4.2 COASTAL EROSION

SECTION 4.2 COASTAL EROSION

4.2-1 HAZARD OVERVIEW

Hazard Definition

Coastal erosion is a natural process where land wears away resulting in beach, shoreline, or dune loss. It may occur as a result of flooding, hurricanes, typhoons, or flooding associated with surges spawned by tropical and extratropical systems and may be long-term or short-term in scale (FEMA, 2020). During storms coastal erosion can occur rapidly, causing damage and potential danger to buildings, infrastructure, and people. Additionally, erosion may be exacerbated by human activities, such as boat wakes, shoreline hardening, and dredging (FEMA, 1996). It is measured as the rate of change in the position or horizontal displacement of a shoreline.

Organizational Changes from 2019

This section focuses solely on coastal erosion. For more information on storm surge, sea-level rise, and coastal flooding, see Section 4.7 Flood. For more information about high winds associated with coastal storms, see Section 4.9 Hurricane, Tropical Storm, and Nor'Easter.

Natural recovery after erosion events can occur, through a process called "accretion", where sediment helps marshes build vertically and horizontally, but full replacement of the lost sand may 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.

Meteorologists can often predict the likelihood of weather events that can impact the shoreline and shoreline communities. NOAA's National Weather Service monitors potential events, and provides forecasts and information, sometimes several days in advance of a storm, to help prepare for an incident. With the number of structures increasing along the coast, the shoreline becomes increasingly modified. Impact from weather incidents and sea-level rise will continue to influence the State's coastal areas, intensifying and exacerbating coastal erosion. For more information on the impacts of sea-level rise, see Section 4.7 Flood.

Historically, some of the methods used by municipalities and property owners to stop or slow down coastal erosion or shoreline change have exacerbated the problem they sought to fix. Attempting to halt the natural process of erosion with shore parallel or perpendicular structures such as seawalls (groins and jetties) and other hard structures typically worsens the erosion in front of the structure (i.e. walls), prevents or starves any sediment behind the structure (groins) from supplying down-drift properties with sediment, and subjects down-drift beaches to increased erosion. Manipulation of the sediment transport mechanisms through these efforts also make it more difficult to model future erosion along the coastline. Since most sediment transport associated with erosion and longshore drift has been reduced, some of the State's greatest assets and attractions – beaches, dunes, barrier beaches, salt marshes, and estuaries – are threatened and will slowly disappear as the sediment sources that feed and sustain them are eliminated.

Secondary Hazards

Windstorm events can blow beach and dune sand overland into adjacent low-lying marshes, upland habitats, inland bays, and communities. Flooding from extreme rainfall events can scour and erode dunes as inland floodwaters return through the dunes and beach face into the ocean (FEMA, 1996). The combined impacts of strong winds and intense precipitation from coastal storms typically lead to erosion events. According to NOAA, sea-level rise can amplify factors that currently contribute to coastal flooding: high tides, storm surge, high waves, and high runoff from rivers and creeks. All these factors change during extreme weather and climate events (NOAA, 2012). Erosion events can create hazardous situations when the removal of sediment impacts the stability of any structure, potentially leading to collapse.

4.2-2 LOCATION, EXTENT, AND MAGNITUDE

New Jersey's coastal zone includes approximately 1,800 miles of tidal coastline, including 127 miles along the Atlantic oceanfront, across portions of 17 counties and 239 municipalities (NJDEP, 2022). These numbers include all tidally influenced

coastlines and counties including Atlantic, Bergen, Burlington, Camden, Cape May, Cumberland, Essex, Gloucester, Hudson, Middlesex, Monmouth, Ocean, Passaic, Salem, Somerset, and Union.

The Richard Stockton College Coastal Research Center (CRC) conducted an analysis to identify and rank the areas with greatest susceptibility to coastal erosion in Ocean County as a result of a 100-year storm event (also known as the 1% annual chance flood event). This area determined susceptible to coastal erosion by CRC was also used to estimate exposure to the hazard in Ocean County and is discussed in Table 4.2-1.

