4.3 HAZARDS OF CONCERN

The Essex County hazards of concern are presented in Section 4.3 and outlined as follows:

- **Hazard Profile**
  - Location - geographic area most affected by the hazard
  - Extent – severity of each hazard
  - Previous Occurrences and Losses
  - Impacts of Climate Change
  - Probability of Future Hazard Events
- **Vulnerability Assessment**
  - Impact to Population
  - Impact to Buildings
  - Impact to Critical Facilities and Lifelines
  - Impact to Economy
  - Future Changes that may Impact Vulnerability
  - Vulnerability Changes Since 2015

4.3.1 Coastal Erosion and Sea Level Rise

2020 HMP Changes

- All subsections have been updated using best available data.
- Previous occurrences were updated with events that occurred between 2014 and 2019.
- Updated sea level rise data from NOAA was used in the Vulnerability Assessment. The 1-foot and 3-foot sea level rise boundaries from NOAA's 2016 dataset were used to align with the 2019 New Jersey State HMP.

4.3.1.1 Profile

Hazard Description

Coastal Erosion

Coastal erosion is the gradual breakdown and removal of land material into a sea or lake due to physical and chemical, natural processes such as wind, wave and tide action, with contribution from man-made interferences. Coastal erosion can take place at two different rates: gradual erosion which occurs on a daily basis along all coastlines; and sudden or catastrophic events primarily due to storms which can result in changes to coasts over a very short period of time (Essex County HMP 2008).

Many natural factors affect erosion of the shoreline, including shore and nearshore morphology, shoreline orientation, and the response of these factors to storm frequency and sea level rise. Coastal shorelines change constantly in response to wind, waves, tides, sea-level fluctuation, seasonal and climatic variations, human alteration, and other factors that influence the movement of sand and material within a shoreline system.

Unsafe tidal conditions, as a result of high winds, heavy surf, erosion, and fog are ordinary coastal hazard phenomena. Some or all of these processes can occur during a coastal storm, resulting in an often detrimental impact on the surrounding coastline. Factors including: (1) storms such as Nor'Easters and hurricanes, (2) decreased sediment supplies, and (3) sea-level rise contribute to these coastal hazards. Nor'easters and hurricanes are further discussed in Section 4.3.2 Coastal Storm.

Coastal erosion can result in significant economic loss through the destruction of buildings, roads, infrastructure, natural resources, and wildlife habitats. Damage often results from an episodic event with the combination of severe storm waves and dune or bluff erosion.

Sea Level Rise

There is evidence that global sea is rising at an increased rate and will continue rising over the next century. The two major causes of sea level rise are thermal expansion caused by the warming of the oceans and the loss of land-based ice (glaciers and polar ice caps) due to increased melting. Thermal expansion can account for 50% of sea level rise and is a result of warming atmospheric temperatures and subsequent warming of ocean waters causing the expansion. Since 1900, records and research have shown that sea level has been steadily rising at a rate of 0.04 to 0.1 inches per year (NOAA 2013).

There are two ways sea level rise is discussed: global and relative. Global sea level rise refers to the increase currently observed in the average global sea level trend (primarily attributed to changes in ocean volume due to ice melt and thermal expansion). The melting of glaciers and continental ice masses can contribute significant amounts of freshwater input to the earth's oceans. In addition, a steady increase in global atmospheric temperature creates an expansion of salt water molecules, increasing ocean volume.

Relative sea level refers to the height of the water as measuring along the coast relative to a specific point on land. Water level measurements at tide stations are referenced to stable vertical points on the land and a known relationship is established. Measurements at any given tide station include both global sea level rise and vertical land motion (subsidence, glacial rebound, or large-scale tectonic motion). The heights of both the land and water are changing; therefore, the land-water interface can vary spatially and temporally and must be defined over time. Relative sea level trends reflect changes in local sea level over time and are typically the most critical sea level trend for many coastal applications (coastal mapping, marine boundary delineation, coastal zone management, coastal engineering, and sustainable habitat restoration) (NOAA 2013).

Short-term variations in sea level typically occur on a daily basis and include waves, tides, or specific flood events. Long-term variations in sea level occur over various time scales, from monthly to several years and may be repeatable cycles, gradual trends, or intermittent differences. Seasonal weather patterns (changes in the earth's declination), changes in coastal and ocean circulation, anthropogenic influences, vertical land motion, etc. may influence changes in sea level over time. When estimating sea level trends, a minimum of 30 years of data are used in order to account for long-term sea level variations and reduce errors in computing sea level trends based on monthly mean sea level (NOAA 2013).

Changes in global temperatures, hydrologic cycles, coverage of glaciers and ice sheets, and storm frequency and intensity are captured in long-term sea level records. Sea levels provide a key to understanding the impact of climate change (NOAA 2013). 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. The historical rate of sea level rise along the New Jersey coast over the past 50 years was 0.12 to 0.16 inches per year (Miller and Kopp 2013).

