.2
Notes: V = Village, T = Town
**Note: Population results are referencing 2010 Census population statistics. Results may be under-estimated.*

Impact on General Building Stock

Wind Only Impacts

Damage to buildings is dependent upon several factors, including wind speed, storm duration, and path of the storm track. Building construction also plays a major role in the extent of damage resulting from a coastal storm.

Due to differences in construction, residential structures are generally more susceptible to wind damage than commercial and industrial structures. Wood and masonry buildings, in general, regardless of their occupancy class, tend to experience more damage than concrete or steel buildings. Furthermore, high-rise buildings are also very vulnerable structures.

To better understand these risks, Hazus was used to estimate the expected wind-related building damages. Hazus estimates $5.3 billion of replacement cost damages and $32.6 billion of replacement cost damages for the 100- and 500-year MRP wind events, respectively (refer to Table 5.4.10-9). Specific types of wind damages are also summarized in Hazus at the following wind damage categories: no damage/very minor damage, minor damage, moderate damage, severe damage, and total destruction. Table 5.4.10-7 summarizes the definition of the damage categories.

Table 5.4.10-7. 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
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
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
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
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
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 Hurricane Technical Manual

Table 5.4.10-8 summarizes the estimated severity of building damage estimated for the 100- and 500-year MRP hurricane wind-only events. Hazus estimated damages are summarized by general occupancy classes.

Table 5.4.10-8. Expected Building Damage by Occupancy Class for 100- and 500-Year Hurricane Events for Suffolk County

Occupancy Class	Total Number of Buildings in Occupancy	Severity of Expected Damage	100-year MRP Event		500-year MRP	
			Building Count	Percent (%) Buildings in Occupancy Class	Building Count	Percent (%) Buildings in Occupancy Class
Residential Exposure (Single and Multi-	492,825	None	455,585	92.4%	272,946	55.4%
		Minor	30,178	6.1%	151,255	30.7%
		Moderate	5,573	1.1%	47,633	9.7%

Occupancy Class	Total Number of Buildings in Occupancy	Severity of Expected Damage	100-year MRP Event		500-year MRP	
			Building Count	Percent (%) Buildings in Occupancy Class	Building Count	Percent (%) Buildings in Occupancy Class
Family Dwellings)		Severe	701	0.1%	9,385	1.9%
		Complete Destruction	788	0.2%	11,606	2.4%
Commercial Buildings	26,925	None	24,509	91.0%	15,335	57.0%
		Minor	1,638	6.1%	5,609	20.8%
		Moderate	667	2.5%	4,622	17.2%
		Severe	110	0.4%	1,357	5.0%
		Complete Destruction	0	0.0%	2	0.0%
Industrial Buildings	3,227	None	3,146	97.5%	2,051	63.6%
		Minor	65	2.0%	651	20.2%
		Moderate	14	0.4%	422	13.1%
		Severe	2	0.1%	102	3.2%
		Complete Destruction	0	0.0%	0	0.0%
Government, Religion, Agricultural, and Education Buildings	10,302	None	9,048	87.8%	6,156	59.8%
		Minor	1,022	9.9%	2,077	20.2%
		Moderate	505	4.9%	1,569	15.2%
		Severe	91	0.9%	501	4.9%
		Complete Destruction	0	0.0%	1	0.0%

Source: Hazus 4.2

Hazus estimates that majority of the damages will occur to residential structures in the County for both the 100- and 500-year MRP wind events; approximately $4.9 billion and $26.3 billion, respectively. Table 5.4.10-9 also summarizes Hazus-estimated damages for commercial and all other occupancy classes for the 100- and 500-year MRP wind events.

Losses will vary between the 100- and 500-year MRP wind events based on the spatial relationship the Hazus probabilistic storm track has with the County and its jurisdictions. As a result of modeling, wind speeds will change between the storms and may decrease for some jurisdictions, while wind speeds may increase for other jurisdictions. Jurisdictions that experience an increase in wind speed may anticipate greater building damages. For example, the Village of North Haven, the Town of Southampton, and the Village of Quogue are amongst 13 of the total jurisdictions that experience a decrease in damages from the 100-year and 500-year MRP wind events (i.e., a decrease of $77.9 million, $703.8 million, and $157.9 million, respectively). Again, this is due to the spatial relationship between the storm track location, wind speeds and relative location to the jurisdiction.

Table 5.4.10-9. Estimated Building Damage (Structure and Content) by the 100-Year and 500-Year MRP Hurricane-Related Winds

Jurisdiction	Total RCV (All Occupancies)	Estimated Total Damages		Percent (%) of Total Building and Contents RCV		Estimated Residential Damages		Estimated Commercial Damages		Estimated Damages for All Other Occupancies	
		100-Year	500-Year	100-Year	500-Year	100-Year	500-Year	100-Year	500-Year	100-Year	500-Year
Amityville (V)	$5,519,611,238	$945,303	$96,899,650	0.0%	1.8%	$805,425	$75,148,912	$63,121	$10,215,648	$76,757	$11,535,091
Asharoken (V)	$379,192,198	$43,056	$22,411,143	0.0%	5.9%	$43,056	$21,387,141	$0	$198,479	$0	$825,523
Babylon (T)	$82,740,965,827	$14,345,702	$1,239,170,619	0.0%	1.5%	$12,115,895	$951,667,995	$761,936	$104,374,374	$1,467,870	$183,128,250
Babylon (V)	$6,110,029,951	$2,540,568	$144,850,738	0.0%	2.4%	$2,421,198	$114,788,769	$68,339	$16,529,339	$51,031	$13,532,630
Belle Terre (V)	$680,761,603	$1,317,918	$96,426,884	0.2%	14.2%	$1,301,317	$83,609,299	$14,553	$11,152,955	$2,048	$1,664,630
Bellport (V)	$2,358,752,934	$17,458,495	$296,930,235	0.7%	12.6%	$14,989,392	$226,313,460	$1,853,136	$52,659,626	$615,967	$17,957,149
Brightwaters (V)	$1,932,120,865	$3,427,345	$105,075,450	0.2%	5.4%	$3,376,124	$94,943,831	$47,908	$9,387,719	$3,313	$743,900
Brookhaven (T)	$221,811,756,528	$683,555,196	$14,375,209,131	0.3%	6.5%	$635,643,674	$11,823,900,049	$34,975,636	$1,790,217,319	$12,935,886	$761,091,763
Dering Harbor (V)	$88,595,797	$8,420,612	$2,382,664	9.5%	2.7%	$7,846,812	$2,307,947	$363,924	$47,657	$209,877	$27,060
East Hampton (T)	$26,516,571,402	$254,952,633	$153,880,323	1.0%	0.6%	$248,040,987	$151,471,094	$4,258,668	$1,621,772	$2,652,978	$787,456
East Hampton (V)	$5,002,346,911	$49,900,963	$33,663,821	1.0%	0.7%	$47,695,609	$32,597,242	$1,503,121	$736,404	$702,233	$330,175
Greenport (V)	$1,316,147,268	$21,836,389	$11,865,792	1.7%	0.9%	$15,513,082	$9,006,282	$5,523,573	$2,521,267	$799,734	$338,243
Head of the Harbor (V)	$1,052,509,872	$1,023,337	$43,233,300	0.1%	4.1%	$1,015,884	$41,014,418	$3,591	$1,156,064	$3,863	$1,062,818
Huntington (T)	$82,709,382,979	$12,308,116	$1,740,271,489	0.0%	2.1%	$11,885,787	$1,434,322,685	$213,063	$186,283,987	$209,266	$119,664,817
Huntington Bay (V)	$642,162,208	$61,484	$38,042,006	0.0%	5.9%	$61,484	$30,166,632	$0	$6,637,836	$0	$1,237,538
Islandia (V)	$4,798,220,611	$1,741,924	$94,416,665	0.0%	2.0%	$1,374,719	$44,679,176	$318,344	$42,704,710	$48,861	$7,032,779
Islip (T)	$157,009,867,271	$193,678,458	$6,781,377,427	0.1%	4.3%	$184,367,480	$5,292,151,940	$6,134,826	$954,592,145	$3,176,153	$534,633,342
Lake Grove (V)	$4,999,176,933	$4,452,258	$287,082,784	0.1%	5.7%	$4,385,846	$256,817,363	$51,111	$22,523,802	$15,301	$7,741,619
Lindenhurst (V)	$9,110,586,538	$2,512,627	$180,035,671	0.0%	2.0%	$2,351,134	$153,907,804	$84,142	$13,660,290	$77,351	$12,467,577
Lloyd Harbor (V)	$2,057,808,899	$513	$38,754,364	0.0%	1.9%	$513	$36,374,049	$0	$391,418	$0	$1,988,897
Nissequogue (V)	$1,430,093,283	$1,415,597	$59,814,848	0.1%	4.2%	$1,405,623	$56,960,197	$4,849	$1,501,528	$5,125	$1,353,123
North Haven (V)	$2,221,433,929	$112,961,509	$35,037,780	5.1%	1.6%	$108,926,049	$34,093,528	$2,875,685	$766,883	$1,159,776	$177,370
Northport (V)	$2,610,724,998	$554,242	$93,299,304	0.0%	3.6%	$554,242	$80,069,579	$0	$8,999,993	$0	$4,229,732
Ocean Beach (V)	$483,689,958	$854,128	$23,602,300	0.2%	4.9%	$798,278	$20,378,094	$26,257	$1,505,423	$29,592	$1,718,782

