5.4.1 Coastal Erosion

This section provides a profile and vulnerability assessment for the coastal erosion hazard.

Hazard Profile

This section provides profile information including description, location and extent, previous occurrences and losses and the probability of future occurrences.

Description

Coastal erosion topples 1,500 waterfront homes each year in the U.S., costing $530 million in damages. According to an erosion study conducted by FEMA in 2000, beaches along the Atlantic and Pacific Oceans, Gulf Coast, and Great Lakes are disappearing at rates that range from one to six feet each year (NYS DHSES, 2013).

Erosion and flooding are the primary coastal hazards that lead to the loss of lives or damage to property and infrastructure in developed coastal areas. In New York State, approximately 85% of the State's population lives in highly urbanized areas within 12% of the total land mass. Certain areas of the State's coastline are especially vulnerable to coastal erosion through natural actions, as well as human activities. In vulnerable areas, coastal erosion can cause extensive damage to public and private properties and to natural resources. This has resulted in economic losses to individuals, private businesses, and the State's economy (NYS DHSES, 2013).

Coastal erosion is a natural phenomenon that is an endless sediment redistribution process that continually changes beaches, dunes, and bluffs. Waves, currents, wind-driven water, ice, rainwater runoff, and groundwater seepage all move sand, sediment, and water along the coastline. Other contributing factors that can increase coastal erosion of a natural protective feature include length of fetch; wind direction and speed; wave length, height, and period; nearshore water depth; tidal influence; and overall strength of a storm (New York State Department of Environmental Conservation [NYSDEC], 2013).

Human activities can also lead to coastal erosion and intensity the effects of natural processes and speed up the coastal erosion process. This includes construction, shipping, boating, and recreation, which can all increase erosion of sandy beaches, dunes, and bluffs (NYSDEC, 2013). Humans contribute to the coastal erosion in several ways:

- By removing vegetation, exposing bare soil to be easily eroded by wind, waves, and precipitation;
- Directing run-off from streets, parking lots, roofs, and other locations over a bluff edge causing it to erode; or
- By construction 'hardened' structures along the shore that block that movement of sand along the coast, reflect wave energy onto adjacent shorelines, or cause deepening of the nearshore area (NYSDEC, 2013).

Many development activities damage or alter natural protective features and the protection these features afford the upland area from coastal erosion and storm damage. These activities include the following:

- Building without considering the potential for damage to property or natural protective features;
- Activities which destroy natural protective features such as dunes or bluffs and their vegetation;
- Building structures intended for coastal erosion prevention which may exacerbate coastal erosion conditions on adjacent or nearby properties; and
- Wakes from boats that produce wave action on the shoreline (NYSDEC, 2013).

According to the New York State Department of Environmental Conservation (NYSDEC) Rules and Regulations (6 NYCRR Part 505.2 – Coastal Erosion Management), coastal erosion means the loss or displacement of land along the coastline due to the action of waves, currents, tides, wind-driven water, waterborne ice, or other impacts associated with storms. It also means the loss or displacement of land due to the action of wind, runoff of surface waters, or groundwater seepage. The principal natural causes of erosion are wave action, wind action, and overland runoff groundwater seepage through intense precipitation and natural sorting of beach sediment through loss of fines. Other contributing factors that can significantly increase erosion of a natural protective feature include length of fetch (length of water over which a given wind has blown), wind direction and speed, wave length, height and period, nearshore water depth, tidal influence, increased lake or sea levels, overall strength and duration of storm events and variability in sediment supply to the littoral zone. Combinations of these factors and events can exacerbate the effects of these processes by increasing water levels, storm rise, wave run up and wind setup, producing damaging waves, driving ice "plates" along the shore scouring beaches and bluff areas, reducing sand from beaches, and allowing water and wave action further inland that intensifies erosion of dunes and bluffs (New York State, 1988).

Erosion can impact beaches, dunes, bluffs, barriers, bays, cliffsides, wetlands, marshes, parks, and other natural landforms and can lead to destructive forces upon nearby manmade structures. One of the major impacts of erosion processes is the permanent breaching or creation of inlets along barrier beaches and islands. An example of this is the creation of the Shinnecock and Moriches Inlets along Suffolk County's South Shore. Impacts associated with new inlets could include (1) increased flooding and erosion on the mainland shoreline due to increased water levels and wave action in the bays, (2) changes in shoaling patterns, water circulation, temperature and salinity that could significantly alter existing bay ecosystems, and (3) disruption of the longshore transport of sand along the ocean shoreline that would result in increased downdrift erosion. It is noted that these stabilized inlets do provide benefits for recreational and commercial navigation, which is the trade-off.

There are a variety of natural- and human-induced factors that influence the erosion process. For example, shoreline orientation and exposure to prevailing winds, open ocean swells and storm surges, and waves all influence erosion rates. Beach composition influences erosion rates as well. For example, a beach composed of a finer sand and silt is easily eroded compared to beaches primarily consisting of course sand, boulders, gravel or large rocks, which are more resistant to erosion. Common contributing factors to coastal erosion include, but are not limited to, the following and further discussed below:

- Impacts from hurricanes and other coastal storms;
- Decreased sediment supplies;
- Storm-induced high water;
- Wave action on inland waters (seiche); and
- Sea level rise

Impacts from Hurricanes and Other Coastal Storms

According to the New York State HMP 2014 update, beaches, dunes, and bluffs are a natural barrier between the ocean and inland communities, ecosystems, and resources. During a strong coastal storm, changes to beaches, dunes, and bluffs can be significant and the results are sometimes catastrophic. The USGS provides scientific support for mitigation planning through observations of beach, dune, and bluff change and models of waves and storm surge in order to identify areas vulnerable to extreme coastal changes. By identifying areas of coastline in New York State that are likely to experience extreme and devastating erosion during a hurricane or coastal storm, it is possible to determine risk levels associated with development in areas where the land shifts and moves with each land-falling storm (NYS DHSES 2013).

Decreased Sediment Supplies

Coastal landforms, such as bluffs, are essential in maintaining a supply of sediment to beaches and dunes. If engineered structures are used to stabilize shorelines, the natural process of erosion is disturbed and decreases the amount of sediment supply. With reduced sediment, the ability of natural protective features (dunes and beaches) to provide prevention from storms and flood control benefits is reduced (NYS DHSES 2013).

Storm-Induced High Water

Coastal storms can occur any time of the year and at varying levels of severity. Natural protective features within coastal erosion hazard areas provide buffering and protection to shorelines from erosion. Dunes and bluffs are effective against storm-induced high water and related wave action (NYS DHSES 2013).

Wave Action on Inland Waters/Seiche

Wave action can cause a surge of water to impact shorelines with great force on inland waterbodies, causing erosion and property damage. This is typically due to a storm system with high winds occurring on a lake (called a seiche) and causes shoreline erosion and property damage (NYS DHSES 2013).

Sea Level Rise

Rising sea levels may have a negative impact on the process that leads to coastal erosion. Studies have shown that an increased sea level attributed to climate change can speed up the natural coastal processes that remove sand and vegetation from protective beaches, dunes, and bluffs. Erosion resulting from sea level rise will lead to more intensive coastal impacts from future storm events (NYS DHSES 2013).

Understanding trends in sea level, along with the relationship between global and local sea level, provides information about the impacts of the earth's climate on the oceans and atmosphere. Changes in global temperatures, hydrologic cycles, coverage of glaciers and ice sheets, and storm frequency and intensity are known effects of climate change. All of these changes are directly related to and captured in long-term sea level records. Sea levels provide a key to understanding the impact of climate change (NOAA 2013).

Sea level rise over the next 100 years is expected to contribute significantly to physical changes along open-ocean shorelines. Predicting the form and magnitude of coastal changes is important for understanding the impacts to humans and to the environment (Gutierrez et al. 2007).

Sea level rise increases the risks coastal communities face from coastal hazards (floods, storm surges, and chronic erosion). It may also lead to the loss of important coastal habitats and public-access areas. Because of existing shoreline development and protective structures, wetlands, beaches, and other intertidal areas may not be able to migrate inland progressively as sea level rises. These areas could become completely inundated by the rising ocean (NOAA 2012).

In New York State, State Legislature created the Sea Level Rise Task Force in 2007. It was created to assess impacts to the State's coastlines from rising seas and recommend protective and adaptive measures. The Task Force had to evaluate ways to protect New York State's remaining coastal ecosystem and natural habitats and increase coastal community resilience in the face of sea level rise (NYSDEC 2013).

During the past 100 years, the rate of global mean sea level rise was approximately 1.7 millimeters per year (0.7 inches per decade) and observations show that the rate of global sea level rise is accelerating. In New York State, tide gauge observations indicate that rates of relative sea level rise in New York State were greater than the global mean, ranging from 2.41 to 2.77 millimeters per year (0.9 to 1.1 inches per decade) over the last 100 years. Sea level on Long Island is projected to rise two to five inches by the 2020s, seven to 12 inches by the 2050s, and 12 to 23 inches by the 2080s. Sea level rise will affect the State's coastal communities and natural resources. Areas beyond the immediate coastline will experience flooding and erosion associated with the increase in storm occurrences. It is projected that coastal erosion will be accelerated by rising sea levels.

For detailed information regarding sea level rise in Suffolk County, see Section 5.4.5 (Flood).

Extent

Coastal erosion is measured at a rate of either linear retreat (feet of shoreline recession per year) or volumetric loss (cubic yards of eroded sediment per linear foot of shoreline frontage per year). It is estimated that the Atlantic coast's average annual erosion rate is approximately two to three feet per year (NYS DHSES 2013). A number of factors determine whether a community exhibits greater long-term erosion or accretion:

- Exposure to high-energy storm waves,
- Sediment size and composition of eroding coastal landforms feeding adjacent beaches,
- Near-shore bathymetric variations which direct wave approach,
- Alongshore variations in wave energy and sediment transport rates,
- Relative sea level rise,
- Frequency and severity of storm events, and
- Human interference with sediment supply (e.g. revetments, seawalls, jetties) (Woods Hole Sea Grant 2003).

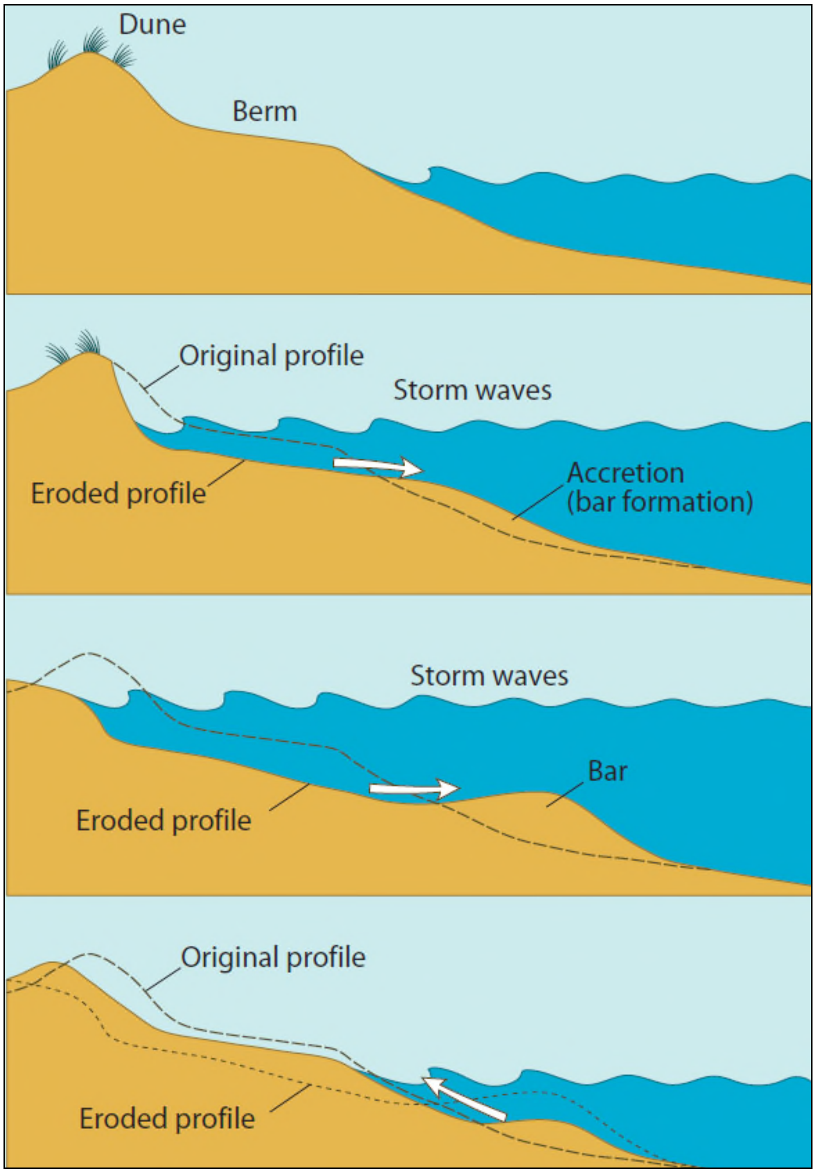
Typically, coastal erosion is associated with storm surges, hurricanes, windstorms, and flooding hazards. Coastal erosion may be intensified by man-made activities such as seawalls, groins, jetties, navigation inlets, boat wakes, shoreline hardening or dredging. Natural recovery after erosive episodes can take months or years. If a dune or beach does not recover quickly enough via natural processes, coastal and upland property may be exposed to further damage in subsequent events. Coastal erosion can cause the destruction of buildings and infrastructure (NYSDEC, Date Unknown).