Table 4.2-1 Coastal Erosion Areas Susceptible to a 100-Year Storm Event in Ocean County

Location in Ocean County	Susceptibility Rank
Lavallette Borough (northernmost)	High
Dover (Toms River) Beaches North (central, Chadwick beach area)	High
Lavallette Borough (central and southern) and Dover (Toms River) Beaches South (northern third)	High
Bay Head (northern half) and Point Pleasant Beach Borough (southernmost tip)	Medium
Brick Township (southern third) and Dover (Toms River) Beaches North (northernmost)	Low
Mantoloking Borough (north-central, central, and southern)	Low
Seaside Park Borough	Low

Source: Richard Stockton College CRC, 2013

A review of historic shoreline data dating back to 1863 provided by NJDEP indicates the coastline of the State has significantly changed because of the effects of erosion, accretion, beach nourishment measures taken by the State to address erosion, and structural shoreline protection measures. Shoreline change, whether erosion or accretion, is dependent upon several factors including location (e.g., open ocean facing shore) and exposure to high-energy storm waves. The coastal high hazard area (or V zone where "V" stands for velocity wave action) is the most hazardous part of the coastal floodplain, because of its exposure to wave effects. Section 5.6 (Flood) discusses the assets exposed and vulnerable in the V Zone.

New Jersey Beach Profile Network (NJBPN)

In 1986, the Richard Stockton College CRC established the New Jersey Beach Profile Network (NJBPN) for the purpose of monitoring shoreline conditions along the coastline of New Jersey. NJBPN is made up of beach profile sites along the State's entire shoreline, including the Raritan and Delaware bays. However, only four counties are discussed below as those are the only ones that are included in the NJBPN annual report. The sites are located in Monmouth, Ocean, Atlantic, and Cape May counties. The profile sites are spaced approximately one mile apart, with at least one site located in each oceanfront municipality. The dune, beach, and near-shore areas are surveyed at each profile site twice a year, in the fall and spring, and are analyzed for seasonal and multi-year changes (retreat or advance)in shoreline position and loss or gain of sand volume. Reports on each beach profile are published annually. The 2016 report included information on change over the 30 years since the NJBPN began, and some of that information is included below. The 2020 report based on a study period between Spring 2019 and Fall 2020 is also summarized below (Stockton University CRC, 2021). For more information on beach replenishment efforts in New Jersey, see Section 5.0 Capability Assessment.

Atlantic County

Atlantic County features a series of barrier island communities, making the county prone to impacts of coastal erosion. Two of these islands, Absecon and Brigantine, have been designated as federal project beaches by the USACE, meaning the Corps completes periodic nourishment of these sites as well as engineering efforts to reduce the risk of storm damage. Overall, the county contains 10 NJBPN sites. Over the 30 years between the start of monitoring in 1986 to 2016, the county saw a mix of advance and retreat depending on the site (Richard Stockton College, CRC 2016). In the most recent NJBPN report detailing the period of 2019 to 2020, Atlantic County was the only county in the study to experience both a shoreline retreat and a loss of sand volume indicating overall erosion (Stockton University CRC, 2021).

Cape May County

Cape May County contains 31 NJBPN survey sites located along the beaches, barrier islands, coastal headlands, and Delaware Bayshore of the County. Of those 31 sites, 27 survey sites are along the Atlantic Ocean profiles and four sites are set along the Delaware Bay. Due to their geography, the sites located on the north end of each barrier island have an erosional tendency. The 30-year assessment for Cape May County revealed only five sites experienced shoreline retreats. The most dramatic retreat of shoreline and loss of sand volume occurred at the North Wildwood site. An adjacent site experienced a high level of shoreline advance which appears to have been gains from the sand lost in North Wildwood. The average changes for all sites in Cape May County from the 2020 report were the largest shoreline advance and gain in sand volume for all four counties indicating overall accretion (Stockton University CRC, 2021).