Location

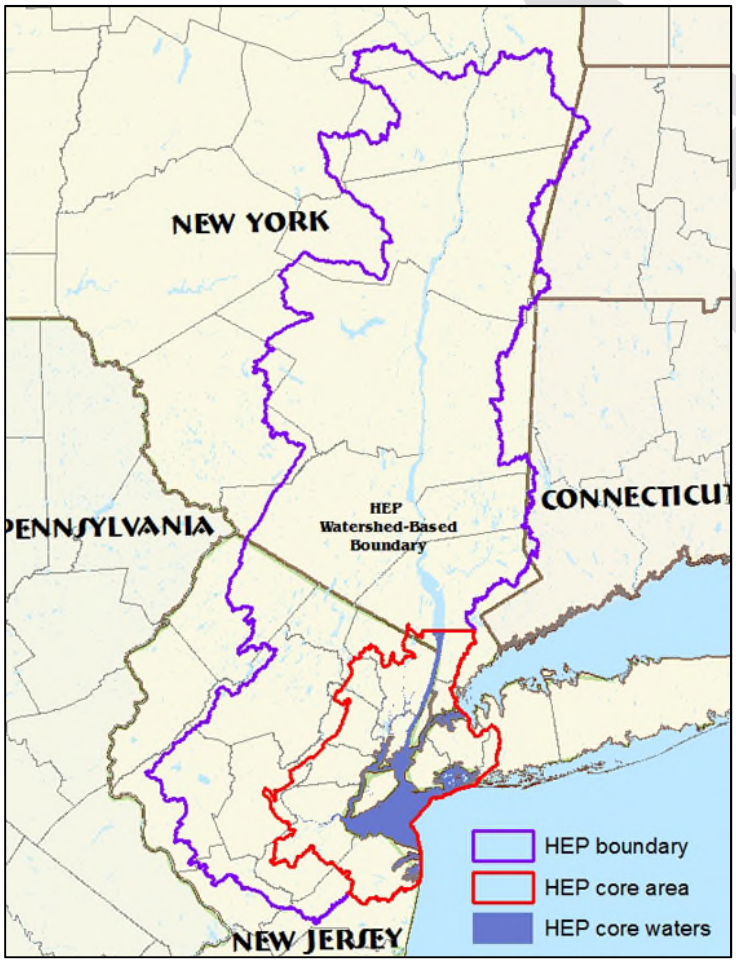
The coastal boundary of New Jersey encompasses the Coastal Area Facility Review Act (CAFRA) area and the New Jersey Meadowlands District. The coastal area includes coastal waters to the limit of tidal influence including: the Atlantic Ocean (to the limit of New Jersey's seaward jurisdiction); Upper New York Bay, Newark Bay, Raritan Bay and the Arthur Kill; the Hudson, Raritan, Passaic, and Hackensack Rivers, and the tidal portions of the tributaries to these bays and rivers. As previously stated, a coastal area is any land adjacent to a

tidally influenced waterway; therefore, Essex County is considered a coastal county because the City of Newark lies along the tidal portion of the Hudson River.

New York-New Jersey Harbor Estuary (Newark Bay)

Essex County has a very limited coastline, present only in the City of Newark and significant coastal erosion is not identified along the limited coastline, which is only present in the City of Newark (Essex County HMP 2008). The County is located within the New York-New Jersey Harbor Estuary (Newark Bay). An estuary is a body of water where rivers meet the ocean and salt water meets fresh water. The Harbor Estuary is positioned at the confluence of the Hudson River and smaller rivers such as the East, Hackensack, and Raritan Rivers. It then opens into the New York Bight and Long Island Sound. The watershed of the Harbor Estuary encompasses a large area that includes the Hudson River watershed up to the Troy Dam, as well as the watersheds of the Raritan, Passaic, and Hackensack Rivers. Coastal storms can cause significant impacts to coastlines, both to the built and natural environments. In an urban region like the Harbor Estuary, the impacts to the built environment can exacerbate the level of impact incurred by natural systems (New York-New Jersey Harbor & Estuary Program 2014). Figure 4.3.1-1 shows the location of the New York-New Jersey Harbor Estuary and its boundaries.

Figure 4.3.1-1. New York-New Jersey Harbor Estuary



Source: New York-New Jersey Harbor & Estuary Program 2014

Extent

Coastal Erosion

Coastal erosion is measured as the rate of change in the position or horizontal displacement of a shoreline over a period of time (FEMA 1996). 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).

Such erosion may be intensified by activities such as 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 (FEMA 1996).

Erosion is typically expressed as a rate: rate of linear retreat (feet of shoreline recession per year) or volumetric loss (cubic yards of eroded sediment per linear foot of shoreline frontage per year). Erosion rates are cited as positive numbers, with corresponding shoreline change rates as negative numbers. For example, an erosion rate of two feet per year is equivalent to a shoreline change rate of -2 feet per year. Accretion rates are stated as positive numbers, with corresponding shoreline change rates as positive numbers. For example, an accretion rate of two feet per year is equivalent to a shoreline change rate of two feet per year.

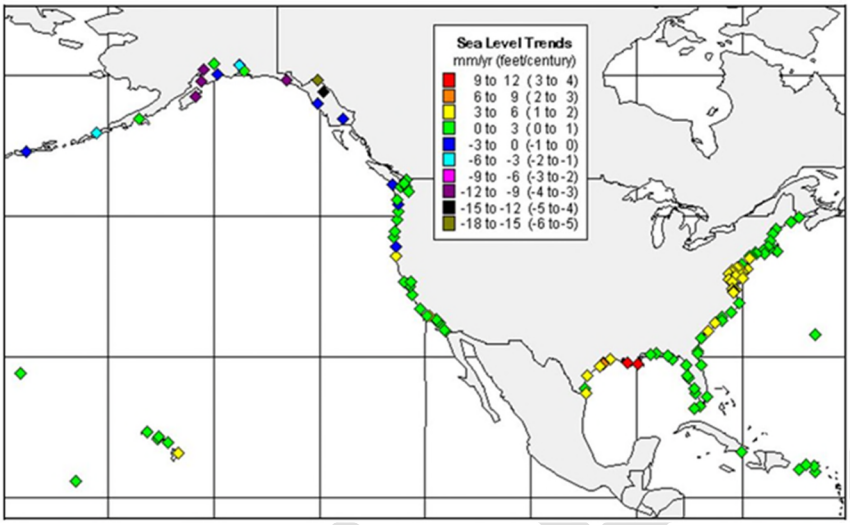
Erosion rates are usually computed and cited as long-term, average annual rates. However, erosion rates are not uniform in time or space and can vary substantially. This includes: from one location along the shoreline to another, even when the two locations are only a short distance apart; over time at a single location; or seasonally.