Long Island is particularly vulnerable to erosion because of the presence of fine-grained sands along the island's shoreline and the island's location facing the ocean in various degrees of orientation opposing the dominant wind and water currents moving up the Atlantic Coast. Suffolk County is surrounded by the Long Island Sound to the north and the Atlantic Ocean to the south; therefore, coastal erosion is an ongoing process along the northern and southern shoreline communities and natural ecosystems (including barrier islands, bays, inlets, beaches and tidal wetlands). Long Island consists of over 1,180 miles of coastline, with Suffolk County consisting of over 980 miles of coastline. Most of Suffolk County has experienced coastal erosion at one time or another, primarily exacerbated by major coastal storms that have directly or indirectly impacted the area. Although there are many contributing factors to coastal erosion, the historical occurrence of coastal storms has been the major contributing factor, permanently changing the landscape of Suffolk County's shorelines, with the creation of inlets (including Shinnecock and Moriches Inlets) as an overall minor to moderate contributor to coastal erosion.

Rates of shoreline change, especially in the long term, are low and relatively uniform along the coast. However, from Fire Island Inlet to Breezy Point, rates are highly variable. The variation in and magnitude of shoreline change rates directly correspond to the level of engineering along the coast. Long term shoreline change was measured on 3,518 transects in Long Island, covering over 100 miles of coastline. Both the long term (-0.08 meters/year) and short term (0.8 meters/year) net shoreline change rates were accretional. In the long term, 60% of the Long Island region was undergoing erosion at an average of -0.6 meters /year, with 9% of the measured transects experiencing erosion rates greater than -1.0 meters /year. The maximum long term erosion rate was along Gilgo Beach in the location of a now-closed inlet. The maximum long term accretion rate was 20.2 meters /year at the western end of Jones Beach (USGS, 2010).

Beaches constantly change from day-to-day, week-to-week, month-to-month, and year-to-year, primarily in response to waves. The size and presence of any part of a beach, at a given time, is influenced by a number of factors: size and direction of the waves, size and shape of sand grains on the beach, the level of water at the time waves strike, and the initial shape of the beach. Waves play a major role in controlling the form, position and size of the beach. Waves are responsible for picking up and moving sand along the coast. The beach responds quickly to changes in wave energy. Very large, choppy waves tend to pick up and remove sand from the beach berm. This lowers the elevation which flattens the beach profile and causes the berm and shoreline to move landward. The material picked up from the waves can move in many directions depending on numerous factors. Most frequent, material is moved offshore and is deposited in a bar during storms. As the bar grows, it causes larger waves to break and dissipate their energy before they reach the landward berm, all which help the beaches protect themselves. In calmer weather, long, gentle waves can pick up much of the sand and bring it back onshore, building up the berm, raising the height of the backshore and moving the beach berm and shoreline back seaward. This creates a cycle where the beach erodes and builds back up in response to wave action. Over the course of a year, beaches can move back and forth by as much as 270 feet (Tanski, 2012). Figure 5.4.1-5 illustrates the beach response to waves.

Figure 5.4.1-1. Beach Response to Waves



Source: Tanski, 2012

Location

The Long Island region is 191 kilometers long and extends from Montauk, New York at the entrance to Long Island Sound to Breezy Point at the mouth of Raritan Bay. This stretch of coast is dominated by barrier islands in the western and central parts of the region. At Southampton, the barrier system joins the mainland and the elevation of the back beach increases eastward. Tall bluffs are the dominant coastal feature at and near Montauk Point. There are few visible engineering structures east of Westhampton Beach, except for several groins in the East Hampton area and a large riprap seawall at Montauk Point. Numerous rock revetments and bulkheads on individual properties are found throughout. Sand fencing is also present along many portions of this region, as it is used to stabilize dunes. Beginning with jetties at Shinnecock Inlet, there are many littoral interceptors along the Long Island coast, including a groin field at Westhampton and six stabilized inlets (Shinnecock, Moriches, Fire Island, Jones, East Rockaway, and Rockaway) (USGS, 2010).

Suffolk County occupies the central and eastern portions of Long Island, New York. The eastern end of the County is divided into two peninsulas (North Fork and South Fork). It is surrounded by the Atlantic Ocean and the Long Island Sound on three sides, with 980 miles of coastline. Suffolk County has 204 beaches, totaling 34.52 miles (USEPA 2013).

Since 1995, the Atlantic Coast of New York Monitoring Program (ACNYMP) has been collecting information and data on beach changes and coastal processes for the 135-mile stretch of shoreline between Coney Island and Montauk Point. The goal of the ACNYMP is to provide coastal managers, regulators, government officials and the public with information that will allow them to make better decisions regarding coastal erosion hazard management and resource use. Data collected under the program includes semi-annual beach profile surveys taken at over 348 locations along the shoreline and semi-annual aerial photographs of the entire coast. Historical data and information from other coastal projects (including historical shorelines, topography, locations of structures, flood zone delineations, etc.) are also being compiled as part of this effort. This data was compiled in the ACNYMP Data Viewer which contains a range of information types, including: beach profile surveys, seasonal aerial photographs, historical shorelines, and cultural and physical data. Additionally, a general CEHA line was established. This data is continually being updated as new information becomes available.

Coastal Erosion Hazard Area

Due to the ongoing coastal erosion problems along the New York State coastline, the State Legislature passed the Coastal Erosion Hazard Areas (CEHA) Act (Article 34 of the Environmental Conservation Law (ECL)), establishing the State's coastal policy in August 1981. Under this act:

- Areas prone to coastal erosion are identified.
- Activities in areas subject to coastal erosion are undertaken in such a way that damage to property is minimized, increases in coastal erosion are prevented, and natural protective features are protected. Public actions likely to encourage new development in CEHA should not be undertaken unless the areas are protected by structural or other erosion control projects which could prevent erosion damage during the life of the proposed action.
- Erosion control projects are publicly financed only where needed to protect human life for existing or new development, which absolutely requires a location within a given hazard area.
- Public and private erosion control projects should minimize damage to other human-made property, natural protective features, and other natural resources.

There are 86 coastal communities in New York State that currently fall under CEHA jurisdiction. The law allows local communities to administer their own CEHA program. Of those 86 communities, 42 have been certified by the NYSDEC and have their own CEHA law. The other communities are managed by the NYSDEC. The following list contains the certified CEHA communities in Suffolk County:

- Babylon (T)
- Belle Terre (V)
- Brookhaven-N (T)
- Brookhaven-S (T)
- East Hampton (V)
- Huntington (T)
- Lloyd Harbor (V)
- Ocean Beach (V)
- Old Field (V)
- Port Jefferson (V)
- Quogue (V)
- Riverhead (T)
- Sagaponack (V)
- Saltaire (V)
- Shoreham (V)
- Southampton (T)
- Southampton (V)
- Southold (T)

- West Hampton Dunes (V)
- Westhampton Beach (V) (NYSDEC, 2014)

As a part of this Act, NYSDEC has developed minimum standards and criteria, 6 NYCRR Part 505 – Coastal Erosion Management, for the statewide regulation of development and other activities within CEHA. Part 505 defines when the Department will administer a regulatory program within identified CEHA and establishes standards for the issuance of coastal erosion management permits by the Department. Procedural requirements are also established for local governments that wish to implement a local program, although local implementation is not required until after the Department has filed CEHA maps for a municipality (NYSDEC 1988). Part 505 establishes two categories of CEHA: (1) Structural Hazard Areas and (2) Natural Protective Features.

- *Structural Hazard Areas* are shorelands, located landward of natural protective features, and have shorelines receding at a long-term average annual recession rate of one foot or more per year. The inland boundary of a structural hazard area is calculated by starting at the landward limit of the fronting natural protective feature and measuring along a line which is perpendicular to the shoreline a horizontal distance which is 40 times the long-term average annual recession rate (NYSDEC 1988).

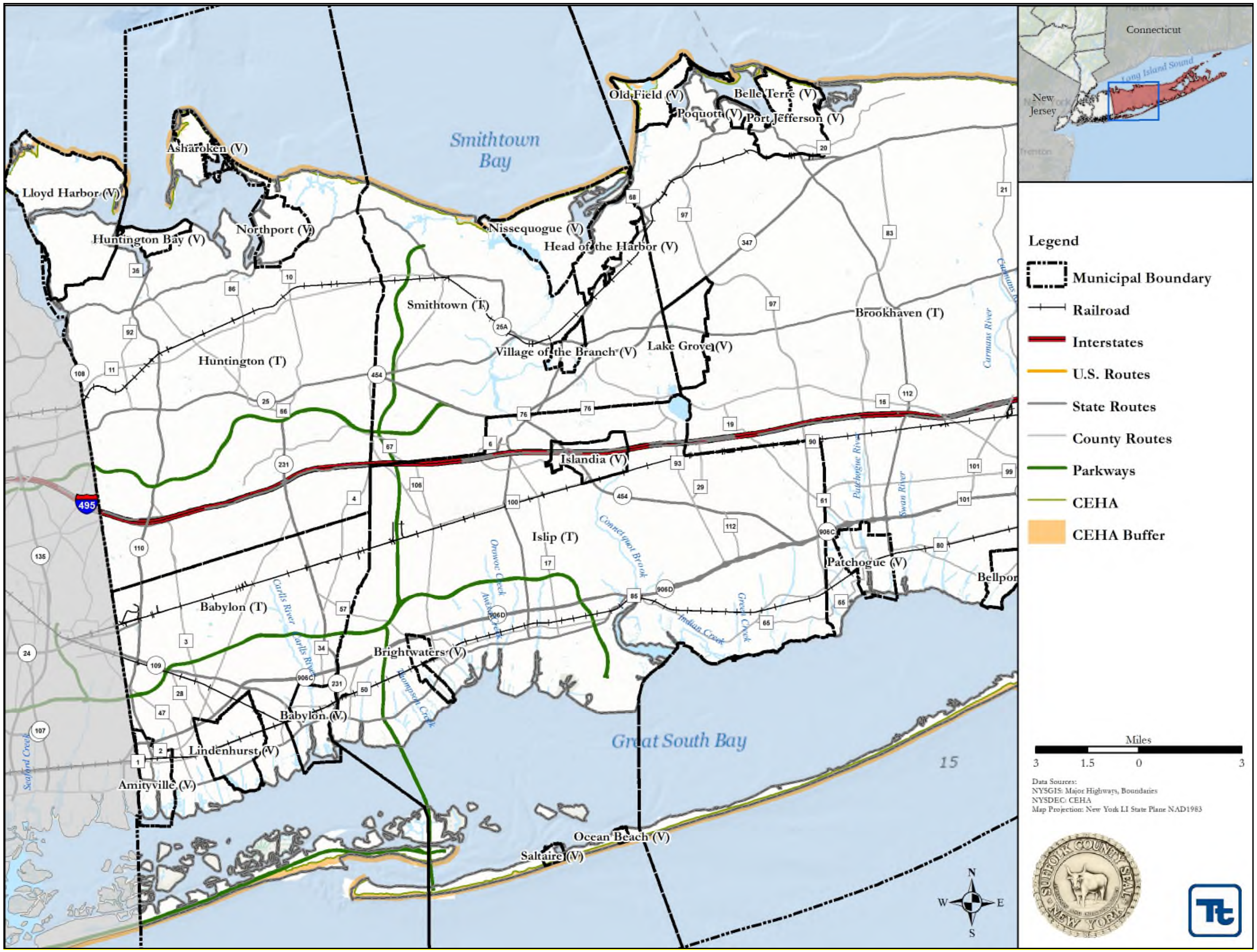
- *Natural Protective Feature Area (NPFA)s* are a land and/or water area containing natural protective features, the alteration of which might reduce or destroy the protection afforded other lands against erosion or high water, or lower the reserves of sand or other natural materials available to replenish storm losses through natural processes. All NPFAs are delineated as such on CEHA maps (NYSDEC 1988).

Currently, NYSDEC is reviewing and updating Part 505 regulations to make it easier for people to understand and comply with the regulations (NYSDEC 2013).

Both types of areas are depicted on CEHA maps, which depict the landward limit of the Surface Hazard Areas and Natural Protective Features and indicate the recession rate in feet per year where applicable. The NYSDEC commissioner is tasked to review the boundaries of these hazard areas every 10 years and after major coastal storms and revise the maps if the CEHA boundary changed by 25 feet or more (NYSDEC Article 34, Chapter 841). According to Mr. Jay Tanski, Outreach Specialist for Coastal Hazards (SUNY Stonybrook) with the New York Sea Grant, such updates have not been implemented in recent years. Therefore, the 1988 maps are still the most recent regulatory delineations of the CEHA.