Monmouth County

There are 102 monitoring sites in Monmouth County that extend from the eastern beaches of the Raritan Bay to the oceanfront shoreline of Sandy Hook and south to Manasquan Inlet. Sixty-seven of these sites were added in the Fall of 2017 to increase monitoring capacity and because of the complexity of its shoreline. Monmouth County is considered to be in good shape for volume and shoreline position when compared to the 1986 conditions. The federal government stepped in post Hurricane Sandy and placed a significant amount of sand along many areas of Monmouth County's shoreline. Due to these efforts, over the 30 years between 1986 and 2016 the county survey sites have averaged a net gain of sand volume and a shoreline advance average of 218 feet. (Richard Stockton College CRC, 2016). The average changes for all sites in the County was a shoreline advance and sand volume gain, which shows the benefits of beach nourishment work done in the study period (Stockton University CRC, 2021).

Ocean County

Ocean County has the longest oceanfront shoreline of the four coastal counties, about half of which is Long Beach Island. Ocean County includes one inlet—Barnegat Inlet—dividing the northern section of the shore from Long Beach Island between Manasquan Inlet to the north and Little Egg Inlet on the south. The northern section is unique along the New Jersey coastline in that it lies within a zone where sand transport parallel to the shoreline is essentially zero over long periods of time (Richard Stockton College, CRC 2016). The 30-year assessment for Ocean County revealed ten sites, mostly in the northern part of the county, that experienced shoreline retreats and eight sites across the county experienced volume losses. The remainder of the sites in the county saw varied levels of shoreline advance and sand volume gain (Richard Stockton College, CRC 2016). The average changes for all sites in Ocean County from the 2020 report revealed that during that it was the county with the largest shoreline retreat, yet it did not experience an average loss of volume like Atlantic County did during the same one-year period.

4.2-3 PREVIOUS OCCURRENCES AND LOSSES

FEMA Disaster Declarations

Between 1954 and 2022, FEMA declared that the State of New Jersey experienced 13 erosion-related disasters (DR) or emergencies (EM) classified as one or a combination of the following disaster types: severe storms, coastal storms, heavy rain, tropical storm, hurricane, high winds, and high tide. Generally, these disasters cover a wide region of the State and have impacted many counties, though not all with coastal erosion effects (FEMA, 2023). Based on all sources researched, known erosion-related events that have affected New Jersey and were declared a FEMA disaster are identified in Table 4.2-2.

Historical Events Summary

As mentioned previously, 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, which occurs due to a combination of factors which may differ by location. Based on all sources researched, known events that have caused coastal erosion in the State of New Jersey and its counties are identified in Table 4.2-2. The table includes FEMA disaster and emergency declaration numbers as well. Table 4.2-2 includes descriptions of three types of coastal erosion: major, moderate, and minor erosion. The difference in erosion types is included below:

- Major erosion – consists of significant or total beach berm (the ridge of a beach that has formed parallel to the shore) loss and/or significant wearing away and scarping of the dunes, in portions or all of the assessed area.

- Moderate erosion – consists of significant beach scarping and/or significant sloped erosion of beach berm and/or minor wearing away of the dunes, in portions or all of the assessed area.
- Minor erosion – consists of redistribution of sand within the beach profile or loss of sand without significant scarping or significant sloped erosion, in portions or all of the assessed area.