Sea Level Rise

The Center for Operational Oceanographic Products and Services has been measuring sea level for over 150 years, with tide stations of the National Water Level Observation Network operating on all coastlines of the United States. Changes in mean sea level (MSL), either a sea level rise or sea level fall has been computed at 128 long-term water level stations using a minimum span of 30 years of observations at each location. The measurements have been averaged by month to remove the effect of higher frequency phenomena (storm surge) in order to compute an accurate linear sea level trend (NOAA 2013).

Figure 4.3.1-2 is a map of regional MSL in the United States. This map provides an overview of variations in the rates of relative local MSL at long-term tide stations. The variations in sea level trends primarily reflect differences in rates and sources of vertical land motion. Areas that experienced little-to-no change in MSL are shown in green, including stations consistent with average global sea level rise rate of 1.7 to 1.8 mm/year. These stations do not experience significant vertical land motion. Stations that experienced positive sea level trends (yellow to red) experience both global sea level rise and lowering or sinking of the local land, causing an apparent exaggerated rate of relative sea level rise. Stations that are blue to brown have experienced global sea level rise and a greater vertical rise in local land, causing an apparent decrease in relative sea level. The rates of relative sea level rise reflect actual observations and must be accounted for in any coastal planning or engineering applications (NOAA, 2013).

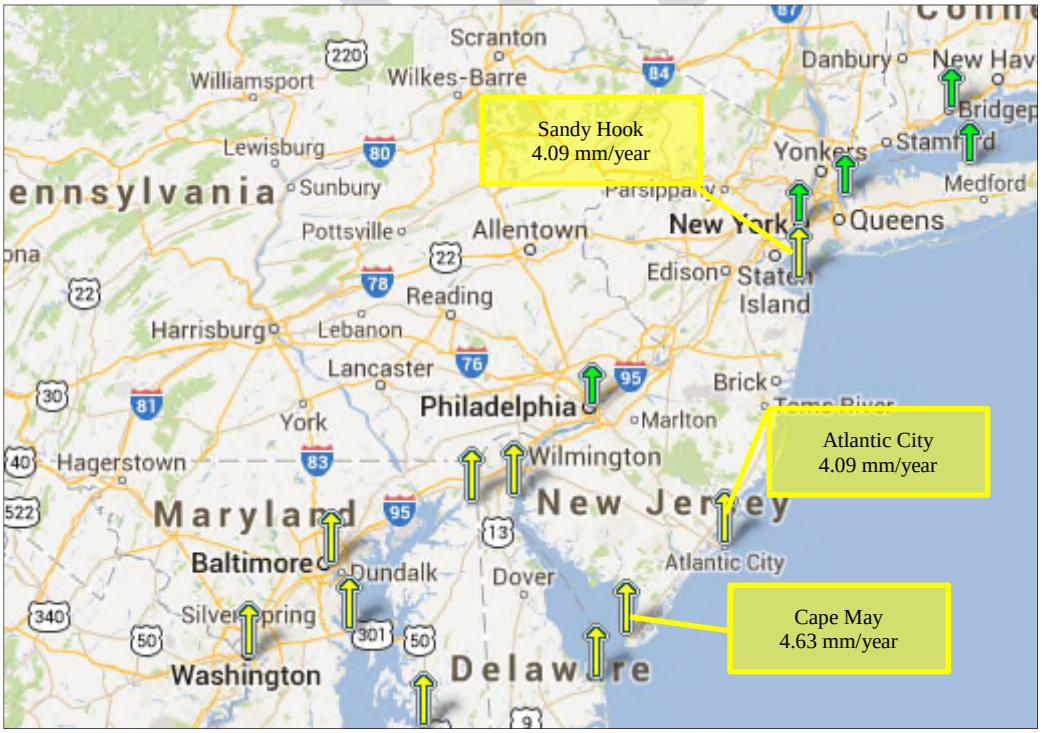
Figure 4.3.1-2. Relative Sea Level Variations of the United States



Source: NOAA, 2013

Figure 4.3.1-3 presents the most recent NOAA relative sea level variations along the Mid-Atlantic coast. Three NOAA tide gauge stations are located on the New Jersey coastline, where tide gauge measurements are made with respect to a local fixed reference level on land: Sandy Hook, Atlantic City and Cape May.

Figure 4.3.1-3. Sea Level Trends in New Jersey



Source: NOAA 2019

Previous Occurrences and Losses

Coastal erosion can occur gradually as a result of natural processes or from episodic events such as hurricanes, Nor'easters, and tropical storms. Coastal erosion also results from sea-level rise. Many sources provided historical information regarding previous occurrences and losses associated with coastal erosion events throughout the State of New Jersey and Essex 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.

Coastal erosion events that have impacted Essex County between 2014 and 2019 are identified in Table 4.3.1-1. For events prior to 2015, refer to Appendix X (Risk Assessment Supplement). Please see Section 9 (Jurisdictional Annexes) for detailed information regarding impacts and losses to each municipality.