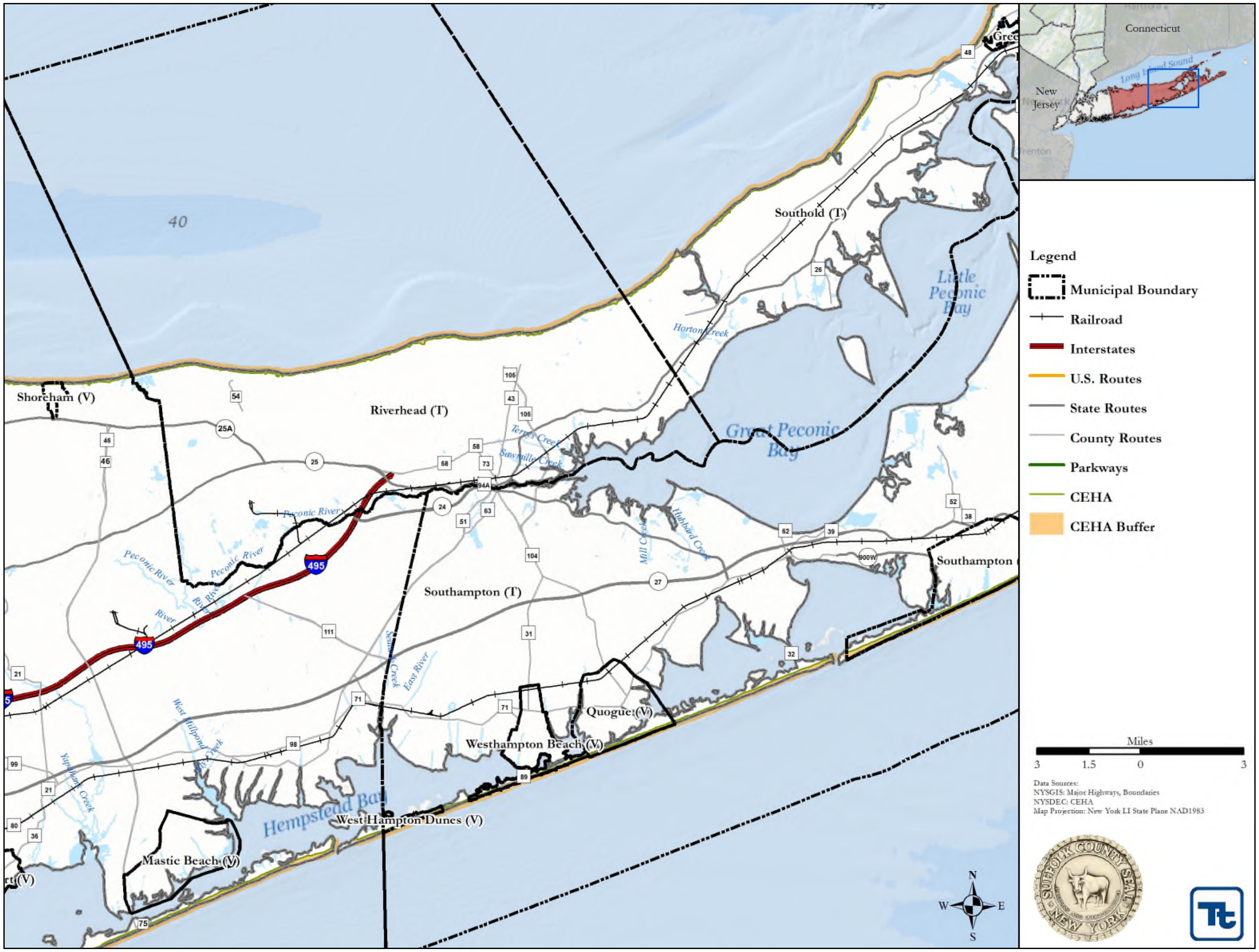
The digitized CEHA line and 1,000-foot buffer zone for Suffolk County was provided regional and local erosion rates by Mr. Robert McDonough of the NYSDEC Division of Water, Coastal Erosion Management Unit in June 2007. Figures 5.4.1-6 through 5.4.1-15 illustrate the digitized line and the average rate at which the eroding shoreline moves landward, expressed in feet per year, for Suffolk County and participating jurisdictions. Although NYSDEC's digitized CEHA line included a rate of recession attribute (as show in the figure legends), it appears the rate for the Suffolk County coastline is undefined (illustrated as a blue line in Figures 5.4.1-6 through 5.4.1-15). CEHA jurisdiction extends 1,000 feet seaward of the mean low water level or to a depth of 15 feet, whichever is greater. The 1,000 foot buffer on the seaward side of the CEHA or NPFA landward limit line has been placed as a reminder of the seaward limit of the nearshore area which is regulated as a Natural Protective Feature. As explained by Mr. McDonough, the CEHA maps filed with the municipality are the official documents containing the legally defined NPFA and SHA boundary lines and should be referred to when considering areas subject to the coastal erosion hazard.

Figure 5.4.1-2. NYSDEC Coastal Erosion Hazard Areas Line for Suffolk County - West



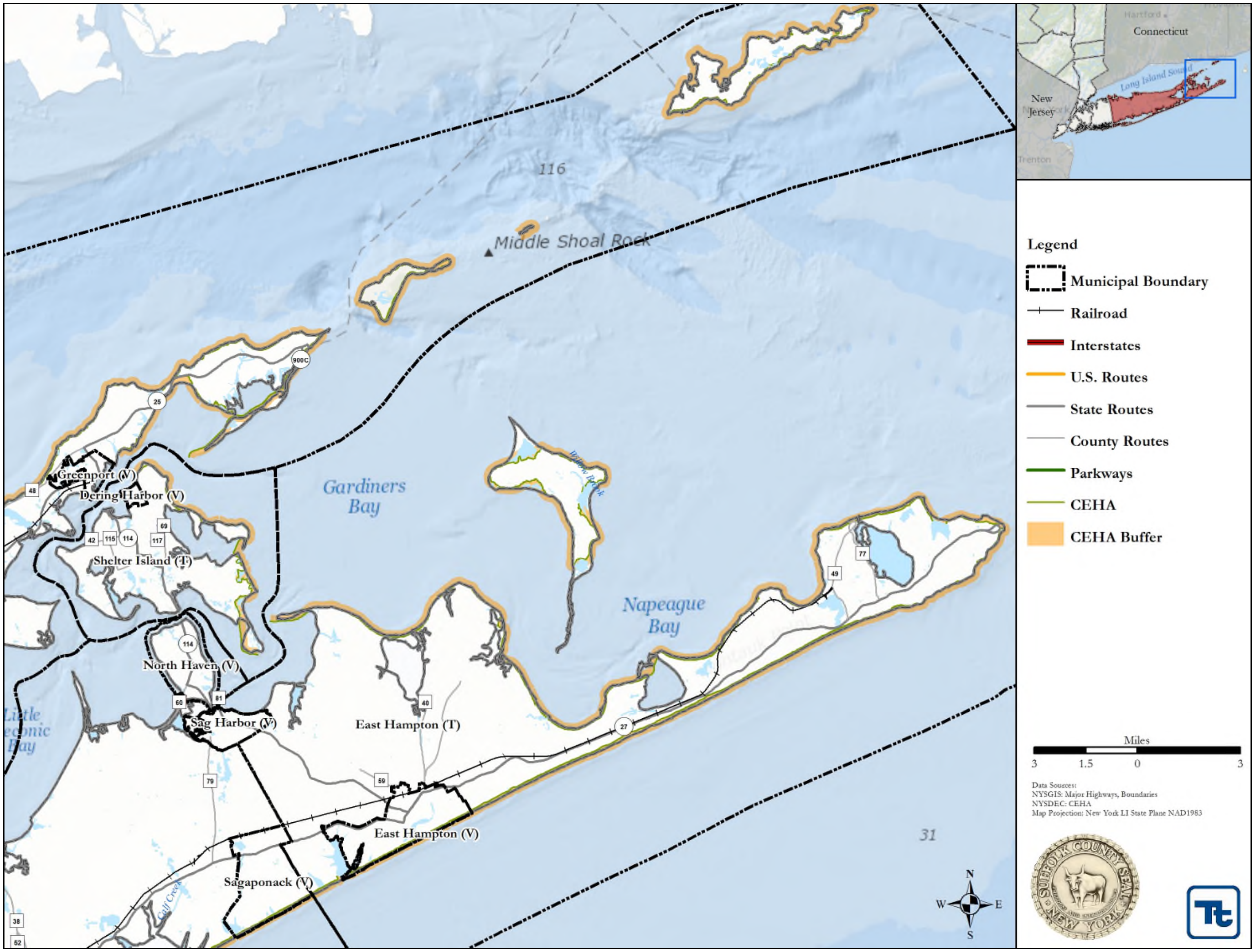
Source: NYSDEC

Figure 5.4.1-3. NYSDEC Coastal Erosion Hazard Areas Line for Suffolk County – Central



Source: NYSDEC

Figure 5.4.1-4. NYSDEC Coastal Erosion Hazard Areas Line for Suffolk County - East



Source: NYSDEC

Previous Occurrences and Losses

Many sources provided historical information regarding previous occurrences of coastal erosion throughout Suffolk County. With so many sources reviewed for the purpose of this HMP, loss and impact information for many events could vary depending on the source. Therefore, the accuracy of monetary figures discussed is based only on the available information identified during research for this HMP.

Although many factors contribute to the natural coastal erosion of Suffolk County shorelines; historical hurricanes, tropical storms and Nor'Easter events have significantly increased coastal erosion processes throughout Suffolk County. Because Suffolk County is primarily surrounded by coastal waters, most tropical and extra-tropical events that commonly occur within the area result in significant losses and temporary or permanent changes to the County's shorelines. The Long Island shorelines have historically experienced coastal erosion and related storm damage. Details regarding Nor'Easter and Hurricane events that have impacted Suffolk County are presented earlier in Section 5.4.7 and Section 5.4.9, respectively.

Although erosion is a common result of most coastal storms that have affected Suffolk County, those events that resulted in significant coastal erosion shorelines are identified in Table 5.4.1-1.

Table 5.4.1-1. Coastal Erosion Events in Suffolk County, 2008 to 2013

Dates of Event	Event Type	FEMA Declaration Number	Suffolk County Designated?	Losses / Impacts
November 4, 2009	High Surf	N/A	N/A	A strong and persistent east northeast wind gradient existed over the region between strong low pressure and a strong high pressure system. The tidal piling over several tidal cycles caused widespread moderate coastal flooding along the south shore back bays of Queens, Brooklyn and Long Island and the eastern bays of Long Island. High seas and long period easterly swells also caused significant beach erosion along Atlantic Ocean facing beaches. Severe beach erosion and cuts into the dunes occurred along the Atlantic Ocean facing beaches. Also an estimated 200,000 cubic yards of sand was lost along a 10,000 ft. stretch of beaches.
March 13, 2010	Coastal Flood	N/A	N/A	The combination of strong high pressure and intensifying low pressure created a prolonged period of strong east winds across the region The highest winds and resultant tidal rises occurred with widespread moderate coastal flooding occurring. Positive tidal departures of 3 to 5 feet were recorded, with many places seeing water levels reaching their highest levels in almost 20 years. In addition, the prolonged east winds generated high surf that battered the Atlantic facing shoreline for several days, which caused severe beach erosion. The Hamptons suffered the worst beach erosion in 20 years according to Suffolk County officials as waves up to 20 ft battered the shoreline. The Hamptons are estimated to have suffered at least 30 million dollars in property damage.
September 2, 2010	Hurricane	N/A	N/A	Hurricane Earl produced battering surf, beach erosion, dangerous rip currents and localized washovers along Atlantic Ocean facing beaches as it passed about 90 miles southeast of Nantucket on September 4th. There were numerous reports of washovers with beaches flooded as water surged up to the dunes. Many beach roads were flooded in the areas of the Hamptons with Dune Road closed between Shinnecock Inlet and Quogue Village. In addition, dangerous rip currents were reported at ocean beaches Thursday into the weekend.
December 26, 2010	Severe Winter Storm	N/A	N/A	This intense low pressure system spread snowfall into the region, The blizzard resulted in severe beach erosion and minor to moderate coastal flooding for much of the North Shore of Suffolk County and the Twin Forks of Long Island. Because of the slow movement of the intense storm, seas were able to build and funnel into the coastline on a long northeast fetch. The high wind speeds were of moderate duration and resulted in very significant beach erosion, particularly during times of high tide. Five to 7 foot wind waves on top of a 2 to 3 foot surge was likely responsible for the severe beach erosion. The additive effects of wave action on top of surge likely compounded the erosion. The combined effect of surge and waves had major impact on the immediate shoreline in terms of beach erosion, washovers, and waterfront damage.
August 28, 2011	Hurricane	EM 3328 DR 4020	Yes- PA and IA	Irene then moved across Southeastern New York and Western Connecticut. The large envelope of winds associated with Tropical Storm Irene pushed a 3 to 5

Dates of Event	Event Type	FEMA Declaration Number	Suffolk County Designated?	Losses / Impacts
				foot surge of water along Western Long Island Sound, New York Harbor, the southern and eastern bays of Long Island and southern bays of New York City. This resulted in moderate to major coastal flooding, wave damage and erosion along the coast, with heavy damage to public beaches and other public and private facilities. The USGS tidal gauge in West Pond at Glen Cove recorded a maximum water level of 9.26 ft. These water levels caused widespread moderate to major coastal flooding.
October 29, 2012	Hurricane Nor'Easter	EM 3351 DR 4085	Yes- PA and IA	As Sandy continued to move northwest and interact with the mid latitude trough, its interaction continued to make it less tropical, but did not weaken it much. Record breaking high tides and wave action was combined with sustained winds of 40 to 60 mph and wind gusts of 80 to 90 mph. These extreme conditions resulted in at least 60 deaths and widespread property damage of at least 42 billion dollars. Emergency managers recommended mandatory evacuations of more than 1/2 million people that lived in low lying areas.
December 26-27, 2012	Nor'Easter	N/A	N/A	The storm brought strong winds and some coastal flooding. $2,000 in property damages from the high winds (gusts up to 68 mph on Plum Island in the town of Southold) was recorded.

Source: *NOAA-NCDC, 2013; FEMA, 2013; NWS, 2013*
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.*
DR *Federal Disaster Declaration*
EM *Federal Emergency Declaration*
FEMA *Federal Emergency Management Agency*
IA *Individual Assistance*
NA *Not Available*
NOAA-NCDC *National Oceanic Atmospheric Administration – National Climate Data Center*
NWS *National Weather Service*
NYSDPC *New York State Disaster Preparedness Commission*
PA *Public Assistance*

Hurricane Sandy

Hurricane Sandy's landfall affected the coastlines over a broad swatch of mid-Atlantic and northeastern states, including New York, New Jersey, Delaware, Maryland, Virginia, and North Carolina. The effects from this storm included breaching, overwash, and erosion of the barrier islands along the coast. The following figures show different areas of Suffolk County pre- and post-Sandy.

Figure 5.4.1-5 shows aerial photographs of Bridgehampton (Town of Southampton), looking northwest across the south shore of Long Island towards Mecox Bay. This is a very narrow area and periodically opens during large storms. Large volumes of material were transported into Mecox Bay when it breached during Hurricane sandy. One week after the storm, the breach was being closed by mechanical means. The yellow arrow in each image points to the same feature.

Figure 5.4.1-5. Bridgehampton, New York

Source: USGS, 2013

Figure 5.4.1-6 shows aerial photographs of Cupsogue Beach (Village of Westhampton Beach) looking northwest across West Hampton towards Moriches Beach. The breach that formed during Hurricane Sandy is just east of Moriches Inlet, which was formed during a Nor'Easter in 1931 and was stabilized in the 1950s. The yellow arrow points to the same feature.