Table 4.2-2 Significant Historical Coastal Erosion Events Since 2010

Date(s) of Event	Event Type	FEMA Disaster Declaration	Description
August 27-September 5, 2011	Tropical Storm Irene	EM-3332 DR-4021	Tropical Storm Irene made landfall near the Little Egg Inlet along southern New Jersey on August 28. The storm created 15- to 18-foot drop offs on some beaches. The NJDEP reported beach erosion of two to four feet in height and 50 to 100 feet wide was common along most of the shoreline.
October 29, 2011	Nor'easter	None.	Northeast New Jersey experienced snow from this storm, while coastal New Jersey experienced flooding and strong winds. Peak wind gusts averaged 50 mph along the coast. Cliffwood Beach and Port Monmouth at Spy House in Monmouth County experienced erosion consisting of shore retreat and sand volume loss.
October 26 - November 8, 2012	Post tropical storm Sandy	EM-3354 DR-4086	Record-breaking high tides and wave action combined with sustained winds as high as 60 to 70 mph with wind gusts as high as 80 to 90 mph to batter the State. Statewide, Sandy caused, an estimated $29.4 billion in damage, destroyed or significantly damaged 30,000 homes and businesses, affected 42,000 additional structures, major coastal erosion, and was responsible directly or indirectly for 38 deaths.
March 1-8, 2013	Nor'easter	None.	Strong wind and flooding caused significant erosion along the barrier islands.
January 23 - 30, 2015	Winter Storm	None.	Widespread dune erosion occurred in parts of the Jersey Shore Monday.
October 2, 2015	Nor'easter	None.	High winds and flooding from the nor'easter caused damage to many beaches along the shore. Above normal tidal cycles and onshore flow persisted beyond the storm, creating even more erosion.
January 22 - 24, 2016	Blizzard	DR-4264	Strong easterly winds combined with high tide levels, resulting in major flooding along parts of the New Jersey. In parts of southern New Jersey, coastal flooding was higher than during post tropical storm Sandy in 2012.
August 28 - September 8, 2016	Tropical Storm Hermine	None.	Many beaches along the shore experienced severe erosion. A week after Hermine made its way toward New Jersey, whipping up high waves, the southernmost beaches in Brick Township remain closed because of severe erosion.
March 14, 2017	Nor'easter	None.	Most shore towns experienced at least some beach erosion. This event provided a short window to replenish the beaches before tourist season.
September 5-26, 2017	Hurricane Jose	None.	Of the 66 municipalities and beach areas surveyed after the hurricane, 55 were determined to have minor beach or dune erosion, 11 had moderate beach or dune erosion and 0 had major beach or dune erosion.
March 6-7, 2018	Nor'easter	DR-4368	Of the 66 beaches surveyed, 55 were determined to have minor beach or dune erosion and 10 had moderate beach or dune erosion.
September 8-12, 2018	Tropical Storm Gordon	None.	Of the 66 municipalities and beach areas surveyed, 53 were determined to have minor beach or dune erosion and 13 had moderate beach erosion.
October 8-13, 2019	Nor'easter/ Subtropical Storm Melissa	None.	Of the 105 areas surveyed, 82 were determined to have minor beach or dune erosion, 15 had moderate beach or dune erosion and 8 had major beach or dune erosion.
August 1-6, 2020	Tropical Storm Isaias	DR-4574	New Jersey experienced strong southernly winds of up to 50mph with gusts over 70mph, heavy rain, and a period of elevated surf and swells. Of the 79 areas surveyed, 75 were determined to have minor beach or dune erosion, and 4 had moderate beach or dune erosion.
August 14-17, 2020	Tropical Storm Kyle	None.	A low-pressure system that formed southeast of Atlantic City and strengthen enough to be considered a Tropical Storm. Of the 79 areas surveyed, 73 were determined to have minor beach or dune erosion and 6 had moderate beach or dune erosion.