Table 4.3.1-1. Coastal Erosion Events in Essex County, 2014 to 2019

Date(s) of Event	Event Type	FEMA Declaration Number (if applicable)	Essex County Designated?	Location	Description
November 2, 2014	Strong Wind	N/A	N/A	Eastern Essex County	A strong low pressure system passed south then east of Long Island. At Newark International Airport, a measured wind of 32 mph was reported at 12:40 pm.
December 9, 2014	Flood	N/A	N/A	East Newark	A coastal storm passed just south and east of the area causing strong winds and heavy rain with isolated flooding in portions of Northeast New Jersey. Passaic Ave. was closed between Central Ave. and Johnston Ave. in East Newark due to flooding.
January 24, 2015	Winter Weather	N/A	N/A	Eastern Essex County	Low pressure moved out of the northern Gulf of Mexico on the morning of the 23rd, to the Mid Atlantic coast on the morning of the 24th, then rapidly intensified on its way northeast to the Canadian Maritimes the following day. This low brought heavy snow to parts of northeast New Jersey on the 24th. Trained spotters measured an average snowfall of 5 inches. The public measured snowfall of 6 inches in Cedar Grove. A trained spotter measured snowfall of 5.6 inches in Bloomfield. Newark Airport measured 5.1 inches of snow.
January 26, 2015	Winter Storm	N/A	N/A	Eastern Essex County	A potent Alberta Clipper low moved from southwestern Canada on January 24th to the Plains states and Ohio Valley on the 25th. The low then redeveloped off the Mid Atlantic coast on the 26th and rapidly intensified into a strong nor'easter, bringing heavy snow and strong winds to parts of northeast New Jersey just west of New York City. Newark Liberty Airport reported snowfall of 6.5 inches, and north winds gusted up to 33 mph, with blowing and drifting of snow.
January 22-23, 2016	Winter Storm, Blizzard	DR-4264	Yes	Essex County	Low pressure moving across the deep South on Thursday January 21st and Friday January 22nd intensified and moved off the Mid Atlantic coast on Saturday January 23rd, bringing heavy snow and strong winds to northeast New Jersey, and blizzard conditions to the urban corridor and some nearby areas. Governor Chris Christie declared a state of emergency for New Jersey on Friday January 22nd. New Jersey Transit stopped running trains, buses and light rail at 2 AM Saturday January 23rd. Bridges and tunnels from New York City into New Jersey were shut down by mid-afternoon Saturday. Travel in and out of airports lagged through Monday January 25th as airlines pre-emptively cut hundreds of flights. More than 1,000 flights out of area airports were cancelled, and Teterboro Airport were shuttered due to whiteout conditions.

Date(s) of Event	Event Type	FEMA Declaration Number (if applicable)	Essex County Designated?	Location	Description
					At Newark Airport, the storm total snowfall was 24.5 inches, where winds gusted to 39 mph. Newark Airport ASOS observations showed blizzard conditions, with visibility less than one quarter mile in heavy snow and frequent wind gusts over 35 mph through the day and into the early evening on Saturday January 23rd.
February 5, 2016	Winter Weather	N/A	N/A	Western Essex County	Low pressure developing along a cold front moving through the region on Thursday February 4th moved off the southern Mid Atlantic coast on Friday February 5th, bringing locally heavy snow to parts of interior Northeast New Jersey on the fifth. Trained spotters reported a widespread 4 to 5 inch snowfall, with locally up to 6 inches in North Caldwell.
November 15, 2016	Flood	N/A	N/A	Bloomfield, Silver Lake	Low pressure moving north along the east coast of the United States resulted in a widespread 1-3 inch rainfall event across northeast New Jersey. Isolated flooding was observed across parts of Essex County, NJ as a result of this rainfall. Newark Airport received 2.79 inches of rain. John F. Kennedy Drive was closed in both directions due to flooding between Hoover Avenue and Belleville Avenue in Bloomfield. Watessing Avenue was closed due to flooding between Grove Street and Franklin Street in Bloomfield. NJ 21 was closed northbound at East 3rd Avenue due to flooding with all lanes detoured.
February 9, 2017	Winter Storm	N/A	N/A	Essex County	Low pressure developed along a cold front over the Middle Atlantic early Thursday, February 9th. The low rapidly intensified as it moved off the Delmarva coast in the morning and then to the south and east of Long Island late morning into the afternoon. The low brought heavy snow and strong winds to portions of Northeast New Jersey. Numerous flights were cancelled or delayed at Newark Airport. Trained spotters, CoCoRaHS observers, and the public reported 6 to 8 inches of snowfall.
March 14, 2017	Winter Storm	N/A	N/A	Essex County	Rapidly deepening low pressure tracked up the eastern seaboard on Tuesday March, 14 bringing blizzard conditions to Western Passaic county. Heavy snow and sleet along with strong winds occurred across the rest of Northeast New Jersey. The storm cancelled numerous flights at Newark airport with some mass transit services suspended. Large trees fell onto homes in Bergen county and approximately 4,500 power outages resulted from the strong winds and heavy snow. Trained spotters and the public reported 8 to 13 inches of snow and sleet.