Figure 5.4.1-6. Cupsogue Beach, New York

Source: USGS, 2013

Figure 5.4.1-7 is an aerial photograph of Pelican Island and Fire Island looking northwest across Fire Island towards Great South Bay. This location is within Fire Island National Seashore, near Old Inlet. It is a very narrow portion of the Island that has experienced breaching in previous large storms. The island breached during Hurricane Sandy, creating a new inlet. Despite the breach, the fishing shack (yellow arrow) remained standing.

Figure 5.4.1-7. Pelican Island and Fire Island, New York

Source: USGS, 2013

Figure 5.4.1-8 is an aerial of Ocean Bay Park, Fire Island looking northwest across Fire Island towards Great South Bay. Overwash from the beach and narrow dunes carried sand inland towards the interior and bayside of the island, and numerous homes were destroyed or severely damaged. The yellow arrow points to the same feature in each photograph.

Figure 5.4.1-8. Ocean Bay Park, Fire Island, New York

Source: USGS, 2013

As stated in the 2014 NYS HMP Update, beginning with Hurricane Irene in 2011 and Hurricane Sandy in 2012, Fire Island in Suffolk County has experienced above average erosion rates and is considered one of the most vulnerable beaches in the State. Some of the most significant coastal erosion that resulted from Hurricane Sandy was found on Fire Island (Figure 5.4.1-9).

Figure 5.4.1-9. Fire Island Coastal Erosion Survey (USGS) After Hurricane Sandy

Source: NYS HMP, 2014
a leveled beaches, scarped dunes
b damaged homes in Davis Park
c leveled dunes, overwash sheets by the lighthouse
d breach at Old Inlet

Recent Beach Nourishment Activities

To counteract the effects of natural erosion, as well as to prevent storms from devastating beachfront communities, the County has worked with the federal government on beach nourishment projects throughout the County.

- *Fire Island Inlet and Shores Westerly to Jones Inlet* – This is a multi-purpose project that provides navigation and shore protection benefits through the periodic maintenance dredging of Fire Island Inlet with placement of dredged sand along the shoreline several miles west of the inlet at designated barrier island's critical erosion area (Gilgo Beach). The sand placed at Gilgo Beach is intended to nourish the westerly beaches and provide storm damage protection. A total of over 953,000 cubic yards of sand was dredged and placed as beach nourishment along the Gilgo Beach shoreline. An additional 135,983 cubic yards of dredged sand was placed as beach nourishment along Robert Moses State Park Beach. These projects were completed during the 2003-2004 fiscal year (USACE, 2014).

The last maintenance dredging cycle was completed in the winter of 2007-2008 that included dredging and placement of 619,000 cubic yards of sand along the critical erosion area at Gilgo Beach. The project was completed on March 26, 2008 (USACE, 2014).

Work planned for fiscal year 2014 includes the completion of a contract to replace the 1.2 million cubic yards of sand lost during Hurricane Sandy using sand from Fire Island Inlet (USACE, 2014).

- *Fire Island Inlet to Montauk Point Beach Erosion Control and Hurricane Protection Project* – This project provides for hurricane protection and beach erosion control along five reaches of the south shore of Long Island between Fire Island Inlet and Montauk Point (approximately 83 miles). This project also authorizes federal participation in periodic nourishment. Currently, a reformulation study is being conducted, which is being done to identify storm damage risk reduction within the study area and to evaluate alternative methods of providing the authorized beach erosion control and hurricane protection (USACE, 2013).

  Completed work-to-date includes the construction of 11 groins in the Westhampton Beach area in 1965. An additional four groins with beach and dune fill was placed west of the 11 groin field in 1969-1970. The Westhampton interim project included groin modification and beachfill within and west of the 15 groin field and was completed in December 1997. In March 2005, beachfill west of the Shinnecock navigation channel was completed. Two groins were constructed in 1965 at Georgica Pond (USACE, 2013).

  State, local, and congressional interests requested that the USACE provide immediate remedial actions for critical vulnerable areas. These actions would be modified, as necessary, based on the ultimate recommendations of the Reformulation Study (USACE, 2013). These actions include the following:

  - *Breach Contingency Plan* – provides a mechanism for rapid beach closure of the barrier islands through the 83-mile project area. A Breach Contingency Plan was approved in February 1996. Hurricane Sandy (October 2012) resulted in damages to Long Island's barrier beaches. This event breached the barrier island in several locations, specifically at Cupsogue County Park and Smith Point County Park, leaving the area vulnerable to significant damages. On November 12, 2012, New York State requested emergency assistance from the USACE to activate the Breach Contingency Plan and emergency contract actions were issued for both areas. The Cupsogue breach was closed on November 27, 2012 and the Smith Point breach was closed on December 7, 2012. Hurricane Sandy caused a third breach within the Fire Island Wilderness Area (Old Inlet area). This breach is currently open and ongoing monitoring by the National Park Service and New York State is underway to determine if the breach will close naturally or if it will be necessary to close the breach via another Breach Contingency Plan contract action (USACE, 2013).
  - *Westhampton Interim Project* – provides interim protection to the Westhampton Beach area west of groin 15 and affected mainland communities north of Moriches Bay. The project provides a protective beach berm and dune, tapering of existing groins 14 and 15, and construction of an intermediate groin (14a). This project also includes periodic nourishment, as necessary, to ensure the integrity of the project design, for up to 30 years (through 2027). Beachfill for this project also includes placement within the existing groin field to fill the groin compartments and encourage sand transport to the areas west of groin 15. Initial construction was completed in December 1997. This project has performed better than anticipated, in terms of anticipated cost, project performance, and beneficial environmental impacts. The first re-nourishment effort was completed in

February 2001; second effort was completed in December 2004; and a portion of the third effort was completed in February 2009 (USACE, 2013).

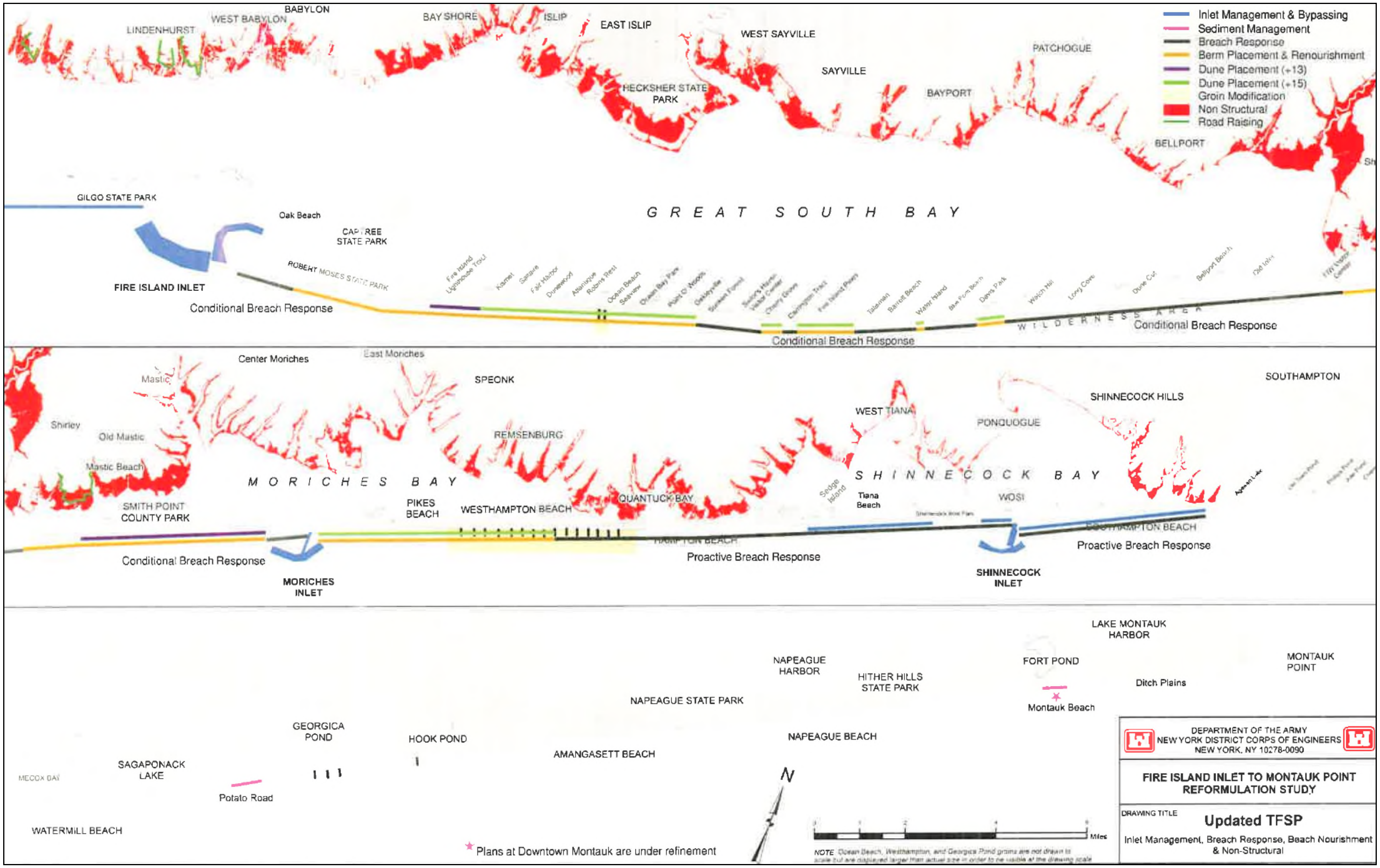
In response to Hurricane Sandy damages, the Disaster Relief Appropriations Act of 2013 will fund the restoration of this project to its original design template. Plans and specifications are currently underway, with contract awarded in late 2013 (USACE, 2013).

- *West of Shinnecock Interim Project* – provided interim protection to the area immediately west of Shinnecock Inlet up to 4,000 feet westerly, a potential breach area. The project was intended to provide protection until implementation of Reformulation Study recommendations. This project consisted of initial beachfill placement, with two anticipated nourishments for a period of six years (through 2011). Placement of sand in this area allowed for future maintenance dredging of Shinnecock Inlet to bypass sand past the influence of the Inlet. Initial beachfill placement was completed in March 2005; however, no renourishment efforts have been completed due to lack of funding. This project is considered completed until a new recommendation is made by the Reformulation Study or a new decision document is prepared (USACE, 2013).

  An emergency contract for rehabilitation of this project, which was damaged by Hurricanes Irene and Sandy, was completed by the USACE in January 2013. Approximately 300,000 cubic yards of sand was placed west of the Inlet to repair the project to pre-storm conditions. In conjunction with this contract, a Memorandum of Agreement was executed between the USACE and New York State for placement of an additional 124,000 cubic yards of material at Tiana Beach. In response to Hurricane Sandy damages, the Disaster Relief Appropriations Act of 2013 will fund the restoration of this project to its original design template (USACE, 2013).

The following table and figure provide information regarding proposed plans for the reaches of Suffolk County (Fire Island Inlet and Gilgo Beach, Moriches Inlet, and Shinnecock Inlet).

Figure 5.4.1-10. Inlet Management, Breach Response, Beach Nourishment, and Non-Structural