Date(s) of Event	Event Type	FEMA Disaster Declaration	Description
September 11-16 & 18-23, 2020	Hurricanes Paulette and Teddy	None.	The impacts of Hurricane Paulette along the coast began on September 11th and were felt through the 16th. Short- to medium-period seas began again on September 18th due to Hurricane Teddy and last through the 23rd. Neither storm made landfall in the United States. Of the 79 areas surveyed, 77 were determined to have minor beach or dune erosion and 2 had moderate beach or dune erosion.
December 16-17, 2020	Nor'easter	None.	The storm had sustained winds over 40 mph with gusts up to 60 mph and generated a sea height peak of 24 feet. Elevated tide levels resulted from the astronomical tide phase and a period of strong offshore winds. Of the 79 areas surveyed, 70 were determined to have minor beach or dune erosion, 5 had moderate beach or dune erosion, and 4 had major beach or dune erosion.
January 31 – February 2, 2021	Nor'easter	DR-4597	The storm had sustained winds near 50 mph with gusts over 60 mph and generated sea heigh peak of 23 feet. Tides reached minor to moderate flood stage levels due to astronomical tides, strong onshore winds, and the proximity of the storm to the coast. Of the 81 sites surveyed, 54 were determined to have minor beach or dune erosion, 18 had moderate beach or dune erosion, and 9 had major beach or dune erosion.
May 28 – May 30, 2021	Nor'easter	None.	The storm generated sustained winds over 40 mph and gust over 50 mph and a sea height peak of 13 feet. Tides reached minor flood stages due to astronomical tide and strong onshore winds. Of the 81 sites surveyed, 70 were determined to have minor beach or dune erosion and 11 had moderate beach or dune erosion.
October 9-12, 2021	Nor'easter	None.	The storm generated wind gusts over 40 mph and a peak sea height of 15 feet. Tides reached minor flood stage levels due to astronomical tide and moderate onshore winds. Of the 81 sites surveyed, 79 had minor beach or dune erosion and 2 had moderate beach or dune erosion.
August 26 – September 1, 2021	Post Tropical Storm Ida	DR-4614 EM-3573	The storm resulted in wind gusts of up to 69 mph in Burlington and dropped nearly 10 inches of rain in Hillsborough. Heavy rainfall led to severe flash flooding and urban flooding across northern New Jersey and 2 tornadoes were recorded in the southern region of the state. The strongest tornado reached EF-3 level in Gloucester County. In total, the storm caused at least 26 deaths across the state and the flooding resulted in about $8-10 billion of damage. Federal funding totaled nearly $1 billion, with the goal of restoring ecosystems and replenishing beaches, along with other flood control measures.
January 16-17, 2022	Winter Storm	None.	The storm generated wind gusts over 50 mph and a sea height peak of 23 feet. Tides reached minor flood stage levels due to moderate onshore winds. Of the 81 sites surveyed, 76 had minor beach or dune erosion and 5 had moderate beach or dune erosion.
May 6 – 11, 2022	Coastal Storm Event	None.	Event result in wind gusts of over 50 mph and peak sea heights of 18 feet. Oceanfront and back bay flooding reached minor levels due to strong onshore winds, with several back bay locations close to moderate flood stages. OF the 81 siters surveyed, 68 had minor beach or dune erosion, 5 had moderate beach or dune erosion, and 8 had major beach or dune erosion.
September 29 – October 5, 2022	Hurricane Ian	None.	The storm resulted in a prolonged period of onshore winds, with gusts near 60 mph and peak sea heights of 22 feet. All oceanfront and back bay location reached minor flooding stages, with several approaching moderate flooding due to the several days of strong onshore winds and the proximity of the storm's center to the coast. Of the 81 sites surveyed, 63 had minor beach or dune erosion, 6 had moderate beach or dune erosion, and 12 had major beach or dune erosion.

Source: NOAA-NCEI, 2023

4.2-4 PROBABILITY OF FUTURE OCCURRENCES

It is highly likely coastal erosion will occur in the future along the Atlantic coastline, the Delaware Bayshore, and within the back bays in New Jersey. Several factors determine whether a community exhibits greater risk of long-term erosion:

- Exposure to high-energy storm waves
- Sediment size and composition of eroding coastal landforms feeding adjacent beaches and marshes
- Near-shore bathymetric variations that direct wave approach
- Alongshore variations in wave energy and sediment transport rates
- Relative sea-level rise
- 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 change (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.

From Sandy Hook south to Little Egg Inlet, the maximum long-term erosion rate is -8.6 meters per year and the maximum short-term erosion rate is -6.1 meters per year. From Little Egg Inlet south to Cape May Inlet, the maximum long-term erosion rate is -4.3 meters per year and the maximum short-term rate is -19.3 meters per year. These rates show that shorelines are eroding (USGS, 2011).

To help prevent future impacts of coastal erosion, New Jersey has participated in many beach nourishment projects. Between 1936 and 2021 the State has participated in 36 projects consisting of 296 events at many different locations along the shore. The known total cost of all of these projects is nearly $1.5 billion. These 296 events have added more than 200,000,000 yds^3 of sand to beaches (National Beach Nourishment Database, 2023). Of the 296 nourishment events in that 85-year period, 37 have occurred in the last 10 years. This data, provided by the American Shore and Beach Preservation Association includes both FEMA and USACE projects, as well as non-federal nourishment projects.