Date(s) of Event	Event Type	FEMA Declaration Number (if applicable)	Essex County Designated?	Location	Description
December 9, 2017	Winter Weather	N/A	N/A	Essex County	Low pressure along a slow moving cold front off the eastern seaboard brought locally heavy snow to portions of northeast New Jersey. A strong upper jet stream enhanced the snow across the Tri-State as the low pressure passed well offshore. Trained Spotters and the public reported 4 to 5 inches of snow.
January 4, 2018	Winter Storm	N/A	N/A	Essex County	The development of the blizzard/winter storm began along the southeast coast on Wednesday January 3, 2018. An amplifying upper level trough spawned the development of low pressure off the coast of Florida. The low pressure rapidly intensified on Wednesday night through Thursday January 4, 2018 as it moved north-northeast along the coast. The low passed just east of the benchmark Thursday afternoon. The central pressure when the storm developed was around 1004 millibars at 1 pm Wednesday. 24 hours later, the central pressure fell to around 950 mb, approximately a 54 millibar drop. The rapid intensification of the storm led to heavy snow, strong winds, and near-blizzard conditions across portions of Northeast New Jersey. Thousands of flights were cancelled at Newark Airport on January 4, 2018. Homes and businesses lost power and there were numerous accidents on area roadways. The public reported 6 inches of snow in West Caldwell. Winds gusts 30 to 40 mph at the Caldwell Airport during the afternoon and evening on January 4, 2018. The FAA Contract Observer at nearby Newark-Liberty Airport reported 8.4 inches of snowfall. Winds also gusted to 44 MPH at 4:38 PM at the airport.
February 17-18, 2018	Winter Weather	N/A	N/A	Essex County	A low pressure developed along a frontal boundary along the southeast coast on the evening of Saturday, February 17, 2018. This low gradually became better organized as it moved up the coast towards the benchmark early Sunday, February 18, 2018. This system brought heavy snow to northern portions of northeast New Jersey. CoCoRahs observers and nearby Newark Liberty Internal Airport reported 3 to 5 inches of snowfall.

Date(s) of Event	Event Type	FEMA Declaration Number (if applicable)	Essex County Designated?	Location	Description
November 15, 2018	Winter Storm	N/A	N/A	Essex County	A wave of low pressure developed along the Middle Atlantic coast during Thursday November 15, 2018. The low was associated with a closed upper level trough across the Midwest. As the trough translated eastward into Friday November 16, 2018, the low pressure moved up the northeast coast. The antecedent air mass ahead of the low was cold and dry for the middle of November with temperatures during the morning and afternoon of November in the upper 20s and low 30s. The moisture associated with the trough and low pressure was able to produce moderate to heavy bands of snow as the precipitation began across the entire Tri-State area due to the cold air in place. Once the low drew warmer air from the south, the precipitation gradually changed to a wintry mix and then plain rain, especially for the New York City metro and Long Island. The moderate to heavy wet snowfall significantly impacted the evening rush hour with 1-2 inch per hour snowfall rates. Hundreds of trees, tree limbs, and branches were brought down by the weight of the snow, which caused many power outages. Numerous accidents were reported and many motorists were stranded on roads until the early morning hours the next day. There were over 1,000 flights cancelled at the New York City metro airports (Kennedy, La Guardia, and Newark). The FAA contract observer at nearby Newark Airport reported 6.4 inches of snow. Trained spotters, social media, and the public reported 4 to 6 inches of snow. Impacts were widely felt across eastern Essex county with major disruption to the evening commute. Trees branches and limbs were downed due to the weight of the heavy wet snow. Nearby Newark airport reported 1-2 inch per hour snowfall rates at times during the evening commute.
March 3-4, 2019	Heavy Snow	N/A	N/A	Essex County	Low pressure developed across the southeast on Sunday March 3, 2019 and then tracked off the Middle Atlantic coast early on Monday March 4, 2019. The low moved just inside the 40N/70W benchmark and continued out to sea. The low brought a widespread snowfall to northeast New Jersey with the heaviest accumulations occurring across the interior. Much of the significant snow occurred overnight with improved conditions during the Monday morning commute. Trained spotters, CoCoRaHS, and the public reported 7 to 9 inches of snow.

Source: FEMA 2019; NCDC 2019; NWS 2014; SPC 2019; NHC 2019

Note: Not all sources have been identified or researched; therefore, the table may not include all events that have occurred in the County. DR Disaster Declaration (FEMA)

FEMA Federal Emergency Management Agency

Mph miles per hour

N/A Not Applicable

Probability of Future Occurrences

Long-term coastal erosion is a continuous and dynamic process. It is anticipated that coastal erosion will continue due to the projected increase in sea level rise, storm frequency and intensity. A number of factors determine whether a community exhibits greater risk of 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 that direct wave approach;
- Alongshore variations in wave energy and sediment transport rates;
- Relative sea-level rise; and
- Human interference with sediment supply (such as revetments, seawalls, and jetties) (Woods Hole Sea Grant 2003).

The long-term patterns of coastal erosion are difficult to detect because of substantial and rapid changes in coastlines in the short-term (that is, over days or weeks from storms and natural tidal processes). It is usually severe short-term erosion events, occurring either singly or cumulatively over a few years, that cause concern and lead to attempts to influence the natural processes. Analysis of both long- and short-term shoreline changes are required to determine which is more reflective of the potential future shoreline configuration (FEMA 1996).

The return period of an episodic erosion event is directly related to the return period of a coastal storm, hurricane or tropical storm. The one-percent annual chance erosion event can be determined using a predictive model that establishes the one-percent annual chance tide and water surface level, or surge elevation and the resulting wave heights. Storm wave heights, periods and directions have specific impacts on the dunes, currents, and other erosion processes. Analyses of coastal erosion impacts from the one-percent annual chance flood event are included in high-hazard zone determinations shown on NFIP maps. The impacts may vary for each reach of coastline.

A more significant measure of coastal erosion is the average annual erosion rate. Erosion rates can be used in land-use and hazard management to define areas in which development should be limited or where special construction measures should be used. The average annual erosion rate is based on analysis of historical shorelines derived from maps, charts, surveys, and aerial photography obtained over a period of record.