Source: USACE 2013

Table 5.4.1-2. FIMP Tentative Federal Selected Plan – Shoreline Reach Features

FIMP TENTATIVE FEDERAL SELECTED PLAN - SHORELINE REACH FEATURES (8-12-13)						
Reach Designations					TFSP Description	
Project Reach	Design Reach	Design Subreach	Reach Name	Reach Length (ft)	Proposed Plan	Cross Section
			Fire Island Inlet and Gilgo Beach		Inlet Dredging and bypassing (FI)	
GSB	GSB-1	1A	Robert Moses State Park - West	6,700	Conditional Breach Response	
		1A	Robert Moses State Park - East	19,000	Beach, no Dune, Renourishment, backpassing	90 ft wide beach
		1B	FI Lighthouse Tract	6,700	Beach, Dune and Renourishment	+13 ft dune, 90 ft wide berm
	GSB-2	2A	Kismet to Lonelyville	8,900	Beach, Dune and Renourishment	+15 ft dune, 90 ft wide berm
		2B	Town Beach to Corneille Estates	5,100	Beach, Dune and Renourishment	+15 ft dune, 90 ft wide berm
		2C	Ocean Beach & Seaview	3,800	Beach, Dune, Renourish, Groin Modification	+15 ft dune, 90 ft wide berm
		2D	OBP to Point O' Woods	7,400	Beach, Dune and Renourishment	+15 ft dune, 90 ft wide berm
		2E	Sailors Haven	8,100	Conditional Breach Response	+9.5 ft closure section
	GSB-3	3A	Cherry Grove	3,000	Beach, Dune and Renourishment	+15 ft dune, 90 ft wide berm
		3B	Carrington Tract	1,500	Conditional Breach Response	+9.5 ft closure section
		3C	Fire Island Pines	6,600	Beach, Dune and Renourishment	+15 ft dune, 90 ft wide berm
		3D	Talisman to Water Island	7,300	Conditional Breach Response	+9.5 ft closure section
		3E	Water Island	2,000	Beach, Dune and Renourishment	+15 ft dune, 90 ft wide berm
		3F	Water Island to Davis Park	4,700	Conditional Breach Response	+9.5 ft closure section
		3G	Davis Park	4,100	Beach, Dune and Renourishment	+15 ft dune, 90 ft wide berm
		3H	Watch Hill	5,000	Conditional Breach Response	+9.5 ft closure section
	GSB-4	4A	Wilderness Area - West	19,000	Conditional Breach Response	+9.5 ft closure section
		4B	Old Inlet	16,000	Conditional Breach Response	+9.5 ft closure section
MB	MB-1	1A	Smith Point CP- West	6,300	Beach, No Dune and Renourishment	90 ft wide beach
		1B	Smith Point CP - East	13,500	Beach, Dune , Renourish, sand bypassing (Moriches)	+13 ft dune, 90 ft wide berm
	MB-2	2A	Great Gun	7,600	Beach, Dune , Renourish, sand bypassing (Moriches)	+13 ft dune, 90 ft wide berm
		2B	Moriches Inlet - West	6,200	Conditional Breach Response	+9.5 ft closure section
			Moriches Inlet		Inlet Dredging and Bypassing	
		2C	Cupsogue Co Park	7,500	Beach, Dune and Renourishment	+15 ft dune, 90 ft wide berm
		2D	Pikes	9,700	Beach, Dune and Renourishment	+15 ft dune, 90 ft wide berm
		2E	Westhampton	18,300	Beach, Dune, Renourish, Groin Modification	+15 ft dune, 90 ft wide berm
SB	SB-1	1A	Hampton Beach	16,800	Proactive Breach Response	+13 ft dune, 90 ft wide berm
		1B	Sedge Island	10,200	Proactive Breach Response, sand bypassing (Shinn)	+13 ft dune, 90 ft wide berm
		1C	Tiana Beach	3,400	Proactive Breach Response, sand bypassing (Shinn)	+13 ft dune, 90 ft wide berm
		1D	Shinnecock Inlet Park West	6,300	Proactive Breach Response, sand bypassing (Shinn)	+13 ft dune, 90 ft wide berm
	SB-2	2A	Ponquogue	5,300	Proactive Breach Response	+13 ft dune, 90 ft wide berm
		2B	WOSI	3,900	Proactive Breach Response, bypassing (Shinn)	+13 ft dune, 90 ft wide berm
			Shinnecock Inlet		Inlet Dredging and bypassing	
	SB-3	2C	Shinnecock Inlet - East	9,800	Proactive Breach Response	+13 ft dune, 90 ft wide berm
		3A	Southampton Beach	9,200	Proactive Breach Response	+13 ft dune, 90 ft wide berm
		3B	Southampton	5,300		
		3C	Agawam	3,800		
P	P-1	1A	Wickapogue	7,700		
		1B	Watermill	8,800		
		1C	Mecox Bay	1,400		
		1D	Mecox to Sagaponack	10,400		
		1E	Sagaponack Lake	1,100		
		1F	Sagaponack to Potato Rd	9,300		
		1G	Potato Rd	4,300	Sediment Management, Pond Management Plan	+9.5 ft beach
		1H	Wainscott	4,600		
		1I	Georgica Pond	1,200		
		1J	Georgica to Hook Pond	11,200		
		1K	Hook Pond	1,100		
		1L	Hook Pond to Amagansett	19,200		
M	M-1	1A	Amagansett	10,400		
		1B	Napeague State Park	9,100		
		1C	Napeague Beach	9,900		
		1D	Hither Hills SP	7,000		
		1E	Hither Hills to Montauk B	15,800		
		1F	Montauk Beach	4,700	Sediment Management (under refinement)	+9.5 ft beach
		1G	Montauk B to Ditch Plains	4,700		
		1H	Ditch Plains	3,400		
		1I	Ditch Plains to Montauk Pt	19,300		

Source: USACE 2013

Probability of Future Events

According to the New York State 2014 HMP Update, the ability to predict coastal impacts from hurricanes and other coastal storms is essential in successful mitigation planning. Long-term coastal erosion is a continuous and dynamic process and is highly probable to occur in the future, impacting all coastal counties along the Atlantic coastline, as well as those with shorelines along the Great Lakes (NYS DHSES 2013).

Based on historical frequency, Suffolk County has the highest probability for future occurrences, with a 27% probability each year. There has been an increase in coastal erosion over the last 20 years and it is expected to continue with the predicted increase in sea level rise and storm frequency and severity (NYS DHSES 2013).

As stated in the New York State 2014 HMP Update, storms are often categorized by return frequencies (e.g. 100 year storm, etc.). There are several shortcomings related to trying to categorize erosion by return frequencies. First, the historical record of storms is relatively short to accurately assess the true long-term frequency of long period events. Second, it is difficult to make an equitable comparison of events involving coastal erosion. Sea level rise changes the vulnerability such that storms of an average 100-year frequency may occur considerably more often, causing more effects including erosion. Third, coastal erosion impacts can vary significantly from one locality to another depending upon such factors as the effects of onshore wind component and incidence of wave activity to structural protective features such as jetties, groins and bulkheads. In addition, the impact of a storm can be compounded if it has multiple severe dimensions (e.g. major coastal flooding in addition to high tides, such as in Hurricane Sandy; very heavy snow; and extreme winds). Finally, development along the coastline or in other vulnerable areas can significantly increase the impact of a storm, increasing the level of erosion. Consequently, the same storm in 1993 might not have caused as much damage then as it would now with the increased coastal development and sea level rise (NYS DHSES 2013).

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).

Sea level rise projects that do not include significant melting of polar ice sheets suggest one to five inches of rise by the 2020s; five to 12 inches by the 2050s; and eight to 23 inches by the 2080s. Scenarios that include rapid melting of polar ice projects four to 10 inches by the 2020s; 17 to 29 inches by the 2050s; and 37 to 55 inches by the 2080s. Accelerated sea level rise will tend to exacerbate barrier island erosion issues. At low-to-moderate increase in the rates of rise, the effects of sea level rise will still be of lesser magnitude than storm events and disruptions of the longshore sediment transport. At the most extreme rates of increased rate of rise, the barrier islands may not be able to maintain themselves if sea level rise outspaces the ability of the system to supply sediment naturally; thus, exposing the bay and mainland shoreline to more oceanic conditions as the barrier disappears (NYSERDA, 2011).

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 2013). Temperatures are predicted to increase in Suffolk County, which lead to an increase in intensity and frequency of severe storm. This increase may lead to more weather patterns that cause coastal erosion events.

Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. While coastal erosion is not generally considered an imminent threat to public safety, its impact to property, infrastructure, environmental resources and local economies is clear. The following text evaluates and estimates the potential impact of coastal erosion on Suffolk County including:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impact on: (1) life, health and safety of residents, (2) general building stock, (3) critical facilities, (4) economy, and (5) future growth and development
- Effect of climate change on vulnerability
- Change of vulnerability as compared to that presented in the 2008 Suffolk County Hazard Mitigation Plan
- Further data collections that will assist understanding this hazard over time

Overview of Vulnerability

Coastal erosion is a significant concern to the County because of the large number of communities and cultural resources (beaches, parks, etc.) located along the coast. As described in detail earlier in this profile, principal natural causes of erosion are wave action, wind action, and overland runoff through intense precipitation. Other contributing factors that can significantly increase erosion of a natural protective feature include length of fetch, wind direction and speed, wave length, height and period, near-shore water depth, tidal influence, increased lake levels, and overall strength and duration of storm events. Additionally, sea-level rise will exacerbate coastal erosion. Refer to Section 5.4.5 (Flood) for exposure to sea-level rise scenarios projected by NOAA.

Data and Methodology

Best available data was used to assess Suffolk County's vulnerability to coastal erosion. To help understand the geographic distribution of coastal risk, the New York Department of State prepared coastal and riverine risk assessment layers with assistance from the National Oceanic and Atmospheric Administration Coastal Services Center (NOAA-CSC) and the Federal Emergency Management Agency (FEMA). Coastal risk assessment areas have been identified for Nassau, Suffolk, and Westchester counties and the New York City boroughs (NYSDOS, 2013).

The coastal risk assessment areas depict the full spectrum of coastal risk, from relatively frequent events to infrequent large storms or future changes in water levels. Risk assessment mapping uses the best currently available science and data sources to identify areas at risk from flooding, erosion, and storm surge as well as potential effects from sea level rise. As Hurricane Sandy demonstrated, areas well inland can be affected, so risk assessment mapping included sources such as the FEMA 0.2% annual risk ("500-year") flood zone and the National Hurricane Center's Sea, Lake, and Overland Surges from Hurricanes (SLOSH) zones. The mapping also assumes a 3-ft rise in sea level by 2100. Risk assessment maps are intended for planning purposes only. These maps can be used in conjunction with other planning tools, maps, and resources and should not be substituted for the regulatory FEMA DFIRMs or other associated boundaries (NYSDOS, 2013). The coastal risk areas do not overlap each other, and do not result in cumulative results. For example, if a critical facility is in the moderate risk aarea it is not also in the hig risk area. Figure 5.4.1-11 through Figure 5.4.1-13 illustrates the moderate, high and extreme risk areas in Suffolk County. More detailed definitions of the three risk areas are described below.

Extreme Risk Areas: The Extreme Risk areas are currently at risk of frequent inundation, vulnerable to erosion in the next 40 years, or likely to be inundated in the future due to sea level rise. In summary, these areas depict the maximum extent of the following areas:

- FEMA V zone
- Areas subject to Shallow Coastal Flooding per NOAA NWS's advisory threshold.
- Areas prone to erosion, natural protective feature areas susceptible to erosion.
- Added 3 feet to the MHHW shoreline and extended this elevation inland over the digital elevation model (DEM) to point of intersection with ground surface.

High Risk Areas: The High Risk areas are outside the Extreme Risk Area that are currently at infrequent risk of inundation or at future risk from sea level rise. In summary these areas depict the maximum extent of following areas upland of the boundary of the Extreme Risk Area:

- Area bounded by the 1% annual flood risk zone (FEMA V and A zones).
- Added 3 feet to NOAA NWS coastal flooding advisory threshold and extended this elevation inland over the DEM to point of intersection with ground surface.

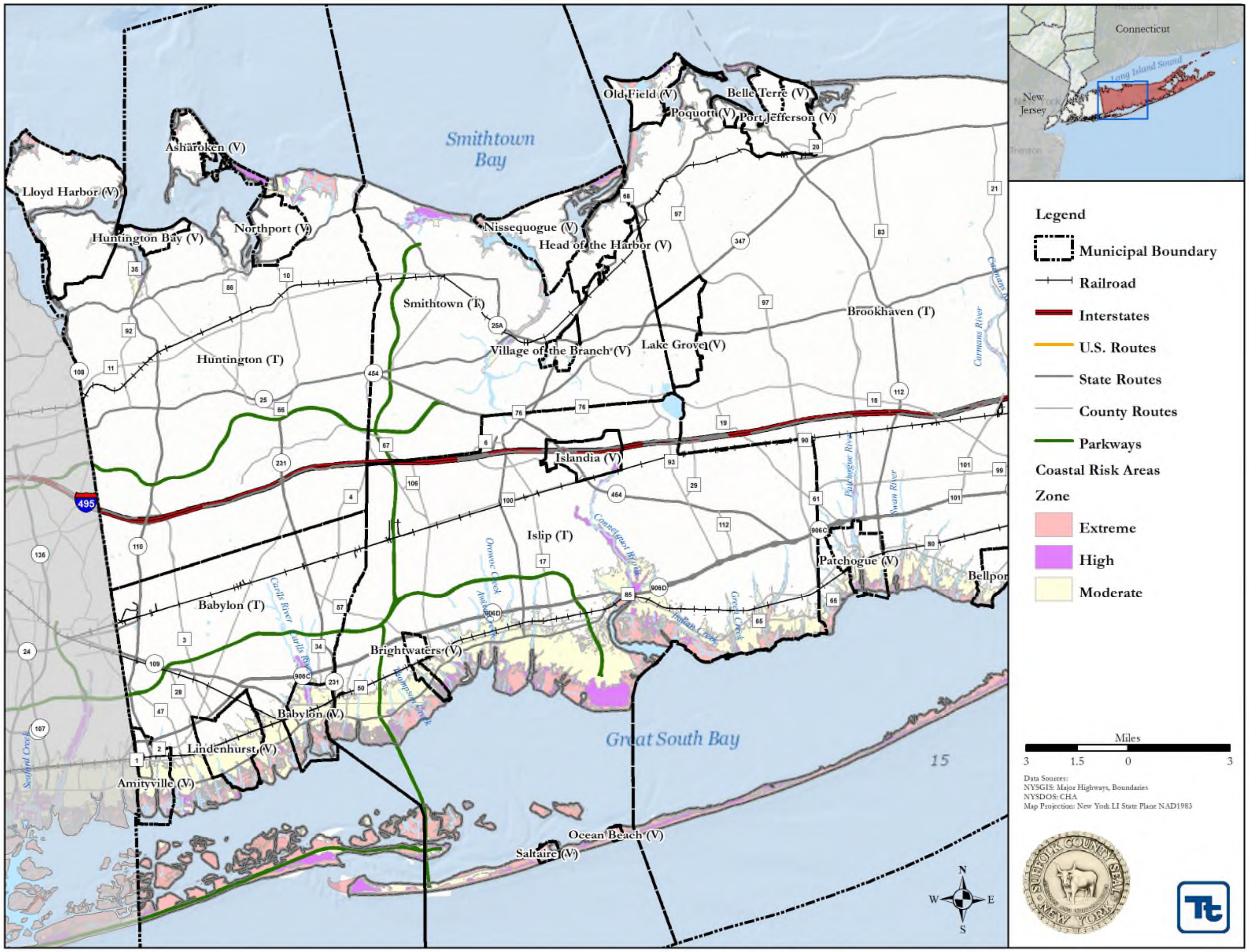
Moderate Risk Areas: The Moderate Risk areas are outside the Extreme and High Risk Areas but currently at moderate risk of inundation from infrequent events or at risk in the future from sea level rise. In summary, these areas depict the maximum extent of the following areas upland of the boundary of the High Risk Area.

- Area bounded by the 0.2% annual risk (500 year) flood zone, where available.
- Added 3 feet to the Base Flood Elevation for the current 1% annual risk flood event and extended this elevation inland over the DEM to point of intersection with ground surface.
- Area bounded by SLOSH category 3 hurricane inundation zone (NYSDOS, 2013).