Potential Effects of Climate Change

New Jersey's 2020 Scientific Report on Climate Change reported that the state should expect more frequent and intense precipitation events and sea level rise at a rate greater than the global average (NJDEP, 2020). The Fifth National Climate Assessment noted that precipitation in all seasons, and extreme precipitation events have increased by 60 percent. The assessment indicates that an increase in Atlantic tropical systems may account for this change (NCA, 2023). Sea level rise is a result of increased water in the oceans from melting of land glaciers and polar ice caps as well as warmer ocean temperatures causing water to expand and increase in volume (NCA, 2018). In New Jersey this sea level rise is being compounded by subsidence or the sinking of land on the coast, possibly due to the extensively developed nature of the shore and groundwater extraction. Additionally, a geological process called post-glacial rebound (also called isostatic rebound or crustal rebound) related to historic ice sheet retreat causes spatial differences in sea-level rise across the East Coast. The current redistribution of mass associated with this rebound results in New Jersey having greater sea-level rise rates than other parts of eastern seaboard (WHOI, 2018). Since 1900, sea level along the coast of New Jersey has risen about 12 inches. According to the report, under current scenarios there is a 50% chance that sea-level rise will meet or exceed an additional 1.4 feet and a 17% chance it will exceed 2.1 feet by 2050. Those levels increase to 3.3 and 5.1 feet by the end of the century (NJDEP, 2020).

Additional climate factors contributing to coastal erosion include increased and intensified precipitation which could increase surface runoff as well as increased frequency and intensity of tropical storms. Sea level rise and storms can threaten natural ecosystems including barrier islands and wetlands, which act as natural defenses, exposing coastlines to higher and more powerful storm surges (NJDEP, 2020). Storm surges, in combination with sea level rise could cause more frequent, larger waves at a higher elevation. All these factors have the potential of worsening coastal erosion and its associated impacts in the state.

4.2-5 VULNERABILITY ASSESSMENT

Vulnerable Jurisdictions

Fifteen of the 21 New Jersey counties included erosion (either coastal and/or riverine erosion) as a hazard of concern in their hazard mitigation plans. The hazard was often combined with sea level rise in those plans. In addition to the coastal counties on the Atlantic Ocean or along inland bays and tidally influenced areas, inland counties indicated they experience minor erosion along their river shorelines. Passaic County's hazard mitigation plan did not list coastal erosion as a hazard of concern but did include it as a subset of coastal storms due to potential impacts on the Passaic River.

Table 4.2-3 Coastal Erosion Risk Rankings

County	Ranking of Hazard by County HMP
Atlantic	Medium
Bergen	Profiled, No Ranking System
Burlington	Low
Camden	High
Cape May	Low
Cumberland	Medium
Essex	High
Gloucester	Low
Hudson	High
Hunterdon	Not Profiled
Mercer	High
Middlesex	High
Monmouth	High
Morris	Not Profiled
Ocean	Medium
Passaic	Not Profiled
Salem	Medium
Somerset	Not Profiled
Sussex	Not Profiled
Union	Medium
Warren	High

Source: FEMA National Risk Index (NRI) (accessed June 2023); County Hazard Mitigation Plans (accessed June 2023)

Based on the historic record, review of the local hazard mitigation plans, and the updated State risk assessment results that continue to be presented in this section, the counties most threatened by coastal erosion are Atlantic, Cape May, Monmouth, and Ocean. More specifically in these counties, engineered channels between the barrier islands and the back bay have left the northeast corners of the barrier islands along the ocean highly vulnerable to wave action and thus coastal erosion.

Built Environment

The NRI does not include a hazard category for coastal erosion, therefore estimated annual losses from buildings due to coastal erosion (and subsequent estimates for estimated annual losses from state-owned facilities) cannot be calculated using NRI data. Table 4.2-4 summarizes the number and type of NJDEP shoreline structures off the coastline of New Jersey along the Atlantic Ocean and Inland Bays (current as of 1993).