Jurisdiction	Total RCV (All Occupancies)	Estimated Total Damages		Percent (%) of Total Building and Contents RCV		Estimated Residential Damages		Estimated Commercial Damages		Estimated Damages for All Other Occupancies	
		100-Year	500-Year	100-Year	500-Year	100-Year	500-Year	100-Year	500-Year	100-Year	500-Year
Old Field (V)	$967,667,970	$1,638,722	$135,903,473	0.2%	14.0%	$1,611,617	$119,456,992	$19,002	$11,001,743	$8,104	$5,444,738
Patchogue (V)	$11,533,289,631	$26,247,711	$676,669,280	0.2%	5.9%	$22,704,381	$385,610,027	$3,267,022	$271,125,340	$276,308	$19,933,913
Poquott (V)	$540,263,069	$509,747	$42,525,408	0.1%	7.9%	$500,963	$37,201,082	$6,257	$3,627,947	$2,527	$1,696,379
Port Jefferson (V)	$10,546,648,033	$5,808,164	$543,911,941	0.1%	5.2%	$5,458,582	$318,659,089	$321,981	$205,113,157	$27,601	$20,139,695
Quogue (V)	$5,371,998,365	$352,731,068	$194,843,102	6.6%	3.6%	$337,279,137	$187,381,266	$10,874,385	$5,334,190	$4,577,547	$2,127,645
Riverhead (T)	$27,561,801,284	$156,399,804	$655,529,542	0.6%	2.4%	$97,513,242	$376,754,184	$21,587,973	$128,341,924	$37,298,588	$150,433,434
Sag Harbor (V)	$3,157,033,580	$60,146,353	$21,642,934	1.9%	0.7%	$57,968,847	$21,077,414	$1,457,352	$415,073	$720,155	$150,447
Sagaponack (V)	$3,548,811,980	$81,330,105	$41,448,250	2.3%	1.2%	$77,170,430	$39,826,416	$2,384,775	$982,316	$1,774,900	$639,518
Saltaire (V)	$406,571,331	$1,325,556	$36,629,383	0.3%	9.0%	$1,238,880	$31,625,606	$40,750	$2,336,328	$45,926	$2,667,449
Shelter Island (T)	$3,894,434,021	$139,056,165	$39,346,798	3.6%	1.0%	$129,580,547	$38,112,936	$6,009,755	$787,002	$3,465,863	$446,860
Shoreham (V)	$381,052,410	$1,056,147	$20,866,074	0.3%	5.5%	$1,029,586	$17,616,303	$19,339	$2,362,771	$7,222	$887,001
Smithtown (T)	$62,086,530,012	$31,413,260	$2,017,989,598	0.1%	3.3%	$30,007,838	$1,658,798,882	$1,170,757	$287,998,548	$234,664	$71,192,168
Southampton (T)	$69,558,169,929	$2,097,026,596	$1,393,201,329	3.0%	2.0%	$1,983,622,938	$1,321,080,851	$70,264,386	$44,984,555	$43,139,272	$27,135,923
Southampton (V)	$13,027,590,722	$372,843,398	$174,602,021	2.9%	1.3%	$339,575,178	$162,244,142	$25,800,748	$9,841,846	$7,467,472	$2,516,034
Southold (T)	$17,842,698,534	$374,581,760	$292,464,354	2.1%	1.6%	$282,602,676	$217,388,684	$50,350,287	$31,282,473	$41,628,797	$43,793,198
Village of the Branch (V)	$1,414,333,647	$678,491	$41,106,762	0.0%	2.9%	$650,639	$32,646,170	$18,583	$5,544,578	$9,268	$2,916,014
West Hampton Dunes (V)	$766,363,715	$13,853,403	$42,014,127	1.8%	5.5%	$13,366,431	$39,108,935	$235,567	$1,887,951	$251,406	$1,017,241
Westhampton Beach (V)	$5,590,458,778	$183,745,477	$186,906,467	3.3%	3.3%	$169,726,590	$172,390,558	$9,198,379	$9,477,992	$4,820,507	$5,037,916
Shinnecock Tribal Nation	$155,005,274	$44,952,341	$18,508,419	29.0%	11.9%	$41,453,576	$17,443,607	$2,617,059	$834,031	$881,705	$230,781
Unkechaug Tribal Nation	$55,549,783	$2,401,693	$10,387,234	4.3%	18.7%	$2,359,333	$10,130,863	$42,359	$256,371	$0	$0
Suffolk County (Total)	**$861,988,782,069**	**$5,338,054,335**	**$32,580,230,887**	**0.6%**	**3.8%**	**$4,902,341,020**	**$26,272,631,493**	**$264,832,501**	**$4,263,922,777**	**$170,880,813**	**$2,043,676,618**

Source: Hazus 4.2
**Total Damages is sum of damages for all occupancy classes (residential, commercial, industrial, agricultural, educational, religious and government).*
Notes: RCV = Replacement Cost Value, V = Village, T = Town

Storm Surge Hurricane Impacts

To estimate potential building exposure to storm surge, the SLOSH inundation zones were used. The estimated total number of buildings and replacement cost value (structure and contents) located in Categories 1 through 4 SLOSH inundation zones are summarized in Table 5.4.10-10 and Table 5.4.10-11. Overall, the Town of Brookhaven has the greatest number of buildings in the SLOSH Category 1 and 2 inundation areas and the Town of Islip has the greatest number of buildings in the SLOSH Category 3 and 4 inundation areas. The Village of Babylon, the Village of Ocean Beach, and the Village of West Hampton Dunes have 100-percent of their buildings located in the SLOSH Category 4 inundation area, which totals approximately $6.1 billion, $483.7 million, and $766.4 million, respectively.

Table 5.4.10-10. Number of Buildings Located in the Hurricane Inundation Zones

Jurisdiction	Total Number of Buildings	Number of Buildings in SLOSH Inundation Zones							
		Cat 1	% Total	Cat 2	% Total	Cat 3	% Total	Cat 4	% Total
Amityville (V)	4,161	872	21.0%	2,143	51.5%	3,256	78.3%	3,851	92.5%
Asharoken (V)	321	169	52.6%	203	63.2%	223	69.5%	243	75.7%
Babylon (T)	51,514	2,752	5.3%	6,366	12.4%	9,397	18.2%	12,509	24.3%
Babylon (V)	4,957	855	17.2%	2,918	58.9%	4,795	96.7%	4,957	100.0%
Belle Terre (V)	316	0	0.0%	1	0.3%	2	0.6%	2	0.6%
Bellport (V)	1,206	14	1.2%	41	3.4%	137	11.4%	236	19.6%
Brightwaters (V)	1,162	122	10.5%	187	16.1%	381	32.8%	622	53.5%
Brookhaven (T)	154,866	3,467	2.2%	7,654	4.9%	11,852	7.7%	16,348	10.6%
Dering Harbor (V)	41	0	0.0%	0	0.0%	3	7.3%	9	22.0%
East Hampton (T)	18,243	493	2.7%	1,384	7.6%	2,444	13.4%	3,300	18.1%
East Hampton (V)	1,938	8	0.4%	55	2.8%	146	7.5%	269	13.9%
Greenport (V)	982	80	8.1%	188	19.1%	584	59.5%	945	96.2%
Head of the Harbor (V)	527	1	0.2%	1	0.2%	1	0.2%	4	0.8%
Huntington (T)	62,226	217	0.3%	377	0.6%	567	0.9%	789	1.3%
Huntington Bay (V)	593	50	8.4%	73	12.3%	113	19.1%	166	28.0%
Islandia (V)	1,039	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Islip (T)	86,764	2,840	3.3%	7,374	8.5%	14,765	17.0%	22,894	26.4%
Lake Grove (V)	3,693	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Lindenhurst (V)	9,387	863	9.2%	3,076	32.8%	6,016	64.1%	7,810	83.2%
Lloyd Harbor (V)	1,301	20	1.5%	43	3.3%	73	5.6%	105	8.1%
Nissequogue (V)	638	17	2.7%	39	6.1%	49	7.7%	64	10.0%
North Haven (V)	772	26	3.4%	93	12.0%	299	38.7%	386	50.0%
Northport (V)	2,702	24	0.9%	44	1.6%	83	3.1%	130	4.8%
Ocean Beach (V)	530	405	76.4%	512	96.6%	530	100.0%	530	100.0%
Old Field (V)	391	16	4.1%	56	14.3%	83	21.2%	114	29.2%
Patchogue (V)	3,900	136	3.5%	805	20.6%	1,659	42.5%	2,156	55.3%
Poquott (V)	379	4	1.1%	9	2.4%	15	4.0%	23	6.1%
Port Jefferson (V)	3,133	28	0.9%	86	2.7%	151	4.8%	181	5.8%
Quogue (V)	1,785	333	18.7%	680	38.1%	918	51.4%	1,193	66.8%
Riverhead (T)	16,853	327	1.9%	684	4.1%	1,402	8.3%	1,851	11.0%
Sag Harbor (V)	1,887	143	7.6%	264	14.0%	525	27.8%	664	35.2%

Jurisdiction	Total Number of Buildings	Number of Buildings in SLOSH Inundation Zones							
		Cat 1	% Total	Cat 2	% Total	Cat 3	% Total	Cat 4	% Total
Sagaponack (V)	908	15	1.7%	70	7.7%	151	16.6%	246	27.1%
Saltaire (V)	399	298	74.7%	385	96.5%	397	99.5%	398	99.7%
Shelter Island (T)	2,729	59	2.2%	221	8.1%	555	20.3%	758	27.8%
Shoreham (V)	216	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Smithtown (T)	35,517	18	0.1%	47	0.1%	86	0.2%	165	0.5%
Southampton (T)	33,290	2,143	6.4%	3,977	11.9%	6,848	20.6%	9,115	27.4%
Southampton (V)	3,500	84	2.4%	224	6.4%	406	11.6%	637	18.2%
Southold (T)	15,123	684	4.5%	1,672	11.1%	3,519	23.3%	5,020	33.2%
Village of the Branch (V)	624	0	0.0%	0	0.0%	0	0.0%	0	0.0%
West Hampton Dunes (V)	279	161	57.7%	276	98.9%	279	100.0%	279	100.0%
Westhampton Beach (V)	1,965	585	29.8%	861	43.8%	1,114	56.7%	1,303	66.3%
Shinnecock Tribal Nation	378	20	5.3%	69	18.3%	159	42.1%	224	59.3%
Unkechaug Tribal Nation	144	23	16.0%	45	31.3%	72	50.0%	107	74.3%
Suffolk County (Total)	**533,279**	**18,372**	**3.4%**	**43,203**	**8.1%**	**74,055**	**13.9%**	**100,603**	**18.9%**

Source: NYS/NOAA 2010; Suffolk County GIS 2020; Suffolk County Real Property Tax Service, 2020; Microsoft, 2018, Open Street Map, 2019
Notes: RCV = Replacement Cost Value, V = Village, T = Town, SLOSH = Sea, Lake and Overland Surge from Hurricanes, % = Percent, Cat = Category

Table 5.4.10-11. Estimated Building Replacement Cost Value in the Hurricane Inundation Zones