The CEHA data provided by NYSDEC (CEHA line and the 1,000-foot seaward buffer) was examined. The average rate of recession is not defined for Suffolk County. The buffered area of the CEHA is incorporated into the risk assessment areas described above. Both the CEHA line with buffer, and the New York Department of State risk assessment area was used as the areas to evaluate this hazard for Suffolk County. There are limitations with the application of this data set for assessing vulnerability. Coastal erosion is generally a hyper localized hazard dependent on the specific dynamics of a location. For example, the data does not account for coastal erosion hazards for bay front communities like Mastic Beach or Bellport, because the data does not cover areas that are not adjacent to the Atlantic Ocean or Lon Island Sound.

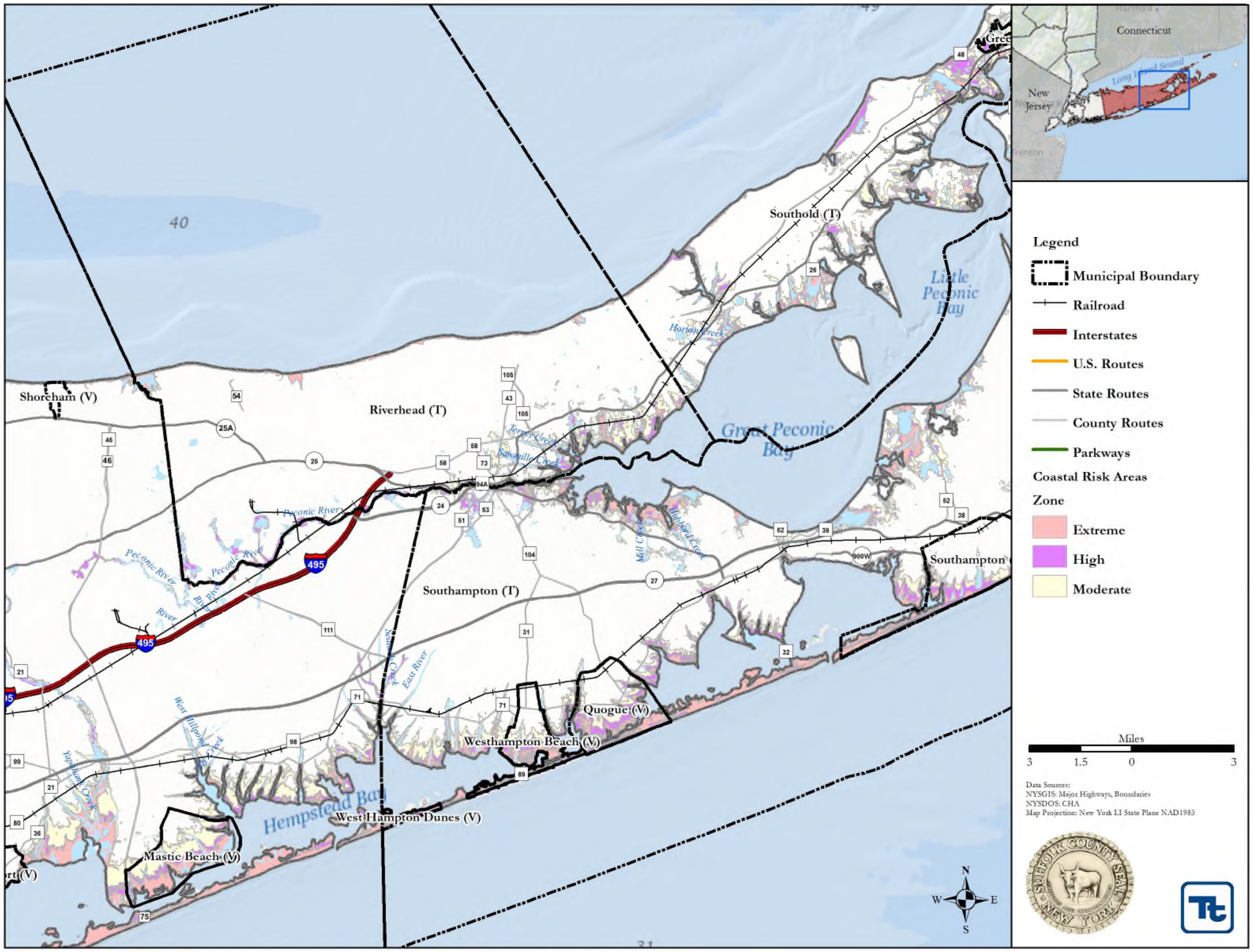
The asset data (population, building stock and critical facilities) presented in the Section 4 (County Profile) were used to support an evaluation of assets exposed and the potential impacts and losses associated with this hazard. To determine what assets are exposed to coastal erosion, available and appropriate GIS data was overlaid upon the hazard area.

Figure 5.4.1-11. Coastal Risk Assessment Areas- West



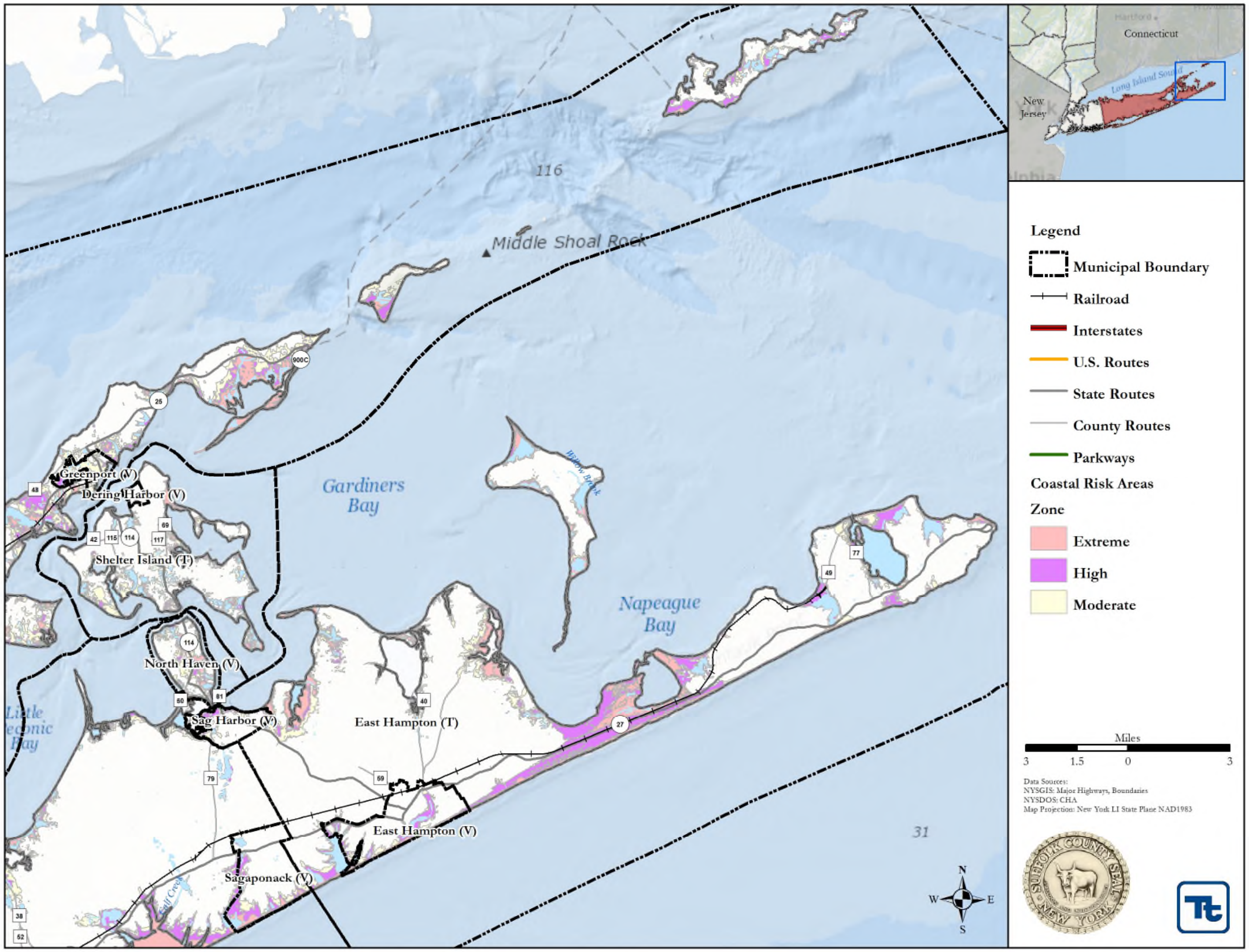
Source: NYSDOS, 2013

Figure 5.4.1-12. Coastal Risk Assessment Areas- Central



Source: NYSDOS, 2013

Figure 5.4.1-13. Coastal Risk Assessment Areas- East



Source: NYSDOS, 2013

Impact on Life, Health and Safety

Coastal erosion is not generally considered an imminent threat to public safety when the changes are gradual over many years. However, drastic changes to the shoreline may occur as a result of a single storm event which can threaten homes and public safety. The population exposed is also considered vulnerable to this hazard.

To estimate the population exposed to the CEHA and the Coastal Risk Areas, the boundaries were overlaid upon the 2010 Census population data in GIS (U.S. Census 2010). The 2010 Census blocks with their centroid in the coastal risk area boundaries were used to calculate the estimated population exposed to these hazards. Using this approach, it was estimated that 111,790 people are exposed to moderate coastal risk, 20,757 people are exposed to high coastal risk, and 25,152 people are exposed to extreme coastal risk. The same analysis was performed for the coastal erosion hazard buffer and it was estimated that 1,747 people are exposed to the coastal erosion hazard. Table 5.4.1-3 lists the estimated population located within the CEHA and Coastal Risk Area boundaries by jurisdiction.

Table 5.4.1-3. Approximate Population in the Coastal Erosion Hazard Areas

Jurisdiction	Total Pop. (2010 U.S. Census)	CEHA with Buffer	NYSDOS Coastal Risk Areas		
			Moderate	High	Extreme
Amityville (V)	9,523	0	3,417	309	1,337
Asharoken (V)	654	127	0	209	280
Babylon (T)	164,661	159	13,857	3,625	5,025
Babylon (V)	12,166	0	7,863	684	2,625
Belle Terre (V)	792	0	0	0	0
Bellport (V)	2,084	0	79	1	23
Brightwaters (V)	3,103	0	804	99	165
Brookhaven (T)	434,886	503	13,028	2,547	2,558
Dering Harbor (V)	11	0	0	0	0
East Hampton (T)	18,205	41	781	433	130
East Hampton (V)	1,083	0	29	13	27
Greenport (V)	2,197	0	1,413	209	3
Head of the Harbor (V)	1,472	0	0	0	10
Huntington (T)	190,124	312	1,660	76	399
Huntington Bay (V)	1,425	0	39	49	0
Islandia (V)	3,335	0	0	0	0
Islip (T)	328,989	40	39,062	4,502	5,928
Lake Grove (V)	11,163	0	0	0	0
Lindenhurst (V)	27,253	0	10,374	1,257	2,227
Lloyd Harbor (V)	3,660	0	56	25	39
Mastic Beach (V)*	12,930	0	4,652	1,235	985
Nissequogue (V)	1,749	0	0	86	0
North Haven (V)	833	0	249	5	114
Northport (V)	7,401	0	142	170	0
Ocean Beach (V)	79	0	0	28	51
Old Field (V)	918	182	194	0	0
Patchogue (V)	11,798	0	3,534	1,019	611
Poquott (V)	953	0	7	0	0

Jurisdiction	Total Pop. (2010 U.S. Census)	CEHA with Buffer	NYSDOS Coastal Risk Areas		
			Moderate	High	Extreme
Port Jefferson (V)	7,750	10	161	108	28
Quogue (V)	967	27	154	57	92
Riverhead (T)	33,506	155	1,838	669	303
Sag Harbor (V)	2,169	0	346	216	0
Sagaponack (V)	313	0	16	28	15
Saltaire (V)	37	0	0	1	24
Shelter Island (T)	2,381	8	262	24	142
Shoreham (V)	531	0	0	0	0
Smithtown (T)	112,773	10	118	118	10
Southampton (T)	49,130	15	3,892	1,820	1,271
Southampton (V)	3,109	22	80	34	10
Southold (T)	19,771	98	3,005	884	507
Village of the Branch (V)	1,807	0	0	59	0
West Hampton Dunes (V)	55	21	0	0	55
Westhampton Beach (V)	1,721	17	233	67	131
Shinnecock Tribal Nation	662	0	236	91	27
Unkechaug Tribal Nation	324	0	209	0	0
Suffolk County	**1,493,350**	**1,747**	**111,790**	**20,757**	**25,152**

Source: NYSDOS, 2013
Note (1): These population estimates do not include the increase in seasonal population along the coast.
Note (2): The populations are reported as in each zone, not cumulative.
* *Mastic Beach Population is based on 2010 CDP population*

As discussed above, there are limitations with the application of the CEHA data set for assessing vulnerability. Communities along inland bays like the Shinnecock Bay and the Great South Bay may be vulnerable to coastal erosion hazard.

Impact on General Building Stock

To estimate the potential losses to the general building stock, the exposure analysis methodology was used. Table 5.4.1-4 summarizes the number of buildings located in the CEHA buffered area and the coastal risk areas by municipality. This estimate is considered high because coastal erosion generally occurs in increments of inches to feet per year along the coastline and may not necessarily occur across the entire coastal resource area at the same time from one event. It is estimated that 4,754 accounting for $4.9 million dollars of replacement cost value is exposed to the CEHA buffer area. The analysis has also shown that there are 55,787 buildings with replacement costs of $52 million dollars on the moderate coastal risk area, 17,417 buildings with replacement costs of $16 million dollars on the high coastal risk area, and 15,483 buildings with replacement costs of $11 million dollars on the high coastal risk area.