As discussed in next subsection, changes in atmospheric and oceanic temperature will impact the probability for future coastal storm events and sea level rise. Sea level rise takes place due to a combination of long term geological and climate related processes. Long term forecasts and recent data suggest the rate of sea level rise is likely to increase in the future (Kopp et al., 2016).

Based upon risk factors for and past occurrences, it is likely that coastal erosion events and sea level rise will continue to occur and impact New Jersey and Essex County. In addition, as temperatures increase (see climate change impacts below), the probability for future events will likely increase as well. It is estimated that Essex County will continue to experience direct and indirect impacts of coastal erosion on occasion.

In Section 4.4, the identified hazards of concern for Essex County were ranked. The probability of occurrence, or likelihood of the event, is one parameter used for hazard rankings. Based on historical records and input from the Steering and Planning Committee, the probability of occurrence for coastal erosion in the County is considered ‘occasional’.

Climate Change Impacts

Providing projections of future climate change for a specific region is challenging. Shorter term projections are more closely tied to existing trends making longer term projections even more challenging. Coastal areas may be impacted by climate change in different ways.

Changes in global temperatures, hydrologic cycles, coverage of glaciers and ice sheets, and storm frequency and intensity are captured in long-term sea level records. Sea levels provide a key to understanding the impact of climate change (NOAA 2013). 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. Sea level along the New Jersey Coast has risen by more than 16 inches since 1911, double the global average (NOAA NCEI 2019). The historical rate of sea level rise along the New Jersey coast over the past 50 years was 0.12 to 0.16 inches per year (Miller and Kopp 2013).

Coastal areas are sensitive to sea-level rise, changes in the frequency and intensity of storms, increase in precipitation, and warmer ocean temperatures. According to NASA, warmer temperatures may lead to an increase in frequency of storms, thus leading to more weather events that cause coastal erosion (NASA 1997).

4.3.1.2 Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed or vulnerable to the identified hazard. Coastal erosion may impact public safety, property, infrastructure, environmental resources and local economies. There are no NJDEP-identified shoreline types in Essex County characterized as vulnerable to erosion. However, to estimate exposure to long-term coastal erosion the entire shoreline was analyzed.

Projected sea-level rise data (in one-foot increments) available from the NOAA Office of Coastal Management (https://coast.noaa.gov/slrdata/) was considered and used for this analysis. Please note these levels do not include additional storm surge due to a hurricane or Nor'easter. The current Flood Insurance Rate Maps (FIRMs) also do not include the effects of sea-level rise. Projected sea level rise inundation areas are considered areas of permanent loss of land and community assets. Refer to Section 4.2 (Methodology and Tools) for additional details on the methodology used to assess coastal erosion and sea level rise risk.

Figure 4.3.1-2. Estimated Coastal Erosion Hazard Area (CEHA)