Jurisdiction	Total Replacement Cost Value (RCV)	Estimated RCV in SLOSH Inundation Zones							
		Cat 1	Percent (%) Total	Cat 2	Percent (%) Total	Cat 3	Percent (%) Total	Cat 4	Percent (%) Total
Amityville (V)	$5,519,611,238	$694,429,216	12.6%	$1,747,833,143	31.7%	$3,649,452,691	66.1%	$5,157,944,285	93.4%
Asharoken (V)	$379,192,198	$168,723,598	44.5%	$203,456,802	53.7%	$231,320,175	61.0%	$251,442,675	66.3%
Babylon (T)	$82,740,965,827	$1,994,340,176	2.4%	$7,245,530,753	8.8%	$11,242,406,608	13.6%	$15,088,132,507	18.2%
Babylon (V)	$6,110,029,951	$844,424,401	13.8%	$3,994,913,582	65.4%	$5,977,458,213	97.8%	$6,110,029,951	100.0%
Belle Terre (V)	$680,761,603	$0	0.0%	$2,338,200	0.3%	$4,269,000	0.6%	$4,269,000	0.6%
Bellport (V)	$2,358,752,934	$28,464,577	1.2%	$96,573,656	4.1%	$258,069,844	10.9%	$435,937,392	18.5%
Brightwaters (V)	$1,932,120,865	$255,351,270	13.2%	$389,577,502	20.2%	$818,319,545	42.4%	$1,261,428,192	65.3%
Brookhaven (T)	$221,811,756,528	$3,432,937,125	1.5%	$7,241,347,907	3.3%	$11,745,190,796	5.3%	$17,057,367,417	7.7%
Dering Harbor (V)	$88,595,797	$0	0.0%	$0	0.0%	$8,559,517	9.7%	$17,090,678	19.3%
East Hampton (T)	$26,516,571,402	$703,459,849	2.7%	$1,973,844,550	7.4%	$3,500,287,443	13.2%	$4,670,396,072	17.6%
East Hampton (V)	$5,002,346,911	$20,722,286	0.4%	$122,456,823	2.4%	$349,852,154	7.0%	$690,205,304	13.8%
Greenport (V)	$1,316,147,268	$166,871,256	12.7%	$465,427,779	35.4%	$977,186,811	74.2%	$1,278,616,089	97.1%
Head of the Harbor (V)	$1,052,509,872	$1,110,000	0.1%	$1,110,000	0.1%	$1,110,000	0.1%	$4,800,824	0.5%
Huntington (T)	$82,709,382,979	$756,046,336	0.9%	$1,181,579,925	1.4%	$1,488,863,232	1.8%	$1,728,973,895	2.1%
Huntington Bay (V)	$642,162,208	$70,696,188	11.0%	$101,484,888	15.8%	$141,014,702	22.0%	$202,363,455	31.5%
Islandia (V)	$4,798,220,611	$0	0.0%	$0	0.0%	$0	0.0%	$0	0.0%
Islip (T)	$157,009,867,271	$4,534,085,784	2.9%	$14,021,623,713	8.9%	$28,406,234,070	18.1%	$41,673,480,746	26.5%
Lake Grove (V)	$4,999,176,933	$0	0.0%	$0	0.0%	$0	0.0%	$0	0.0%
Lindenhurst (V)	$9,110,586,538	$748,873,206	8.2%	$2,751,039,163	30.2%	$6,298,982,593	69.1%	$7,930,026,787	87.0%
Lloyd Harbor (V)	$2,057,808,899	$38,145,623	1.9%	$85,723,587	4.2%	$124,373,662	6.0%	$172,028,093	8.4%
Nissequogue (V)	$1,430,093,283	$23,525,022	1.6%	$53,148,945	3.7%	$68,347,922	4.8%	$102,608,696	7.2%
North Haven (V)	$2,221,433,929	$58,052,089	2.6%	$264,139,949	11.9%	$851,461,316	38.3%	$1,093,661,673	49.2%
Northport (V)	$2,610,724,998	$42,120,935	1.6%	$78,235,197	3.0%	$222,718,566	8.5%	$286,747,049	11.0%
Ocean Beach (V)	$483,689,958	$393,307,864	81.3%	$468,714,219	96.9%	$483,689,958	100.0%	$483,689,958	100.0%
Old Field (V)	$967,667,970	$41,230,405	4.3%	$145,206,991	15.0%	$231,172,057	23.9%	$297,782,948	30.8%
Patchogue (V)	$11,533,289,631	$335,728,413	2.9%	$1,409,613,511	12.2%	$2,558,543,250	22.2%	$3,733,428,934	32.4%
Poquott (V)	$540,263,069	$3,004,113	0.6%	$10,991,794	2.0%	$25,544,360	4.7%	$41,007,714	7.6%

Jurisdiction	Total Replacement Cost Value (RCV)	Estimated RCV in SLOSH Inundation Zones							
		Cat 1	Percent (%) Total	Cat 2	Percent (%) Total	Cat 3	Percent (%) Total	Cat 4	Percent (%) Total
Port Jefferson (V)	$10,546,648,033	$516,038,221	4.9%	$1,921,803,818	18.2%	$3,199,901,440	30.3%	$3,526,219,504	33.4%
Quogue (V)	$5,371,998,365	$1,294,778,609	24.1%	$2,529,181,945	47.1%	$3,241,524,615	60.3%	$3,903,286,116	72.7%
Riverhead (T)	$27,561,801,284	$324,788,162	1.2%	$725,768,873	2.6%	$1,471,318,057	5.3%	$1,932,768,862	7.0%
Sag Harbor (V)	$3,157,033,580	$452,596,592	14.3%	$659,154,692	20.9%	$1,169,071,649	37.0%	$1,419,550,843	45.0%
Sagaponack (V)	$3,548,811,980	$41,959,920	1.2%	$241,599,210	6.8%	$579,692,435	16.3%	$886,833,727	25.0%
Saltaire (V)	$406,571,331	$302,623,189	74.4%	$393,142,731	96.7%	$405,037,131	99.6%	$406,208,931	99.9%
Shelter Island (T)	$3,894,434,021	$120,232,352	3.1%	$398,565,368	10.2%	$843,106,743	21.6%	$1,139,770,579	29.3%
Shoreham (V)	$381,052,410	$0	0.0%	$0	0.0%	$0	0.0%	$0	0.0%
Smithtown (T)	$62,086,530,012	$31,286,940	0.1%	$81,111,507	0.1%	$144,106,441	0.2%	$245,162,546	0.4%
Southampton (T)	$69,558,169,929	$4,790,300,922	6.9%	$8,652,737,925	12.4%	$14,175,855,397	20.4%	$18,963,926,697	27.3%
Southampton (V)	$13,027,590,722	$402,106,229	3.1%	$1,264,311,642	9.7%	$2,303,874,226	17.7%	$3,469,292,188	26.6%
Southold (T)	$17,842,698,534	$828,985,073	4.6%	$1,726,116,605	9.7%	$3,372,580,216	18.9%	$4,996,893,609	28.0%
Village of the Branch (V)	$1,414,333,647	$0	0.0%	$0	0.0%	$0	0.0%	$0	0.0%
West Hampton Dunes (V)	$766,363,715	$422,680,295	55.2%	$760,684,715	99.3%	$766,363,715	100.0%	$766,363,715	100.0%
Westhampton Beach (V)	$5,590,458,778	$1,664,810,467	29.8%	$2,524,030,073	45.1%	$3,437,879,463	61.5%	$3,957,785,199	70.8%
Shinnecock Tribal Nation	$155,005,274	$7,706,724	5.0%	$25,390,313	16.4%	$63,549,474	41.0%	$87,908,246	56.7%
Unkechaug Tribal Nation	$55,549,783	$6,868,379	12.4%	$14,810,152	26.7%	$28,056,257	50.5%	$40,207,590	72.4%
Suffolk County (Total)	**$861,988,782,069**	**$26,563,411,807**	**3.1%**	**$65,974,322,150**	**7.7%**	**$114,866,345,744**	**13.3%**	**$155,515,638,688**	**18.0%**

Source: NYS/NOAA 2010; Suffolk County GIS 2020; Suffolk County Real Property Tax Service, 2020; Microsoft, 2018, Open Street Map, 2019

Notes: T = Town, V = Village, % = Percent, Cat = Category, RCV = Replacement Cost Value, SLOSH = Sea, Lake and Overland Surge from Hurricanes

Impact on Land Uses

A spatial analysis was completed to assess the total acres of the County exposed to storm surge. To estimate the land use located in the Category 1 through Category 4 storm surge inundation zones, the SLOSH boundaries were overlaid upon the County boundary (refer to Table 5.4.10-12). Approximately 19.8-percent of the County is exposed to the highest storm surge category (i.e., Category 4).

Table 5.4.10-12. Total Acres of Suffolk County Exposed to SLOSH Categories 1 through 4

Boundary	Acres	Percent (%) of the County
Category 1	43,742	7.4%
Category 2	70,282	11.9%
Category 3	95,364	16.2%
Category 4	116,740	19.8%

Sources: NYS/NOAA 2010; Suffolk County GIS 2020
Note: The County boundary includes all land area, including waterbodies

Impact on Critical Facilities

Critical facilities and lifelines are at risk of being impacted by high winds associated with structural damage, or falling tree limbs/flying debris, which can result in the loss of power. Power loss can greatly impact households, business operations, public utilities, and emergency personnel. For example, vulnerable populations in Suffolk County are at risk if power loss results in interruption of heating and cooling services, stagnated hospital operations, and potable water supplies. Emergency personnel such as police, fire, and EMS will not be able to effectively respond in a power loss event to maintain the safety of its citizens if backup power is not available.

The critical facilities located in the Category 1 through 4 inundation zones are summarized in Table 5.4.10-13 through Table 5.4.10-16 by jurisdiction. These critical facilities were also categorized by FEMA's lifeline categories. The number of critical facilities labeled as a lifeline facility for the County that are exposed to the Category 1 through 4 SLOSH inundation areas is also summarized by Table 5.4.10-13 through Table 5.4.10-16. The County has the greatest number of buildings located in SLOSH Category 1 and 2 inundation areas.