Table 4.2-4 Number and Type of NJDEP Shoreline Structures

County	Breakwater	Groin	Jetty	Revetment	Seawall
Atlantic County	0	30	3	0	0
Cape May County	1	94	8	4	3
Cumberland County	0	1	1	0	0
Middlesex County	0	4	0	0	0
Monmouth County	0	172	9	1	11
Ocean County	0	72	3	0	0
Total	**1**	**368**	**24**	**5**	**14**

Source: NJDEP, 1993

Coastal erosion is of concern to the State because of the large number of communities and cultural resources located along the coast. Beaches serve as a buffer and protect the built environment and other natural resources on the mainland from coastal storm events such as hurricanes, tropical storms, and nor'easters, which can cause shoreline erosion or accretion.

The New Jersey Administrative Code Coastal Zone Management Rules (N.J.A.C 7:7-9.19) defines erosion hazard areas as, "shoreline areas that are eroding and/or have a history of erosion causing them to be highly susceptible to further erosion, and damage from storms." Erosion hazard areas may be identified by any one of the following characteristics:

- Lack of beaches
- Lack of beaches at high tide
- Narrow beaches
- High beach mobility
- Foreshore extended under boardwalk
- Low dunes or no dunes
- Escarped foredune
- Steep beach slopes
- Cliffed bluffs as adjacent to beach
- Exposed, damaged, or breached jetties, groins, bulkheads, or seawalls
- High long-term erosion rates
- Pronounced downdrift effects of groins (jetties)

Further, erosion hazard areas are defined as extending inland from the edge of a stabilized upland area to the limit of the area likely to be eroded in 30 years for one- to four-unit dwelling structures, and 60 years for all other structures, including developed and undeveloped areas (N.J.A.C., 2020). The extent of an erosion hazard area is calculated by multiplying the projected annual erosion rate at a site by 30 for the development of one- to four-unit dwelling structures, and by 60 for all other developments.

As stated above, the USGS report for the National Assessment of Shoreline Change found that the average net long-term rate of shoreline changes for the New Jersey 'North' region (located from Sandy Hook to south to Little Egg Inlet) was -0.6 meters per year. Meanwhile, the long- term net shoreline change rate in the New Jersey 'South' region (located from Little Egg Inlet south to Cape May Point) is strongly accretional (0.8 meters per year) (USGS, 2011). (Earlier rates of shoreline change reported in this section were maximum rates, not averages).

To estimate exposure to long-term coastal erosion in the previous plan update, the following shoreline types as defined by NJDEP were used: (1) "beach," which includes waterfront areas composed of 100 percent sand; and (2) "erodible," which includes any soft shoreline other than beach, such as rock, marsh, sea wall or earthen dike. To generate the extent of the estimated coastal erosion hazard area, an erosion rate of 0.6 meters per year was multiplied by 60 to include all structure types and developed/undeveloped areas (annual erosion rate of 0.6 meters x 60 years = 36 meters or approximately 120 feet). Although the 'South' region indicated an average accretion rate, to estimate potential vulnerability and losses, the average rate of erosion of the 'North' region was used. Therefore, population, buildings, and infrastructure within 120 feet of the identified beach or erodible shoreline types are identified as vulnerable to long-term coastal erosion. Please note this methodology assumes that once lost to erosion, an area of land is not subsequently restored. This methodology is consistent with that

used to evaluate coastal erosion in the Atlantic and Monmouth County hazard mitigation plans. This process was not replicated for the purposes of this 2024 Plan update as the USGS data used in the 2019 Plan update analysis remains the best available measurement of average erosion rate along the New Jersey shoreline.

Lifeline Impacts

FEMA created the eight Community Lifelines to contextualize information from incidents, communicate impacts in plain language, and promote a more unified effort across a community that focuses on stabilization of these lifelines during response. More information on these lifelines can be found in Section 4.1 Risk Assessment Overview. Table 4.2-5 showcases the most likely lifelines to be impacted by coastal erosion, including a short description of anticipated impacts.