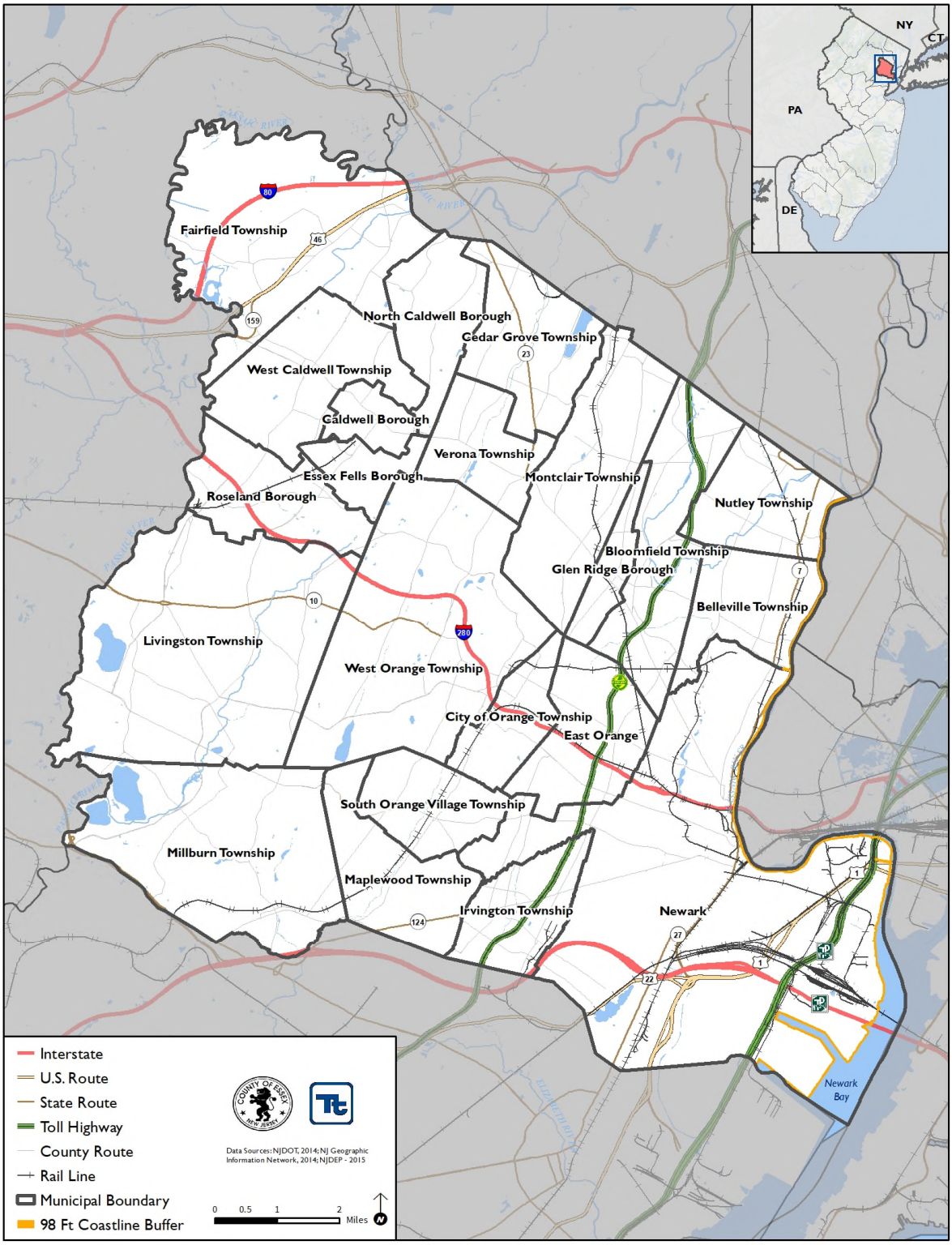
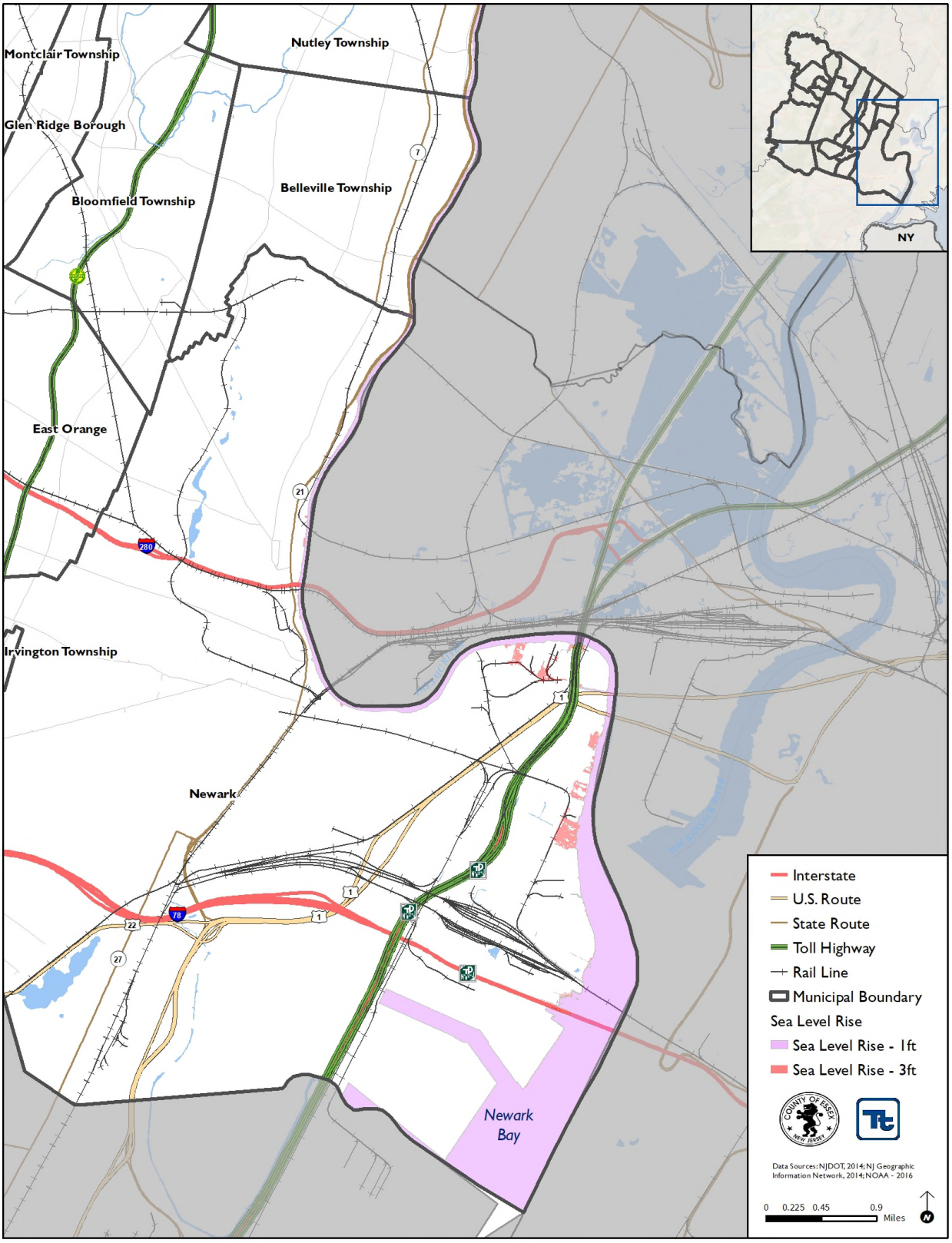


Figure 4.3.1-3. Sea Level Rise Scenarios for Essex County



Impact on Life, Health and Safety

To estimate population exposed and vulnerable to the coastal erosion and sea level rise hazards, a spatial analysis was conducted using the 98-foot buffer along shoreline and the NOAA sea level rise inundation areas. The City of Newark is the only community in Essex County with populations located within each of the hazard areas. There are 270 people located in the coastal erosion hazard area, which accounts for less than 1% of the City's total population.

Houses and apartment buildings vulnerable to sea level rise may result in the loss of these structures. It is estimated that 28 City of Newark residents may be displaced as a result of +1-ft sea level rise. This increases to 251 displaced residents due to +3ft of sea level rise.