Hazus estimates the probability that critical facilities (i.e., medical facilities, fire/EMS, police, EOC, schools, and user-defined facilities such as shelters and municipal buildings) may sustain damage as a result of 100-year and 500-year MRP wind-only events. Additionally, Hazus estimates the loss of use for each facility in number of days. Table 5.4.10-17 and Table 5.4.10-18 list the estimated loss of use in days for each critical facility and the probability of sustaining the damage category as defined by the column heading for the 100-year and 500-year wind-only events, respectively. The damage categories are defined in Table 5.4.10-7 under "Impact on General Building Stock". Overall, schools are at greatest risk of losing functionality during the 100- and 500-year MRP wind events.

Table 5.4.10-13. Critical Facilities and Lifelines Located in the Category 1 SLOSH Inundation Zones

Jurisdiction	Total Critical Facilities Located in Jurisdiction	Total Lifelines Located in Jurisdiction	Number of Critical Facilities and Lifelines Exposed to the Storm Surge Hazard Areas			
			Critical Facilities in SLOSH 1	% of Total Critical Facilities	Lifelines in SLOSH 1	% of Total Lifelines
Amityville (V)	85	62	2	0.0%	2	3.2%
Asharoken (V)	4	3	3	75.0%	2	66.7%
Babylon (T)	1,029	741	9	0.9%	7	0.9%
Babylon (V)	93	64	1	1.1%	1	1.6%
Belle Terre (V)	6	5	1	16.7%	1	20.0%
Bellport (V)	35	25	0	0.0%	0	0.0%
Brightwaters (V)	14	11	2	14.3%	2	18.2%
Brookhaven (T)	2,798	2,272	43	1.5%	40	1.8%
Dering Harbor (V)	2	2	0	0.0%	0	0.0%
East Hampton (T)	234	204	8	3.4%	6	2.9%
East Hampton (V)	37	23	1	2.7%	1	4.3%
Greenport (V)	33	20	6	18.2%	5	25.0%
Head of the Harbor (V)	11	9	0	0.0%	0	0.0%
Huntington (T)	961	664	12	1.2%	9	1.4%
Huntington Bay (V)	2	2	0	0.0%	0	0.0%
Islandia (V)	70	62	0	0.0%	0	0.0%
Islip (T)	2,275	1,740	45	2.0%	44	2.5%
Lake Grove (V)	50	38	0	0.0%	0	0.0%
Lindenhurst (V)	104	62	3	2.9%	2	3.2%
Lloyd Harbor (V)	16	12	1	6.3%	1	8.3%
Nissequogue (V)	7	4	0	0.0%	0	0.0%
North Haven (V)	3	1	0	0.0%	0	0.0%
Northport (V)	40	24	1	2.5%	1	4.2%
Ocean Beach (V)	5	4	5	100.0%	4	100.0%
Old Field (V)	4	3	0	0.0%	0	0.0%
Patchogue (V)	92	63	6	6.5%	6	9.5%

Jurisdiction	Total Critical Facilities Located in Jurisdiction	Total Lifelines Located in Jurisdiction	Number of Critical Facilities and Lifelines Exposed to the Storm Surge Hazard Areas			
			Critical Facilities in SLOSH 1	% of Total Critical Facilities	Lifelines in SLOSH 1	% of Total Lifelines
Poquott (V)	2	2	0	0.0%	0	0.0%
Port Jefferson (V)	95	71	5	5.3%	4	5.6%
Quogue (V)	19	13	4	21.1%	4	30.8%
Riverhead (T)	428	346	16	3.7%	16	4.6%
Sag Harbor (V)	37	24	3	8.1%	3	12.5%
Sagaponack (V)	3	3	1	33.3%	1	33.3%
Saltaire (V)	8	6	6	75.0%	5	83.3%
Shelter Island (T)	41	32	11	26.8%	11	34.4%
Shoreham (V)	7	5	0	0.0%	0	0.0%
Smithtown (T)	708	542	4	0.6%	4	0.7%
Southampton (T)	667	580	28	4.2%	27	4.7%
Southampton (V)	63	44	1	1.6%	1	2.3%
Southold (T)	275	230	11	4.0%	10	4.3%
Village of the Branch (V)	38	23	0	0.0%	0	0.0%
West Hampton Dunes (V)	5	5	3	60.0%	3	60.0%
Westhampton Beach (V)	47	39	13	27.7%	13	33.3%
Shinnecock Tribal Nation	22	22	2	9.1%	2	9.1%
Unkechaug Tribal Nation	11	10	2	18.2%	2	20.0%
Suffolk County (Total)	**10,486**	**8,117**	**259**	**2.5%**	**240**	**3.0%**

Source: Suffolk County GIS 2020; NYS/NOAA 2010
Notes: V = Village, T = Town, SLOSH = Sea, Lake and Overland Surge from Hurricanes; % = Percent

Table 5.4.10-14. Critical Facilities and Lifelines Located in the Category 2 SLOSH Inundation Zones

Jurisdiction	Total Critical Facilities Located in Jurisdiction	Total Lifelines Located in Jurisdiction	Number of Critical Facilities and Lifelines Exposed to the Storm Surge Hazard Areas			
			Critical Facilities in SLOSH 2	% of Total Critical Facilities	Lifelines in SLOSH 2	% of Total Lifelines
Amityville (V)	85	62	9	10.6%	6	7.1%
Asharoken (V)	4	3	3	75.0%	2	50.0%
Babylon (T)	1,029	741	63	6.1%	49	4.8%
Babylon (V)	93	64	57	61.3%	35	37.6%
Belle Terre (V)	6	5	1	16.7%	1	16.7%
Bellport (V)	35	25	0	0.0%	0	0.0%
Brightwaters (V)	14	11	4	28.6%	4	28.6%
Brookhaven (T)	2,798	2,272	78	2.8%	67	2.4%
Dering Harbor (V)	2	2	0	0.0%	0	0.0%
East Hampton (T)	234	204	15	6.4%	13	5.6%
East Hampton (V)	37	23	1	2.7%	1	2.7%
Greenport (V)	33	20	12	36.4%	11	33.3%
Head of the Harbor (V)	11	9	0	0.0%	0	0.0%
Huntington (T)	961	664	23	2.4%	19	2.0%
Huntington Bay (V)	2	2	0	0.0%	0	0.0%
Islandia (V)	70	62	0	0.0%	0	0.0%
Islip (T)	2,275	1,740	113	5.0%	95	4.2%
Lake Grove (V)	50	38	0	0.0%	0	0.0%
Lindenhurst (V)	104	62	23	22.1%	13	12.5%
Lloyd Harbor (V)	16	12	1	6.3%	1	6.3%
Nissequogue (V)	7	4	0	0.0%	0	0.0%
North Haven (V)	3	1	0	0.0%	0	0.0%
Northport (V)	40	24	1	2.5%	1	2.5%
Ocean Beach (V)	5	4	5	100.0%	4	80.0%
Old Field (V)	4	3	0	0.0%	0	0.0%
Patchogue (V)	92	63	14	15.2%	12	13.0%

Jurisdiction	Total Critical Facilities Located in Jurisdiction	Total Lifelines Located in Jurisdiction	Number of Critical Facilities and Lifelines Exposed to the Storm Surge Hazard Areas			
			Critical Facilities in SLOSH 2	% of Total Critical Facilities	Lifelines in SLOSH 2	% of Total Lifelines
Poquott (V)	2	2	0	0.0%	0	0.0%
Port Jefferson (V)	95	71	13	13.7%	11	11.6%
Quogue (V)	19	13	10	52.6%	8	42.1%
Riverhead (T)	428	346	21	4.9%	20	4.7%
Sag Harbor (V)	37	24	4	10.8%	4	10.8%
Sagaponack (V)	3	3	1	33.3%	1	33.3%
Saltaire (V)	8	6	8	100.0%	6	75.0%
Shelter Island (T)	41	32	14	34.1%	13	31.7%
Shoreham (V)	7	5	0	0.0%	0	0.0%
Smithtown (T)	708	542	4	0.6%	4	0.6%
Southampton (T)	667	580	50	7.5%	48	7.2%
Southampton (V)	63	44	2	3.2%	2	3.2%
Southold (T)	275	230	21	7.6%	19	6.9%
Village of the Branch (V)	38	23	0	0.0%	0	0.0%
West Hampton Dunes (V)	5	5	4	80.0%	4	80.0%
Westhampton Beach (V)	47	39	16	34.0%	16	34.0%
Shinnecock Tribal Nation	22	22	3	13.6%	3	13.6%
Unkechaug Tribal Nation	11	10	2	18.2%	2	18.2%
Suffolk County (Total)	**10,486**	**8,117**	**596**	**5.7%**	**495**	**4.7%**

Source: Suffolk County GIS 2020; NYS/NOAA 2010
Notes: V = Village, T = Town, SLOSH = Sea, Lake and Overland Surge from Hurricanes; % = Percent

Table 5.4.10-15. Critical Facilities and Lifelines Located in the Category 3 SLOSH Inundation Zones

Jurisdiction	Total Critical Facilities Located in Jurisdiction	Total Lifelines Located in Jurisdiction	Number of Critical Facilities and Lifelines Exposed to the Storm Surge Hazard Areas			
			Critical Facilities in SLOSH 3	% of Total Critical Facilities	Lifelines in SLOSH 3	% of Total Lifelines
Amityville (V)	85	62	51	60.0%	34	40.0%
Asharoken (V)	4	3	3	75.0%	2	50.0%
Babylon (T)	1,029	741	135	13.1%	94	9.1%
Babylon (V)	93	64	90	96.8%	61	65.6%
Belle Terre (V)	6	5	1	16.7%	1	16.7%
Bellport (V)	35	25	0	0.0%	0	0.0%
Brightwaters (V)	14	11	5	35.7%	4	28.6%
Brookhaven (T)	2,798	2,272	117	4.2%	97	3.5%
Dering Harbor (V)	2	2	0	0.0%	0	0.0%
East Hampton (T)	234	204	30	12.8%	24	10.3%
East Hampton (V)	37	23	2	5.4%	2	5.4%
Greenport (V)	33	20	18	54.5%	14	42.4%
Head of the Harbor (V)	11	9	0	0.0%	0	0.0%
Huntington (T)	961	664	30	3.1%	25	2.6%
Huntington Bay (V)	2	2	0	0.0%	0	0.0%
Islandia (V)	70	62	0	0.0%	0	0.0%
Islip (T)	2,275	1,740	306	13.5%	242	10.6%
Lake Grove (V)	50	38	0	0.0%	0	0.0%
Lindenhurst (V)	104	62	63	60.6%	39	37.5%
Lloyd Harbor (V)	16	12	1	6.3%	1	6.3%
Nissequogue (V)	7	4	0	0.0%	0	0.0%
North Haven (V)	3	1	2	66.7%	1	33.3%
Northport (V)	40	24	5	12.5%	4	10.0%
Ocean Beach (V)	5	4	5	100.0%	4	80.0%
Old Field (V)	4	3	0	0.0%	0	0.0%
Patchogue (V)	92	63	23	25.0%	20	21.7%