Table 4.2-5 Lifelines Most Likely Impacted by Coastal Erosion

Lifeline Categories	Notable Impacts
Safety and Security	Community safety may be threatened due to potential direct harm from coastal erosion and compounding effects on administration of services. Transportation infrastructure issues may directly impact the abilities of law enforcement, fire service, search and rescue, and other government services.
Food, Hydration, Shelter	Potential impacts for the Food, Hydration, Shelter consist of physical damage to structures which provide shelter.
Health and Medical	Potential Impacts to the Health and Medical lifeline could be a result of damage to medical structures and transportation infrastructure. Patient movement and medical supply chains can be impacted by damage to roadways and other transportation infrastructure near the shoreline.
Transportation	Coastal erosion has the potential to cause direct damage to infrastructure such as roads and bridges in communities with road networks close to the shoreline. Sea level rise can cause groundwater to move into the pavement base layers resulting in reduction of pavement life. Damage to the Transportation Lifeline has cascading effects among other lifelines which depend on movement of people or goods.

Population and the Economy

Life and property within the coastal erosion hazard areas are potentially at risk for loss from coastal erosion. Over 8 million people live in New Jersey's 17 coastal counties. In terms of employment, New Jersey is one of the five largest contributors to marine-based tourism and recreation in the nation (NOAA, 2023). Coastal New Jersey employs almost three million people annually, earning a total of over $188 billion. This equates to over $461 billion in gross domestic product (NOAA, 2023). The State's coastal resources are an enormous driver to the local and statewide economy and losses can greatly impact the State's tax base and the local industries (e.g., tourism).

Coastal erosion can lead to building and infrastructure damage. Events like Superstorm Sandy in 2012 have shown that public safety and human well-being become jeopardized by the disruption of the impacts from coastal erosion. As climate continues to change and New Jersey's coast evolves, repeated disruption of lives, infrastructure functions, and important economic activities will be a burden for coastal communities (Moser et al, 2014).

Change in growth and development provide an opportunity to reduce or increase those vulnerable and the number of losses in the future. To increase protection and decrease future potential losses, new construction and redevelopment will need to meet building and planning standards that account for future occurrences.

Ecosystems and Natural Assets

Coastal erosion can impact a variety of natural systems including beaches, wetlands, marshes, and coastal habitats. The erosion that could be experienced on the barrier islands will decrease their ability to function as buffers against further estuarine, wetland, and land loss. If there is a reduction of these natural environments and the ecological and natural functions they

provide, coastal communities may experience more frequent and destructive flooding, compromised water supplies, and smaller or fewer beaches (Center for Ocean Solutions, 2013).

Beaches and Dunes

Coastal erosion can impact the functions of beaches and dunes as a buffer against inland destruction to coastal communities, business, roadways, and infrastructure. Without the barrier functions that beaches and dunes provide inland wetlands and communities face added exposure to hazards such storm surge and flood waters resulting in property damage, degradation of recreational areas and wildlife habitat, and loss of land. Additionally, as beach and dune erosion continue, evacuation and emergency routes should be considered.

Freshwater and Coastal Wetlands

New Jersey's estuarian ecosystems have experienced historic disruption of sediment transport due to impoundments, coastal protection structures, dredging, and beach replenishment activities, among other development. Sediment within the estuarian system helps to feed coastal ecosystems through accretion contributing to the overall health of the ecosystem. A healthy system rich in sediment has greater resilience due to its capacity to grow up and out, whereas a sediment starved system may be more vulnerable since it lacks appropriate amounts building materials to keep pace with disturbances.

Wetlands cover 17% of the State's area and provide economic benefits including flood storage which reduces the frequency and intensity of floods; and water filtration that supports commercial fisheries, drinking water, recreation, and wildlife habitat. Coastal wetlands also provide valuable carbon sequestration functions. Coastal erosion degrades the functions of wetlands by leaving these areas open to inundation with saltwater converting them to open water areas (NJDEP, 2020).