Socially vulnerable populations (e.g. the elderly and low-income populations) are particularly vulnerable to a hazard event. Of these 270 people located in the coastal erosion hazard area, 16 are over the age of 65 and 82 are below poverty level. Within the sea level rise +1 ft inundation area, 1 person is over the age of 65 and 4 people are below the poverty level; within the sea level rise +3 ft inundation area, 14 people are over the age of 65 and 60 people are below the poverty level.

Impact on General Building Stock

Similar to the analysis on the County's population, the City of Newark is the only community with buildings located in the coastal erosion hazard area and sea level rise hazard areas. Projected sea level rise inundation areas are considered areas of permanent loss of land and community assets. The analysis indicates there are 42 buildings with a replacement coast value of $42 million located in the coastal erosion hazard area. Additionally, there 8 buildings with a replacement value of $19 million in the sea level rise +1 ft inundation area, which increases to 43 buildings with a replacement value of $68 million in the sea level rise + 3 ft inundation area. All these estimates account for less than 1% of the County's total building stock.

Impact on Critical Facilities

Coastal erosion and sea level rise can impact critical facilities. Coastal erosion can degrade the surrounding infrastructure and utility lines, depending on their location on the property. This could inhibit the facilities ability to respond during or after an emergency event. In the case of a single, severe event, the structural foundation of a facility can be compromised as well.

Regarding sea level rise, access to these facilities and infrastructure can be permanently inundated, as well as permanent inundation of the facilities themselves. There are five critical facilities, including three ports and two bridge in the City of Newark located within the coastal erosion hazard area and the sea level rise +1 ft inundation area. Within the sea level rise +3 ft inundation area, there is an oil facility that is also exposed. While the bridge elevations may be at a height greater than any sea level rise impacts, the access roads and ramps may vulnerable. Additionally, a severe coastal erosion event during a coastal storm could erode the river bank and foundation of the bridge and could impact the structural integrity of the bridge.

Impact on Economy

Coastal erosion and sea level rise can also severely impact roads and infrastructure. As coastline evolution continues, evacuation and emergency routes need to be considered. Essex County includes significant westbound and northbound evacuation routes. Using the hurricane evacuation routes in the North Jersey Transportation Planning Authority (NJTPA) spatial dataset, routes used to direct traffic inland in case of a hurricane threat are located in the coastal erosion hazard area and sea level rise area. Evacuation routes exposed to Tier 1 and Tier 2 scenarios from the NJTPA climate resilience plan show impacts to New Jersey Route 23, U.S. and Interstate 80. Evacuation routes from the Homeland Infrastructure Foundation Level Data (HIFLD) show potential impacts

to portions of the New Jersey Turnpike, U.S. Route 280 and 78. The City of Newark has the largest port facility in the State and as indicated in the exposure analysis could be exposed to sea level rise in the future.

Potential economic loss as a result of sea level rise is based on replacement cost value of structures based on the County Assessor's data. The total replacement cost value of structures located in the +1 and +3ft of sea level rise inundation areas are $18,754,730 and $68,375,036 respectively.

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. The county considered the following factors to examine potential conditions that may affect hazard vulnerability:

- Potential or projected development
- Projected changes in population
- Other identified conditions as relevant and appropriate, including the impacts of climate change

Projected Development

The County and participating municipalities intend to discourage development within vulnerable areas or to encourage higher regulatory standards on the local level. Any areas of growth could be affected by the identified hazards if located within identified hazard areas. Each municipality identified areas of recent development and proposed development in their community (refer to Section 3 – County Profile and Section 9 – Jurisdictional Annexes). Developments that could be located using an address or Parcel ID were geocoded and overlaid with the hazard area boundaries to determine vulnerability to coastal erosion and sea level rise. There are no recent and proposed development locations vulnerable to the coastal erosion and sea level rise hazard.

Projected Changes in Population

According to population projections from the State of New Jersey Department of Labor and Workforce Development, Essex County will experience an increase in population through 2034 (approximately 40,000 people between 2017 and 2034). Population change is not expected to have a direct effect on the overall vulnerability of the county's population over time. The coastal erosion and sea level rise hazard areas have a limited exposure along the eastern boundary of the County, while population growth will occur throughout the County. While some populations could see increased vulnerability due to impacted roadways and transportation routes traversing the hazard areas, the overall impact to the County's vulnerability will be low. Refer to Section 4.3.1, Population Trends in the County Profile, includes a discussion on population trends for the county.

Climate Change

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).

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 public safety, buildings, and critical infrastructure. As previously stated, warmer temperatures may lead to an increase in frequency of storms, and an increase in the frequency and intensity of storms could increase the potential for severe coastal erosion events.

Change of Vulnerability Since 2015 HMP

The City of Newark and Townships of Belleville and Nutley continue to be vulnerable to the coastal erosion hazard and sea level rise. Several differences exist between the 2015 Plan and this update. For this plan update, an updated general building stock based upon replacement cost value from MODIV tax assessment data and 2019 RS Means, and an updated critical facility inventory were used to assess the county's risk to the hazard areas. In addition, the 2017 American Community Survey population estimates were used and estimated at a structural level in place of the 2010 U.S. Census blocks. An updated hazard area was used as well; the 2016 sea-level rise spatial layer from NOAA was used. The original sea level rise data incorporated sea level rise into the floodplain, while this analysis looks at sea level rise only to be consistent with the 2019 NJSHMP. Due to changes in the data used, a direct comparison of vulnerability between the plans is difficult. The updated vulnerability assessment provides a more current exposure analysis for the county.

Figure 4.3.1-4. Potential New Development and Coastal Erosion Hazards and Coastal Risk Areas