Jurisdiction	Total Critical Facilities Located in Jurisdiction	Total Lifelines Located in Jurisdiction	Number of Critical Facilities and Lifelines Exposed to the Storm Surge Hazard Areas			
			Critical Facilities in SLOSH 3	% of Total Critical Facilities	Lifelines in SLOSH 3	% of Total Lifelines
Poquott (V)	2	2	0	0.0%	0	0.0%
Port Jefferson (V)	95	71	22	23.2%	17	17.9%
Quogue (V)	19	13	12	63.2%	9	47.4%
Riverhead (T)	428	346	42	9.8%	39	9.1%
Sag Harbor (V)	37	24	16	43.2%	15	40.5%
Sagaponack (V)	3	3	1	33.3%	1	33.3%
Saltaire (V)	8	6	8	100.0%	6	75.0%
Shelter Island (T)	41	32	14	34.1%	13	31.7%
Shoreham (V)	7	5	0	0.0%	0	0.0%
Smithtown (T)	708	542	4	0.6%	4	0.6%
Southampton (T)	667	580	77	11.5%	74	11.1%
Southampton (V)	63	44	4	6.3%	3	4.8%
Southold (T)	275	230	40	14.5%	37	13.5%
Village of the Branch (V)	38	23	0	0.0%	0	0.0%
West Hampton Dunes (V)	5	5	4	80.0%	4	80.0%
Westhampton Beach (V)	47	39	28	59.6%	24	51.1%
Shinnecock Tribal Nation	22	22	15	68.2%	15	68.2%
Unkechaug Tribal Nation	11	10	4	36.4%	4	36.4%
Suffolk County (Total)	**10,486**	**8,117**	**1178**	**11.2%**	**934**	**8.9%**

Source: Suffolk County GIS 2020; NYS/NOAA 2010
Notes: V = Village, T = Town, SLOSH = Sea, Lake and Overland Surge from Hurricanes; % = Percent

Table 5.4.10-16. Critical Facilities and Lifelines Located in the Category 4 SLOSH Inundation Zones

Jurisdiction	Total Critical Facilities Located in Jurisdiction	Total Lifelines Located in Jurisdiction	Number of Critical Facilities and Lifelines Exposed to Storm Surge Hazard Areas			
			Critical Facilities in SLOSH 4	% of Total Critical Facilities	Lifelines in SLOSH 4	% of Total Lifelines
Amityville (V)	85	62	79	92.9%	59	69.4%
Asharoken (V)	4	3	3	75.0%	2	50.0%
Babylon (T)	1,029	741	231	22.4%	173	16.8%
Babylon (V)	93	64	93	100.0%	64	68.8%
Belle Terre (V)	6	5	1	16.7%	1	16.7%
Bellport (V)	35	25	3	8.6%	2	5.7%
Brightwaters (V)	14	11	7	50.0%	6	42.9%
Brookhaven (T)	2,798	2,272	177	6.3%	147	5.3%
Dering Harbor (V)	2	2	0	0.0%	0	0.0%
East Hampton (T)	234	204	37	15.8%	29	12.4%
East Hampton (V)	37	23	4	10.8%	3	8.1%
Greenport (V)	33	20	33	100.0%	20	60.6%
Head of the Harbor (V)	11	9	0	0.0%	0	0.0%
Huntington (T)	961	664	34	3.5%	28	2.9%
Huntington Bay (V)	2	2	0	0.0%	0	0.0%
Islandia (V)	70	62	0	0.0%	0	0.0%
Islip (T)	2,275	1,740	537	23.6%	424	18.6%
Lake Grove (V)	50	38	0	0.0%	0	0.0%
Lindenhurst (V)	104	62	94	90.4%	58	55.8%
Lloyd Harbor (V)	16	12	1	6.3%	1	6.3%
Nissequogue (V)	7	4	1	14.3%	1	14.3%
North Haven (V)	3	1	2	66.7%	1	33.3%
Northport (V)	40	24	7	17.5%	6	15.0%
Ocean Beach (V)	5	4	5	100.0%	4	80.0%
Old Field (V)	4	3	0	0.0%	0	0.0%
Patchogue (V)	92	63	37	40.2%	27	29.3%

Jurisdiction	Total Critical Facilities Located in Jurisdiction	Total Lifelines Located in Jurisdiction	Number of Critical Facilities and Lifelines Exposed to Storm Surge Hazard Areas			
			Critical Facilities in SLOSH 4	% of Total Critical Facilities	Lifelines in SLOSH 4	% of Total Lifelines
Poquott (V)	2	2	0	0.0%	0	0.0%
Port Jefferson (V)	95	71	28	29.5%	19	20.0%
Quogue (V)	19	13	15	78.9%	10	52.6%
Riverhead (T)	428	346	58	13.6%	53	12.4%
Sag Harbor (V)	37	24	17	45.9%	16	43.2%
Sagaponack (V)	3	3	2	66.7%	2	66.7%
Saltaire (V)	8	6	8	100.0%	6	75.0%
Shelter Island (T)	41	32	14	34.1%	13	31.7%
Shoreham (V)	7	5	0	0.0%	0	0.0%
Smithtown (T)	708	542	6	0.8%	6	0.8%
Southampton (T)	667	580	103	15.4%	99	14.8%
Southampton (V)	63	44	6	9.5%	5	7.9%
Southold (T)	275	230	66	24.0%	58	21.1%
Village of the Branch (V)	38	23	0	0.0%	0	0.0%
West Hampton Dunes (V)	5	5	5	100.0%	5	100.0%
Westhampton Beach (V)	47	39	34	72.3%	28	59.6%
Shinnecock Tribal Nation	22	22	17	77.3%	17	77.3%
Unkechaug Tribal Nation	11	10	7	63.6%	7	63.6%
Suffolk County (Total)	**10,486**	**8,117**	**1772**	**16.9%**	**1400**	**13.4%**

Source: Suffolk County GIS 2020; NYS/NOAA 2010
Notes: V = Village, T = Town, SLOSH = Sea, Lake and Overland Surge from Hurricanes; % = Percent

Table 5.4.10-17. Estimated Wind Impacts to Critical Facilities for Mean Return Period Hurricane-Related Storm Events

Facility Type	100-Year Event				
	Loss of Days	Percent-Probability of Sustaining Damage			
		Minor	Moderate	Severe	Complete
EOC	0	1.5% - 19.7%	0.0% - 13.2%	0.0% - 2.7%	0.0%
Medical	0	0.0% - 10.3%	0.0% - 5.9%	0.0% - 24.7%	0.0% - 1.7%
Police	0	0.0% - 19.7%	0.0% - 13.2%	0.0% - 2.7%	0.0%
Fire	0	0.0% - 13.3%	0.0% - 9.2%	0.0% - 1.6%	0.0%
Schools	0-4	0.0% - 11.7%	0.0% - 25.7%	0.0% - 13.3%	0.0%

Source: HAZUS-MH v4.2, Suffolk County GIS 2020
Notes: % = Percent, EOC = Emergency Operation Center

Table 5.4.10-18. Estimated Wind Impacts to Critical Facilities for Mean Return Period Hurricane-Related Storm Events

Facility Type	500-Year Event				
	Loss of Days	Percent-Probability of Sustaining Damage			
		Minor	Moderate	Severe	Complete
EOC	0	7.4% - 22.8%	1.0% - 30.6%	0.0% - 32.8%	0.0%
Medical	0-10	5.4% - 15.7%	1.2% - 42.4%	0.0% - 23.6%	0.0% - 5.3%
Police	0	3.4% - 23.9%	0.0% - 31.2%	0.0% - 32.8%	0.0%
Fire	0	2.4%-15.3%	0.0% - 29.4%	0.0% - 22.1%	0.0% - 2%
Schools	0-56	3.1% - 12.4%	0.0% - 47.5%	0.0% - 49.9%	0.0%

Source: HAZUS-MH v4.2, Suffolk County GIS 2020
Notes: % = Percent, EOC = Emergency Operation Center

At this time, Hazus does not estimate losses to transportation lifelines and utilities as part of the hurricane model. Transportation lifelines are not considered particularly vulnerable to the wind hazard; they are more vulnerable to cascading effects such as flooding, falling debris etc. Impacts to transportation lifelines affect both short-term (e.g., evacuation activities) and long-term (e.g., day-to-day commuting) transportation needs. Any issue with the public transportation system can be detrimental to residents and commuting populations. Furthermore, evacuation routes are vulnerable to coastal storm surge events and hurricane wind events (refer to Figure 5.4.10-14 through Figure 5.4.10-16). The spatial analysis conducted estimates that 10 miles, 47.4 miles, 76.4 miles, and 102.5 miles of evacuation routes in Suffolk County are exposed to Category 1, Category 2, Category 3, and Category 4 storm inundation hazard areas, respectively. Evacuation routes within the center of the County are less vulnerable to these hazard areas; however, may be impacted by heavy rain events and falling debris. If the evacuation routes around the perimeter of Suffolk County become inundated and shut down due to coastal surge, households within Suffolk County can become isolated due to road closures or traffic build-up on routes that are not impacted.