Table 5.4.1-4. Building Exposure to the Coastal Erosion Hazard Areas

Jurisdiction	Total Number of Buildings	Total RCV	CEHA (with buffer)		Coastal Risk Area - Moderate		Coastal Risk Area - High		Coastal Risk Area - Extreme	
			Count	Total RCV	Count	Total RCV	Count	Total RCV	Count	Total RCV
Amityville (V)	4,112	$4,252,136,181	0	$0	1,634	$1,317,983,358	360	$245,937,349	941	$503,832,423
Asharoken (V)	439	$372,107,179	84	$69,072,634	30	$25,703,931	233	$187,404,423	63	$46,611,979
Babylon (T)	56,432	$65,453,076,501	146	$189,568,376	5,509	$4,621,250,611	1,374	$746,534,524	2,408	$1,198,961,473
Babylon (V)	5,287	$4,543,925,987	0	$0	3,009	$2,898,071,140	489	$488,917,850	1,196	$743,400,155
Belle Terre (V)	401	$669,659,013	17	$50,892,010	3	$1,317,178	0	$0	6	$16,955,339
Bellport (V)	1,684	$1,916,728,157	0	$0	179	$226,424,580	26	$35,110,982	37	$31,547,047
Brightwaters (V)	1,676	$1,513,218,570	0	$0	390	$423,925,581	155	$152,952,259	38	$22,616,358
Brookhaven (T)	165,626	$190,143,257,364	796	$735,424,292	6,544	$6,145,372,709	2,520	$2,219,784,554	1,825	$1,395,963,744
Dering Harbor (V)	71	$50,907,547	0	$0	7	$5,347,899	0	$0	2	$602,970
East Hampton (T)	22,561	$14,753,173,216	776	$646,964,308	1,664	$1,186,953,794	1,440	$941,371,717	349	$284,573,692
East Hampton (V)	2,994	$2,592,657,128	104	$111,111,679	163	$134,208,681	83	$48,300,516	74	$92,366,448
Greenport (V)	1,363	$959,195,848	0	$0	801	$584,922,595	87	$107,692,274	44	$30,832,595
Head of the Harbor (V)	836	$1,460,689,661	0	$0	9	$8,420,723	1	$888,001	1	$731,606
Huntington (T)	76,595	$87,620,284,012	177	$173,753,044	650	$1,300,698,034	115	$245,451,575	80	$68,839,395
Huntington Bay (V)	739	$824,147,761	0	$0	96	$107,668,115	40	$44,514,888	17	$20,754,597
Islandia (V)	1,195	$3,165,387,995	0	$0	0	$0	0	$0	0	$0
Islip (T)	102,388	$116,722,805,765	234	$244,094,372	14,646	$16,181,017,803	2,878	$3,070,740,147	2,960	$2,389,319,294
Lake Grove (V)	4,015	$4,981,641,857	0	$0	0	$0	0	$0	0	$0
Lindenhurst (V)	10,823	$7,338,416,625	0	$0	4,344	$2,954,929,332	352	$276,345,659	1,313	$727,047,695
Lloyd Harbor (V)	1,807	$2,454,429,712	18	$24,332,105	63	$75,421,820	12	$17,460,430	15	$29,434,673
Mastic Beach (V)	7,305	$3,233,984,869	0	$0	2,835	$1,235,652,949	848	$348,715,139	823	$337,985,408
Nissequogue (V)	854	$3,556,614,754	27	$43,219,968	28	$72,172,019	41	$61,972,059	26	$38,910,754
North Haven (V)	742	$1,038,696,076	0	$0	232	$303,540,376	21	$22,809,300	1	$365,700
Northport (V)	3,475	$3,098,715,281	0	$0	86	$260,949,894	9	$27,195,352	17	$8,360,451
Ocean Beach (V)	573	$506,864,928	40	$29,028,204	3	$1,815,236	136	$103,265,797	434	$401,783,895
Old Field (V)	529	$999,833,880	59	$97,055,455	72	$172,876,798	24	$24,519,902	11	$14,099,195
Patchogue (V)	4,277	$5,365,465,598	0	$0	1,508	$1,684,754,136	129	$208,348,578	74	$71,778,914
Poquott (V)	480	$613,660,785	0	$0	15	$23,209,146	2	$856,712	8	$1,982,175
Port Jefferson (V)	2,931	$4,974,246,594	24	$80,604,607	97	$287,642,892	30	$107,894,005	10	$1,737,721
Quogue (V)	1,675	$2,538,333,603	103	$180,736,488	347	$566,550,799	292	$481,011,044	150	$203,382,362

Jurisdiction	Total Number of Buildings	Total RCV	CEHA (with buffer)		Coastal Risk Area - Moderate		Coastal Risk Area - High		Coastal Risk Area - Extreme	
			Count	Total RCV	Count	Total RCV	Count	Total RCV	Count	Total RCV
Riverhead (T)	21,343	$20,620,083,411	359	$215,982,152	1,485	$934,372,852	583	$385,608,739	275	$147,854,491
Sag Harbor (V)	3,011	$2,555,414,041	0	$0	461	$484,551,174	195	$254,923,159	5	$3,406,855
Sagaponack (V)	759	$1,538,825,257	42	$76,344,684	76	$229,697,400	61	$103,786,200	30	$37,131,384
Saltaire (V)	443	$577,966,672	67	$62,794,490	0	$0	73	$147,882,771	370	$430,083,901
Shelter Island (T)	4,061	$2,627,033,680	65	$54,664,469	611	$377,737,099	99	$96,982,425	38	$31,409,115
Shoreham (V)	304	$444,350,589	13	$29,106,506	0	$0	0	$0	0	$0
Smithtown (T)	42,097	$72,444,940,121	39	$61,379,611	95	$94,586,907	21	$27,198,577	13	$30,511,774
Southampton (T)	32,382	$38,161,684,004	247	$340,683,189	3,566	$3,959,609,083	2,231	$2,412,189,100	693	$658,026,212
Southampton (V)	3,578	$5,883,613,602	126	$362,544,114	187	$423,003,432	170	$411,823,092	88	$187,171,667
Southold (T)	21,584	$15,067,456,341	812	$570,250,981	3,749	$2,501,888,169	1,526	$1,029,410,190	453	$246,499,286
Village of the Branch (V)	675	$1,314,993,732	0	$0	0	$0	2	$388,707	0	$0
West Hampton Dunes (V)	285	$309,912,300	119	$129,967,500	2	$2,254,200	148	$168,487,800	135	$139,170,300
Westhampton Beach (V)	2,265	$2,752,056,759	260	$318,122,177	354	$544,255,269	528	$661,339,598	456	$484,226,589
Shinnecock Tribal Nation	618	$473,022,431	0	$0	181	$139,327,249	64	$46,925,715	1	$335,896
Unkechaug Tribal Nation	146	$76,936,042	0	$0	56	$29,136,505	19	$8,428,952	3	$1,666,881
Suffolk County	**617,436**	**$702,562,551,431**	**4,754**	**$4,897,697,416**	**55,787**	**$52,529,221,468**	**17,417**	**$15,971,370,062**	**15,483**	**$11,082,272,407**

Source: NYSDEC, 2007; NYSDOS, 2013
Notes: RCV = Total replacement cost value (structure and contents)

Impact on Critical Facilities

There are identified critical facilities exposed to the Coastal Erosion Hazard Area and the Coastal Risk Areas as listed in Table 5.4.1-5 through Table 5.4.1-8. These facilities are summarized by facility type. Refer to Appendix F for a specific list of these facilities.

Table 5.4.1-5. Critical Facilities in the NYSDOS Moderate Coastal Risk Area

Jurisdiction	Facility Types																						
	Bus	Care	Church	Communication	DPW/DOT	Electric Power	Electric Substation	EOC	Ferry	Fire	Military	Municipal	Other	POD	Police	Port	Potable Water	Rail	Suffolk County	School	Senior	Tribal	Wastewater
Amityville (V)	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	1	0	0	0
Babylon (T)	0	0	0	0	0	1	1	0	0	2	0	0	0	2	0	0	5	0	0	4	0	0	1
Babylon (V)	0	0	0	1	5	0	1	1	0	3	0	1	0	0	0	0	4	1	0	5	0	0	0
Brookhaven (T)	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1	2	0	0	0
East Hampton (T)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	0	1	0	0	0
East Hampton (V)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Greenport (V)	0	1	0	0	2	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Huntington (T)	0	0	2	0	0	1	0	0	0	4	0	0	0	0	0	0	3	0	0	0	0	0	1
Islip (T)	0	2	0	0	1	0	2	1	0	7	2	1	0	2	1	0	10	1	0	12	0	0	2
Lindenhurst (V)	0	0	0	1	0	0	0	1	0	2	1	1	0	1	0	0	0	1	0	4	0	0	0
Mastic Beach (V)	0	0	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
North Haven (V)	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Northport (V)	0	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1	0	0	0
Patchogue (V)	0	0	0	0	0	0	1	0	0	2	0	2	0	0	1	0	1	1	0	2	0	0	0
Port Jefferson (V)	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	2
Quogue (V)	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	0	0	2	3	0	0	0
Riverhead (T)	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	1	0	0	0	1
Sag Harbor (V)	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0	1	1	0	0	0

Jurisdiction	Facility Types																						
	Bus	Care	Church	Communication	DPW/DOT	Electric Power	Electric Substation	EOC	Ferry	Fire	Military	Municipal	Other	POD	Police	Port	Potable Water	Rail	Suffolk County	School	Senior	Tribal	Wastewater
Shelter Island (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Shinnecock Tribal Nation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0
Southampton (T)	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	4	0	4	0	2	0	1
Southold (T)	0	0	0	0	0	1	1	1	0	0	0	0	0	0	1	0	5	0	0	0	0	0	0
Unkechaug Tribal Nation	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
Westhampton Beach (V)	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
Suffolk County	**0**	**3**	**4**	**6**	**11**	**4**	**8**	**5**	**1**	**28**	**3**	**9**	**2**	**7**	**6**	**1**	**35**	**4**	**9**	**36**	**5**	**12**	**8**

Source: NYSDOS, 2013

Table 5.4.1-6. Critical Facilities in the High Coastal Risk Area

Jurisdiction	Facility Types																			
	Airport	Bus	Communication	DPW\DOT	Electric Power	Electric Substation	Ferry	Fire	Military	Park/Rec	POD	Police	Port	Potable Water	Rail	Suffolk County	School	Senior	Tribal	Wastewater
Amityville (V)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Brightwaters (V)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Brookhaven (T)	0	0	0	0	0	1	0	2	1	0	0	0	0	7	0	0	0	0	0	0
East Hampton (T)	1	0	0	0	1	1	1	0	1	0	0	0	0	0	1	0	0	0	0	0
Greenport (V)	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
Islip (T)	0	0	0	1	0	0	0	0	0	0	0	1	0	8	0	0	1	1	0	1
Nissequogue (V)	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Northport (V)	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	1

Jurisdiction	Facility Types																			
	Airport	Bus	Communication	DPW\DOT	Electric Power	Electric Substation	Ferry	Fire	Military	Park/Rec	POD	Police	Port	Potable Water	Rail	Suffolk County	School	Senior	Tribal	Wastewater
Patchogue (V)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Riverhead (T)	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	3	0	0	0	3
Sag Harbor (V)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Saltaire (V)	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Shelter Island (T)	0	0	0	0	0	0	4	0	0	0	1	0	0	0	0	1	0	0	0	0
Shinnecock Tribal Nation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Smithtown (T)	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Southampton (T)	0	0	4	0	0	0	0	0	0	0	0	3	0	4	0	1	0	0	0	0
Southold (T)	1	0	0	1	1	1	0	0	0	0	0	0	1	0	0	1	0	0	0	1
West Hampton Dunes (V)	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0
Suffolk County	**2**	**0**	**5**	**2**	**2**	**3**	**5**	**2**	**2**	**2**	**3**	**5**	**2**	**21**	**2**	**6**	**1**	**1**	**1**	**12**

Source: NYSDOS, 2013

Table 5.4.1-7. Critical Facilities in the Extreme Coastal Risk Area

Jurisdiction	Facility Types													
	Airport	Electric Substation	EOC	Ferry	Fire	Military	Municipal	Police	Port	Potable	Suffolk County	School	Senior	Wastewater
Asharoken (V)	0	0	0	0	0	0	1	1	0	0	0	0	0	0
Babylon (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Brookhaven (T)	0	0	0	0	2	0	0	0	0	3	0	0	0	0
East Hampton (T)	0	0	0	1	0	0	0	0	0	0	1	0	0	0

Jurisdiction	Facility Types													
	Airport	Electric Substation	EOC	Ferry	Fire	Military	Municipal	Police	Port	Potable	Suffolk County	School	Senior	Wastewater
Islip (T)	0	3	0	0	2	0	0	0	0	2	0	0	1	7
North Haven (V)	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Ocean Beach (V)	0	0	0	0	1	0	0	1	0	0	0	0	0	1
Patchogue (V)	0	0	0	2	0	0	0	0	0	0	0	0	0	1
Port Jefferson (V)	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Saltaire (V)	1	0	1	0	1	0	0	1	0	1	0	0	0	0
Shelter Island (T)	0	0	0	2	0	0	0	0	0	0	2	0	0	0
Southampton (T)	0	0	0	0	0	1	0	0	0	0	1	0	0	0
Southold (T)	1	0	0	0	1	0	0	0	0	1	0	0	0	0
West Hampton Dunes (V)	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Westhampton Beach (V)	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Suffolk County	**2**	**3**	**1**	**5**	**7**	**1**	**1**	**3**	**1**	**8**	**4**	**1**	**1**	**11**

Source: NYSDOS, 2013

Table 5.4.1-8. Critical Facilities in the Coastal Erosion Hazard Area Buffer

Name	Municipality	Facility Type
U.S. Neck Coast Guard Station	Huntington (T)	Military
Callahans Beach Town Park	Smithtown (T)	Communication
Potable Water Facility	Brookhaven (T)	Potable Water
Potable Water Facility	Brookhaven (T)	Potable Water
Potable Water Facility	Brookhaven (T)	Potable Water
SCWA Wells	West Hampton Dunes (V)	Potable Water
Yardarm Condominiums	Westhampton Beach (V)	Wastewater

Source: NYSDEC

Several of the planning partners including the Town of Smithtown, the Suffolk County Water Authority, the Shinnecock and Unkechaug Tribal Nations provided specific parcel data as identified critical properties. Specifically, the Shinnecock and Unkechaug Tribal Nations provided the locations of sacred land. An exposure analysis was completed to identify the amount of land exposed. Table 5.4.1-9 below summarizes results of the exposure analysis.