Figure 5.4.10-14. Coastal Evacuation Routes and SLOSH Categories 1-4 Inundation Areas – West Suffolk

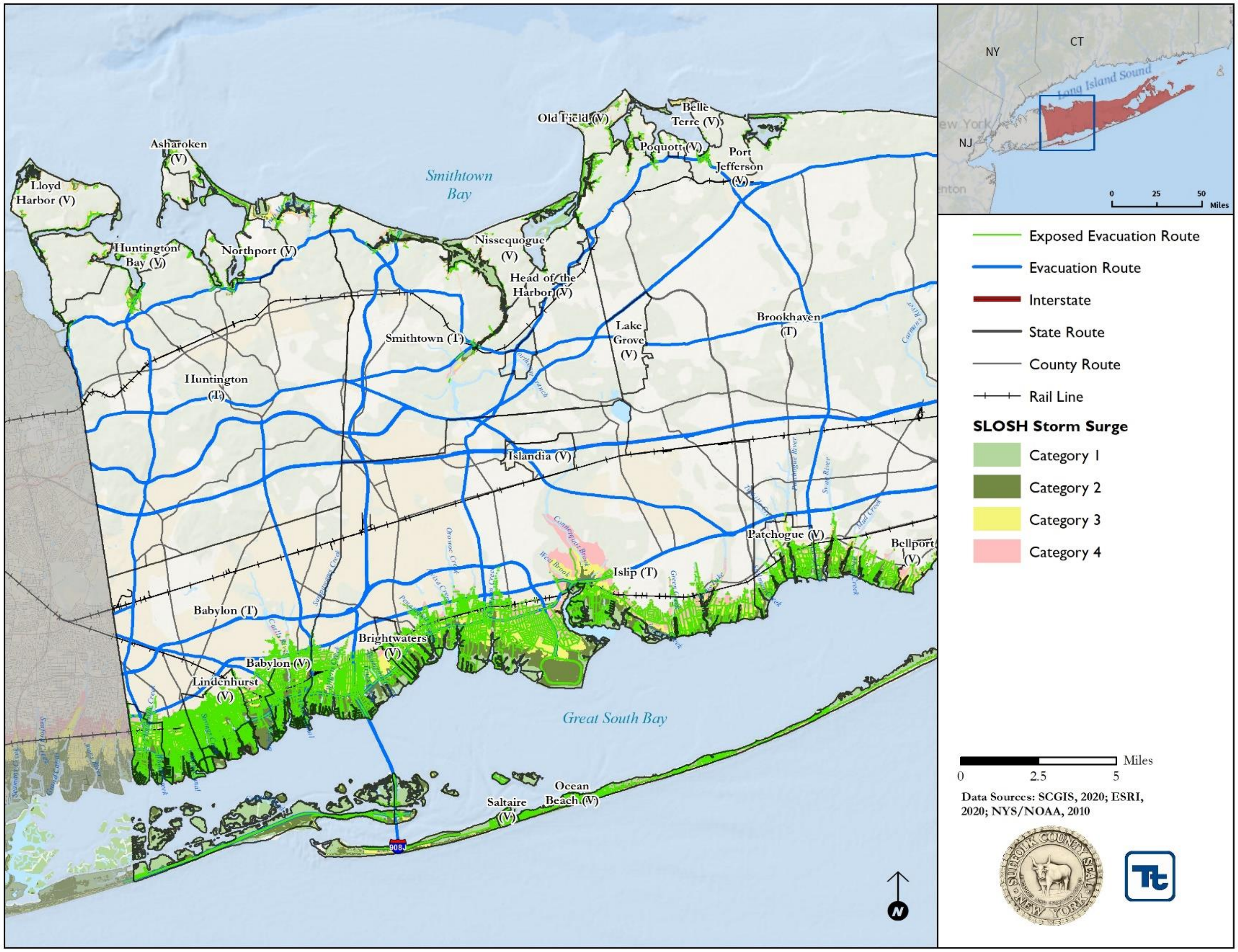


Figure 5.4.10-15. Coastal Evacuation Routes and SLOSH Categories 1-4 Inundation Areas – Central Suffolk

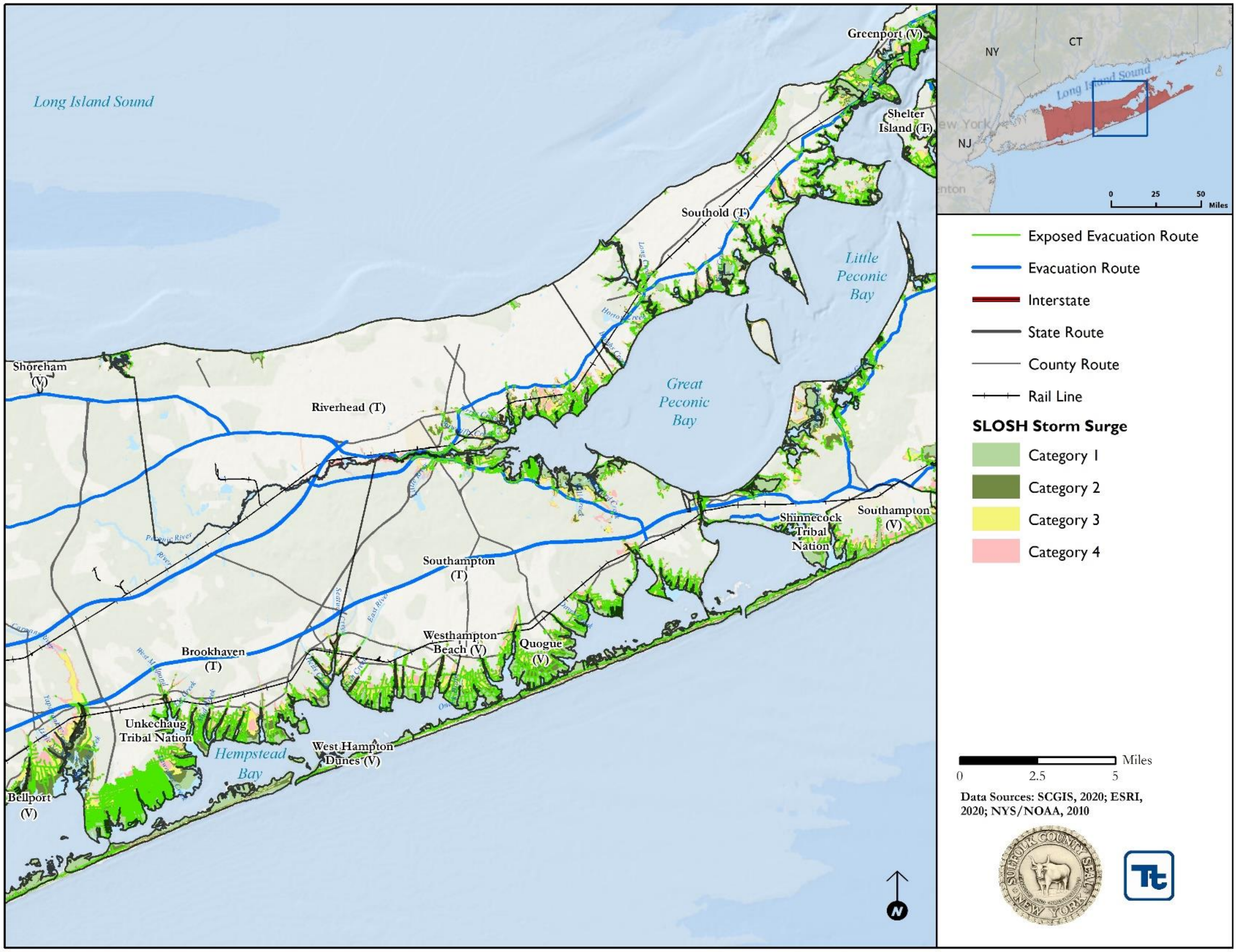
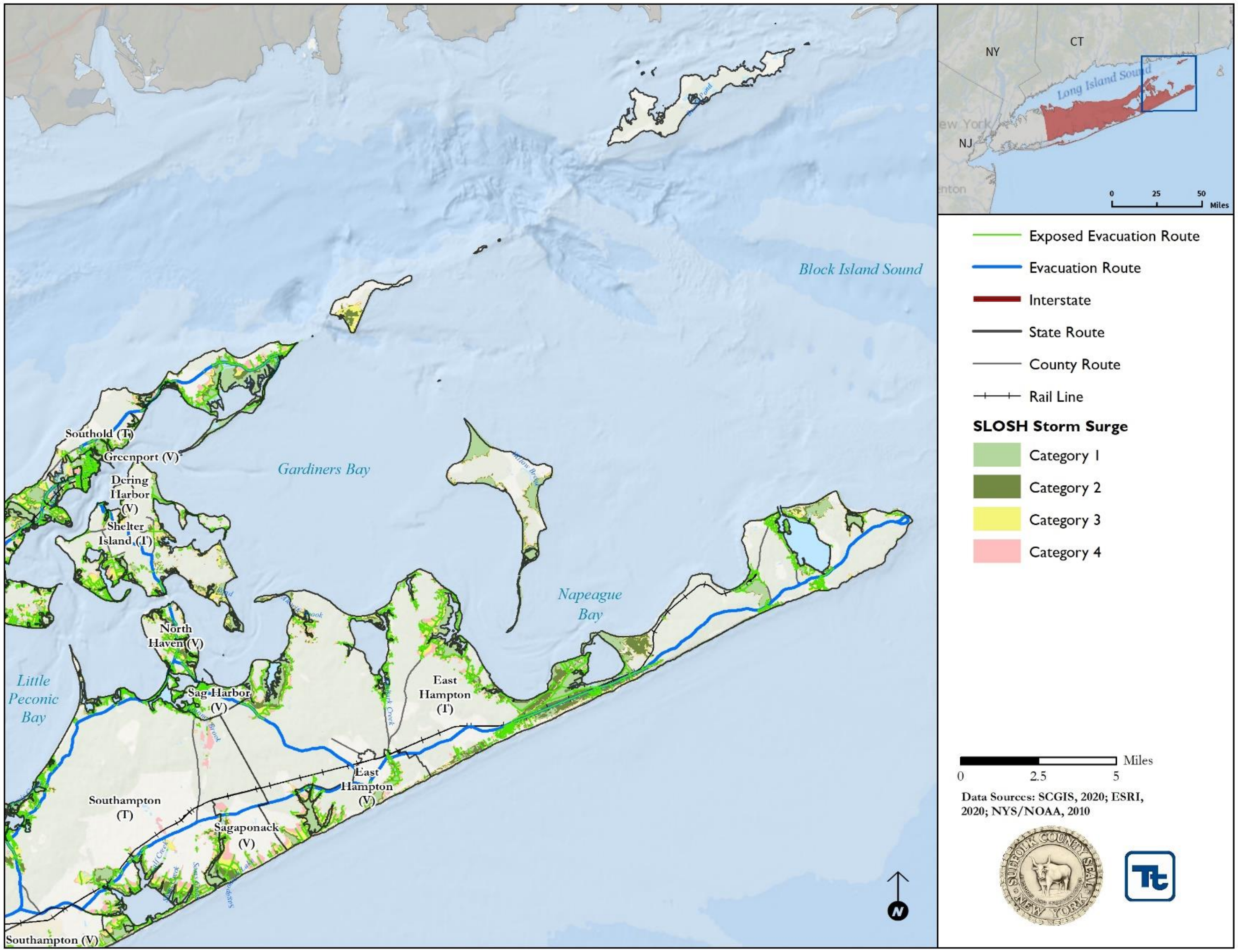


Figure 5.4.10-16. Coastal Evacuation Routes and SLOSH Categories 1-4 Inundation Areas – East Suffolk



Impact on Economy

Damage to structures from flooding and wind can be the most immediate result of coastal storm events; however, this damage can have long-lasting impacts on the economy. When a business is closed during storm recovery, there is lost economic activity in the form of day-to-day business and wages to employees. Overall, economic impacts include the loss of business function (e.g., tourism, recreation), damage to inventory, relocation costs, wage loss and rental loss due to the repair/replacement of buildings. As evidenced by Hurricane Sandy, the State of New York, including Suffolk County, lost billions of dollars in wages and economic activity (NYC 2020).

Hazus 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" section discussed earlier. Business interruption losses are the losses associated with the inability to operate a business because of the wind damage sustained during the storm or the temporary living expenses for those displaced from their home because of the event. Refer to Table 5.4.10-19 for a summary of Hazus estimated economic losses for Suffolk County.

Table 5.4.10-19. Estimated Economic Losses for the 100-Year and 500-Year Mean Return Period Hurricane Wind Events

Mean Return Period (MRP)	Inventory Loss	Relocation Loss	Building and Content Losses	Wages Losses	Rental Losses	Income Losses
100-year MRP	$908,680	$268,565,620	$5,338,054,340	$13,879,460	$90,849,420	$7,992,070
500-year MRP	$12,091,020	$1,829,897,770	$32,580,230,890	$104,835,460	$628,917,400	$80,750,600

Source: Hazus v4.2
MRP = Mean Return Period

Impacts to transportation lifelines affect both short-term (e.g., evacuation activities) and long-term (e.g., day-to-day commuting and goods transport) transportation needs. Utility infrastructure (power lines, gas lines, electrical systems) could suffer damage and impacts can result in the loss of power, which can impact business operations and can impact heating or cooling provision to the population.

Debris management can be costly and may also impact the local economy. Hazus estimates the amount of building and tree debris that may be produced as result of the 100- and 500-year MRP wind events. Because the estimated debris production does not include flooding, this is likely a conservative estimate and may be higher if multiple impacts occur. According to the Hazus Hurricane User Manual, estimates of weight and volume of eligible tree debris consist of downed trees that would likely be collected and disposed at public expense. Refer to the User Manual for additional details regarding these estimates. Table 5.4.10-20 summarizes debris production estimates for the 100- and 500-year MRP wind events.

Table 5.4.10-20. Estimated Debris Production for 100- and 500-Year Mean Return Period Hurricane-Related Winds

Jurisdiction	Brick and Wood (tons)		Concrete and Steel (tons)		Tree (tons)		Eligible Tree Volume (cubic yards)	
	100-Year	500-Year	100-Year	500-Year	100-Year	500-Year	100-Year	500-Year
Amityville (V)	54	5,167	0	7	106	1,836	982	16,966
Asharoken (V)	0	1,272	0	13	1	1,361	3	6,645
Babylon (T)	977	69,621	0	59	1,755	32,949	11,187	214,674

Jurisdiction	Brick and Wood (tons)		Concrete and Steel (tons)		Tree (tons)		Eligible Tree Volume (cubic yards)	
	100-Year	500-Year	100-Year	500-Year	100-Year	500-Year	100-Year	500-Year
Babylon (V)	189	8,125	0	12	188	1,752	1,716	15,868
Belle Terre (V)	30	4,116	0	79	59	1,056	387	6,968
Bellport (V)	875	11,351	0	397	651	2,877	4,388	19,344
Brightwaters (V)	110	5,848	0	46	145	1,246	1,274	11,018
Brookhaven (T)	30,946	643,348	54	9,926	55,937	308,680	258,181	1,578,354
Dering Harbor (V)	441	121	1	0	736	391	2,682	1,425
East Hampton (T)	13,165	7,041	3	0	33,530	24,370	108,624	79,543
East Hampton (V)	2,769	1,681	1	1	3,153	2,401	14,912	11,442
Greenport (V)	951	555	3	2	1,331	871	6,168	4,376
Head of the Harbor (V)	22	2,358	0	51	91	2,915	260	8,256
Huntington (T)	142	89,560	0	1,095	1,810	66,035	11,551	415,617
Huntington Bay (V)	0	1,857	0	22	0	810	0	6,556
Islandia (V)	70	3,336	0	20	74	2,734	430	15,630
Islip (T)	8,307	323,594	8	2,058	14,027	121,970	90,417	792,357
Lake Grove (V)	126	14,623	0	176	86	3,677	739	33,225
Lindenhurst (V)	159	11,434	0	6	191	3,064	1,685	27,144
Lloyd Harbor (V)	0	2,596	0	30	0	5,886	0	11,726
Nissequogue (V)	30	3,270	0	70	128	4,026	369	11,349
North Haven (V)	6,230	1,877	25	1	2,848	1,571	13,288	7,313
Northport (V)	1	4,815	0	51	75	2,044	650	17,618
Ocean Beach (V)	54	1,202	1	12	44	170	180	691
Old Field (V)	31	5,437	0	125	144	2,824	641	12,600
Patchogue (V)	1,212	21,354	1	341	783	3,234	6,591	28,080
Poquott (V)	10	1,699	0	39	45	887	202	3,930
Port Jefferson (V)	127	17,614	0	272	211	3,873	1,515	27,690
Quogue (V)	19,151	10,842	166	46	5,450	4,152	35,039	26,677
Riverhead (T)	7,837	27,790	12	148	33,576	69,601	61,741	138,916
Sag Harbor (V)	3,303	1,129	12	0	2,407	1,441	8,892	5,210
Sagaponack (V)	4,685	2,346	20	0	4,046	2,841	10,116	7,092
Saltaire (V)	84	1,865	1	18	69	264	280	1,072
Shelter Island (T)	7,290	1,997	20	0	12,160	6,460	44,286	23,527
Shoreham (V)	32	788	0	13	126	562	595	2,678
Smithtown (T)	788	103,884	0	718	2,043	45,613	13,768	311,425
Southampton (T)	115,528	77,324	717	373	92,402	84,633	294,789	245,896
Southampton (V)	20,249	9,906	77	7	7,039	5,124	33,375	24,560
Southold (T)	18,586	14,525	97	70	47,216	39,031	159,690	131,424
Village of the Branch (V)	17	1,991	0	15	61	964	453	7,116

Jurisdiction	Brick and Wood (tons)		Concrete and Steel (tons)		Tree (tons)		Eligible Tree Volume (cubic yards)	
	100-Year	500-Year	100-Year	500-Year	100-Year	500-Year	100-Year	500-Year
West Hampton Dunes (V)	784	2,213	4	38	348	515	1,951	2,748
Westhampton Beach (V)	9,856	9,971	55	53	3,071	3,136	18,957	19,325
Shinnecock Tribal Nation	2,378	1,011	14	6	1,827	1,288	7,347	5,176
Unkechaug Tribal Nation	158	604	1	7	60	140	557	1,321
Suffolk County (Total)	**277,757**	**1,533,057**	**1,291**	**16,422**	**330,052**	**871,275**	**1,230,856**	**4,340,570**

Source: Hazus v4.2

Impact on the Environment

Coastal storms can cause beach and dune erosion, wetland loss, and barrier island breaching that disrupts coastal habitats and migration patterns of species (NYC 2019). Flooding caused by coastal storms may breach structures containing hazardous wastes, which can contaminate water resources and soil resources. Debris caused by coastal storms may also be hazardous to aquatic habitats and species.

Cascading Hazards

Hurricanes can escalate the impacts of flooding, coastal erosion, and groundwater contamination. Storm surge may increase erosion along the shoreline, which alters the extent of flooding. The structures most at risk of coastal erosion and flooding can be reviewed in Section 5.4.1 and Section 5.4.8, respectively. Risk of groundwater contamination may also increase as a result of impacts from hurricanes that breach facilities housing hazardous materials or structures that are major sources of contaminates. Sources of contaminates are discussed in Section 5.4.9 (Groundwater Contamination).

Future Changes That May Impact Vulnerability

Understanding future changes that effect vulnerability in the County can assist in planning for future development and ensure establishment of appropriate mitigation, planning, and preparedness measures. Changes in the natural environment and built environment and how they interact can also provide insight about ways to plan for the future.

Projected Development

As discussed in Section 4, areas targeted for future growth and development have been identified across the County. Any areas of growth located in the storm surge inundation areas or development along the coastline could be potentially impacted by hurricane events if mitigation measures are not implemented during the design and construction phase. There are 25 new development project areas identified by plan participates located in the Category 4 SLOSH storm surge hazard area and 11 new development project areas located in the Category 1 SLOSH storm surge hazard area. The results of this analysis were shared with plan participants to inform decision making.

It is recommended that the County and municipal partners implement design strategies that mitigate against the risk of storm surge and hurricane winds. For example, New York City has developed a zoning plan for coastal flood resiliency in 2019 that can be referenced for development projects (NYC Department of Planning 2019). This plan recommends greater zoning flexibility to allow developers to remove components of the structure out of the flood inundation areas and storm surge hazard areas. The plan also recommends solutions to make reconstruction repairs easier and more affordable for structures built in coastal flooding areas.

Please refer to Figure 5.4.10-17 through Figure 5.4.10-19 to view the new development locations throughout the County and their proximity to the SLOSH storm surge hazard areas.