Table 5.4.1-9. Planning Partner Property Specific Exposure Analysis

			Acres Exposed				% of Total Exposed			
Entity/Type	Municipality	Total Acres of Critical Properties	CEHA	CHA Moderate	CHA High	CHA Extreme	CEHA	CHA Moderate	CHA High	CHA Extreme
SCWA	Babylon (T)	76	0	0	2	0	0.0%	0.0%	2.9%	0.0%
SCWA	Belle Terre (V)	1	0	0	0	0	0.0%	0.0%	0.3%	2.3%
SCWA	Brookhaven (T)	458	0	0	3	0	0.0%	0.0%	0.6%	0.1%
SCWA	Islip (T)	234	0	0	1	0	0.1%	0.0%	0.2%	0.2%
ST Parks	Nissequogue (V)	137	57	0	22	86	41.3%	0.0%	16.3%	62.6%
SCWA	Patchogue (V)	12	0	0	2	7	0.0%	0.0%	15.1%	63.8%
Tribe SL	Shinnecock Tribal Nation	37	0	0	10	21	0.0%	0.0%	25.6%	55.9%
ST Parks	Smithtown (T)	1,248	10	1	12	39	0.8%	0.1%	0.9%	3.1%
SCWA	Southampton (T)	275	0	0	6	11	0.0%	0.0%	2.3%	4.1%
Tribe SL	Unkechaug Tribal Nation	2	0	0	0	0	0.0%	0.0%	7.8%	4.1%
SCWA	West Hampton Dunes (V)	2	1	0	1	1	60.3%	0.0%	33.5%	66.5%
SCWA	Westhampton Beach (V)	3	0	0	0	0	0.0%	0.0%	0.5%	3.5%

Source: FEMA, Town of Smithtown, Suffolk County Water Authority, The Unkechaug Tribal Nation, and The Shinnecock Tribal Nation
Note: SCWA- Suffolk County Water Authority, ST Parks- Smithtown Parks, Tribe SL- Tribal Sacred Land

Impact on Economy

According to the Suffolk County Planning Department "The population of eastern Suffolk County increases substantially during the summer months because of tourism and the presence of seasonal homes." The beaches, parks and coastal communities in Suffolk County are a huge draw for tourists in the summer months which substantially contribute to the County's economy. According to Suffolk County Legislature's Budget Review Office report entitled Impact on the Atlantic Ocean Beaches to the Economy of Suffolk County (2003), an estimated 9.1 million tourists visit Long Island annually, with 5.5 million visiting Suffolk County. An estimated 11.3 million people are estimated to visit Suffolk County's south shore beaches each year, and of these, 500,000 (or 4.6-percent) are estimated to be tourists. Table 5.4.5-4 lists the beaches, parks and residential and natural communities located within the CEHA jurisdiction that are may potentially be impacted by coastal erosion.

Table 5.4.1-10. Beaches, Parks and Residential and Natural Communities Exposed to Coastal Erosion

Reach	Asset
Jones Island Reach	West Gilgo Beach
	Gilgo Beach
	Gilgo State Park
	Cedar Beach
	Oak Beach
	Captree State Park / Island
Fire Island Reach	Democrat Point
	Great South Beach
	Robert Moses State Park
	Kismet
	Saltaire
	Fair Harbor
	Lonelyville
	Atlantique
	Robbins Rest
	Dunewood
	Ocean Beach
	Ocean Bay Park
	Point o'Woods
	Cherry Grove
	Fire Island Beach/Fire Island Pines
	Fire Island National Seashore
	Davis Park
	Bayberry Dunes
	Moriches Inlet
	Smith Point County Park
Westhampton Reach	Cupsoque Beach
	Westhampton Dunes

Reach	Asset
	Potunk Point
	Westhampton Beach
	Hampton Beach
	Quogue Beach
	Tiana Beach
	Shinnecock Inlet
Ponds Reach	Southampton Beach
	Watermill Beach
	Mecox Beach
	Sagoponack Inlet
	Wainscott Beach
Montauk Reach (South Fork or "The Hamptons")	East Hampton Beach
	Atlantic Double Dunes
	Amagansett Beach
	Napeague Beach
	Montauk Beach
	Montauk Point
	Montauk Park
North Shore	Lloyd Beach (Lloyd Neck, Caumsett State Park)
	Eaton's Neck (Huntington Bay)
	North Port
	Asharoken Beach
	Crab Meadow Park
	Sunken Meadow State Park (Kings Park)
	Nissequogue (Smithtown Bay)
	Stony Brook
	West Meadow Beach
	Port Jefferson Harbor (Setauket)
	Cedar Beach (Mount Sinai)
	Mount Sinai Harbor
	Rocky Point
	Scott's Beach
	Shoreham Beach
	Wading River Beach (Wading River)
	Herod Point
	Wildwood State Park
	Woodcliff Park
	Roanoke Point
	Reeves Park
	Jacob's Point
	Northville

Reach	Asset
	Mattituck Inlet/Creek
	Duck Pond Point
	Goldsmith Inlet/Park
	Horton Point
	Peconic Dunes Park
	Greenport Park
	Truman Beach
	Orient Point (North Fork)
East End	Orient Beach State Park (Long Beach)
	Mashomack Preserve Nature Conservancy (Shelter Island)
	Cedar Point Park
	Sammy's Beach
	Gardiners Island
	Greenport

Source: ACNYMP

According to *Impact on the Atlantic Ocean Beaches to the Economy of Suffolk County* (2003), tourism accounts for an estimated $790 million or 1.65-percent of the County's economic activity. It is estimated that direct spending or output from Suffolk County's south shore beaches contributes approximately $255.7 million annually to the County's economy (measured in 1999 dollars), supporting 3,855 jobs and $99 million in labor income. Information was not found regarding the north shore beaches' contribution to the Suffolk County economy. It is clear that impact to Suffolk County beaches, from coastal erosion or other natural hazards, would impact the local economy.

Coastal erosion can also severely impact Suffolk County's roads and infrastructure. There are 10.1 miles of parkway, State, and County roads that lie within the CEHA jurisdiction and therefore, exposed to coastal erosion. These include: Robert Moses State Parkway, Ocean Parkway (State Route 909), and State Routes 25, 27 and 48. Additionally, there are 61.7 miles of secondary (local) roads that lie within the CEHA. There are two bridges, located at the intersection of Main Street and Gardiners in the Town of Southold, located within the CEHA. There are no railroad stations, railway lines, or airports vulnerable to coastal erosion. Of the electrical power facilities, substations, and potable water facilities, none are located within the CEHA; however, there are four substations located on the barrier islands in the Town of Islip and one substation located on Fire Island in the Town of Brookhaven. One military installation, the U.S. Neck Coast Guard Station in the Village of Asharoken, has property located in the CEHA jurisdiction that could be impacted by coastal erosion.

As described earlier, Sewer District 3's sewer outfall is highly vulnerable to coastal erosion. Traversing through the barrier island and 2.5 miles into the Atlantic Ocean, the outfall disposes treated sewage for the Towns of Babylon and Islip. The original construction of the outfall had cover over the pipe at the shoreline approximately 17 feet. Storms have reduced that cover to 8 feet at the shoreline and less to the south. In 1992, a project was implemented ($3.5 million) to install 700 feet of sheeting with a rehabilitated cathodic protection system at the shoreline. According to SCDPW, preliminary assessments indicate that the system does not have the 100-year life, as projected in 1980 (Wright, 2007).

Effect of Climate Change on Vulnerability

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 that exacerbate coastal erosion. While predicting changes of coastal erosion 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).

Impacts of climate change can lead to shoreline erosion, coastal flooding, and water pollution, affecting man-made coastal infrastructure and coastal ecosystems. Coastal areas may be impacted by climate change in different ways. Coastal areas are sensitive to sea-level rise, changes in the frequency and intensity of storms, increase in precipitation, and warmer ocean temperatures. Additionally, oceans are absorbing more carbon dioxide from the rising atmospheric concentrations of the gas, resulting in oceans becoming more acidic. This could have significant impacts on coastal and marine ecosystems (U.S. EPA 2013). As previously stated, warmer temperatures may lead to an increase in frequency of storms, thus leading to more weather events that cause coastal erosion.

Change of Vulnerability

Suffolk County, its municipalities and the Tribal Nations continue to be vulnerable to the coastal erosion hazard. However, there are several differences between the exposure estimates between this plan update to the results reported in the original 2008 HMP. Their differences are due to the new and updated population (U.S. Census 2010 now available) and building inventories used, and newly available coastal risk area delineations.

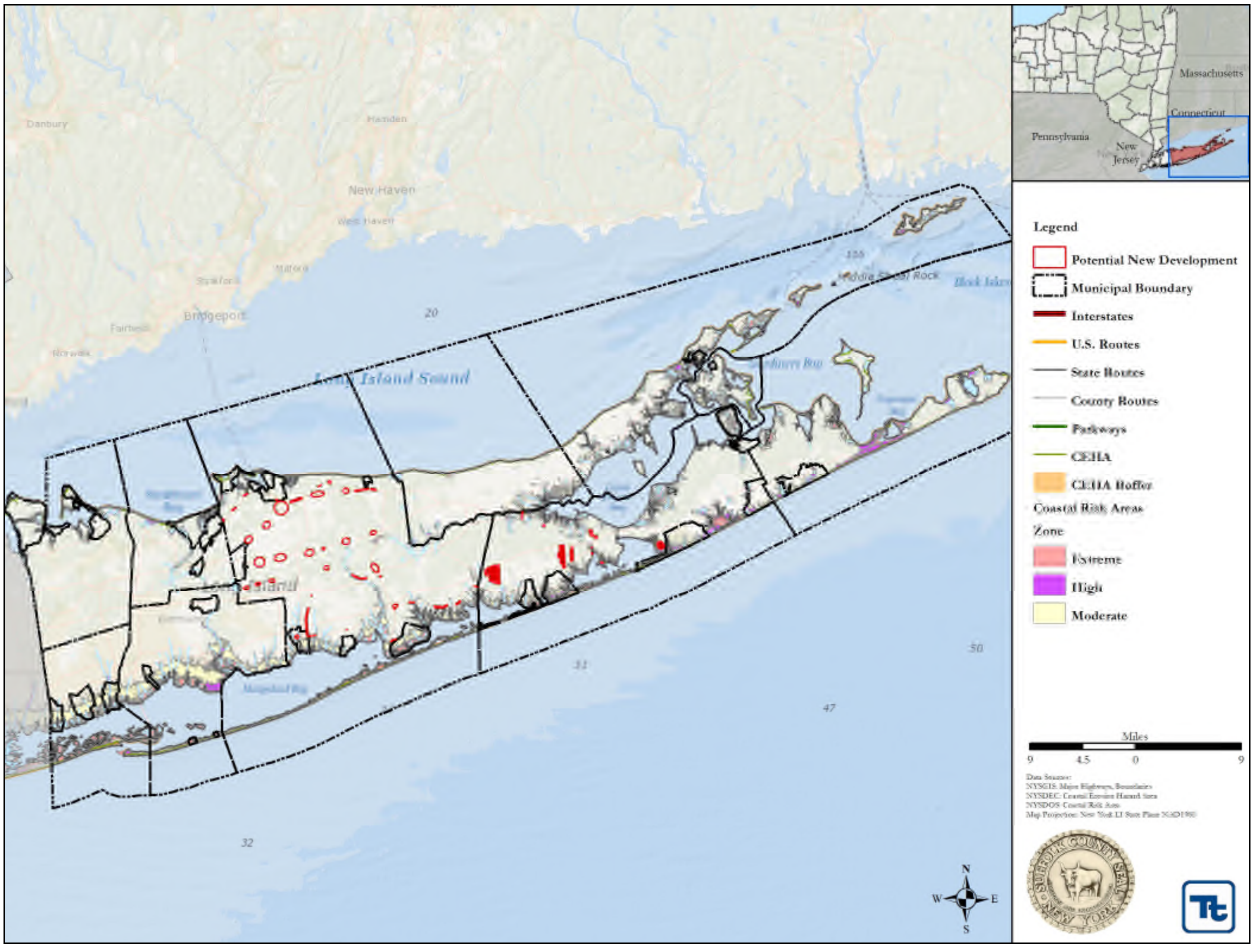
For example, the 2008 HMP building inventory used the default HAZUS-MH general building stock with replacement values based on 2006 RS Means. The analysis was conducted at the aggregate level (Census block). For this plan update, the exposure analysis was conducted at the structure level using building footprint locations and 2014 RS Means replacement cost values with a regional factor applied specific to Suffolk County as determined by the Steering Committee.

Overall, this vulnerability assessment uses a more accurate and updated building inventory which provides more accurate exposure estimates for Suffolk County.

Future Growth and Development

As discussed in Section 4, areas targeted for future growth and development have been identified across the County. Any areas of growth located in the defined coastal risk areas could be potentially impacted by coastal erosion similar to those that currently exist within the County. Please refer to Figure 5.4.1-14 of the potential new development in the County and the Coastal Erosion Hazards and Coastal Risk Areas.

Figure 5.4.1-14. Potential New Development and Coastal Erosion Hazards and Coastal Risk Areas



Sources: NYSDOS, NYSDEC

Additional Data and Next Steps

When the CEHA maps and the NYSDOS coastal risk assessment areas are updated, this section of the plan will be updated to reflect new areas and/or assets located in the coastal erosion hazard area. Additional data on historic costs incurred to reconstruct buildings and/or infrastructure due to coastal erosion impacts would assist in estimating future losses.