Projected Changes in Population

According to the Suffolk County Economic Development and Planning Department's February 2017 Annual Report update, slow population growth is expected to continue in the future. Any growth can create changes in density throughout the County. Higher density can, not only create issues for local residents during evacuation of a natural hazard event but can also impact tourists that travel to or through Suffolk County for vacation. Historically, flood and storm events with associated surge have severely impacted transportation corridors as well as infrastructure. Refer to Section 4 (County Profile), which includes a discussion on population trends for the County.

Climate Change

As discussed above, most studies project that the State of New York will see an increase in average annual temperatures and precipitation. Annual precipitation amounts in the region are projected to increase, primarily in the form of heavy rainfalls, which have the potential to increase the risk of storm surge, and flood critical transportation corridors and infrastructure. Increases in precipitation may alter and expand the floodplain boundaries of storm surge areas and runoff patterns, resulting in the exposure of populations, buildings, and critical facilities and infrastructure that were previously outside the floodplain. This increase in exposure would result in an increased risk to life and health, an increase in structural losses, a diversion of additional resources to response and recovery efforts, and an increase in business closures affected by future flooding events due to loss of service or access.

Furthermore, climate is defined not simply as average temperature and precipitation but also by the type, frequency and intensity of weather events. Both globally and at the local scale, climate change has the potential to alter the prevalence and severity of events like hurricanes. While predicting changes to the prevalence or intensity of hurricanes and the events affects under a changing climate is difficult, understanding vulnerabilities to potential changes is a critical part of estimating future climate change impacts on human health, society and the environment (U.S. Environmental Protection Agency [EPA], 2006).

Change of Vulnerability Since the 2014 HMP

Suffolk County, its municipalities, the Suffolk County Water Authority, and the Tribal Nations continue to be vulnerable to the hurricane hazard. However, there are several differences between the exposure and loss estimates between this plan update to the results reported in the 2014 HMP. Updated building stock provided by the participating jurisdictions and assessor's data was used in the updated risk assessment. Further, updated population data from the ACS 2018 5-year population estimates was utilized. In addition, an updated version of FEMA's Hazus hurricane module (version 4.2) was used to estimate potential losses for the 100- and 500-year MRP hurricane wind events. This model has an expanded historic hurricane database upon which the model draws from to create the MRP scenarios. Overall, this vulnerability assessment uses a more accurate and updated building inventory which provides more accurate estimated exposure and potential losses for Suffolk County.

Figure 5.4.10-17. New Development and SLOSH Storm Surge Hazard Areas in Suffolk County - West

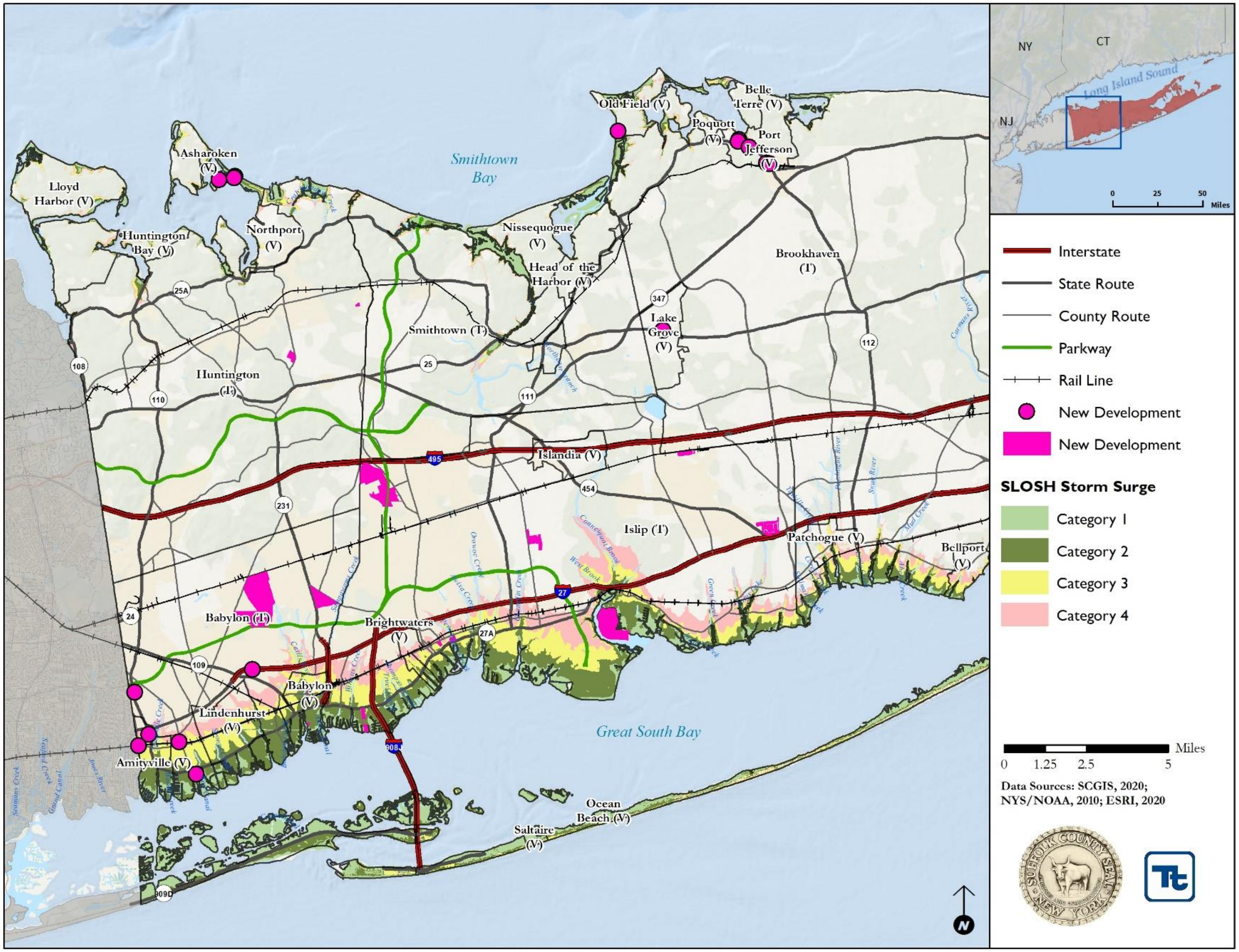


Figure 5.4.10-18. New Development and SLOSH Storm Surge Hazard Areas in Suffolk County - Central

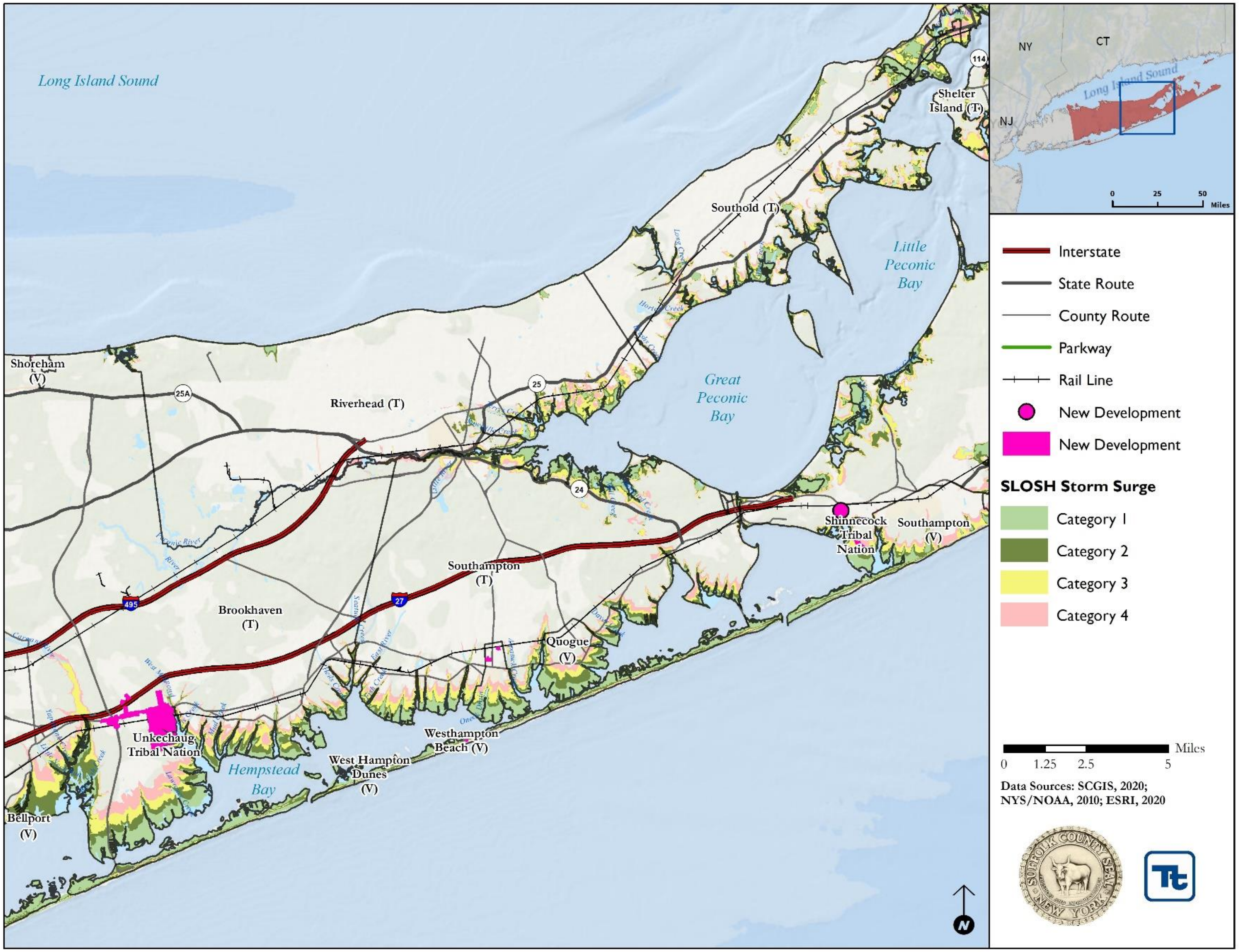


Figure 5.4.10-19. New Development and SLOSH Storm Surge Hazard Areas in Suffolk County - East