9. FLOOD

9.1 Hazard Profile

9.1.1 Hazard Description

A flood is an overflow of water from oceans, rivers, groundwater, or rainfall that submerges areas that are usually dry. This natural phenomenon can be exacerbated by features of the built environment.

Flooding is a natural hazard that can occur during any season. Flooding in Hudson County can be the result of heavy rainfall produced by hurricanes moving up the coast, large frontal storms from the west and south, and local thunderstorms (FEMA FIS 2015). Flooding can also result from the failure of a water control structure, such as a dam or levee (NWS 2019) (refer to Chapter 6 Dam and Levee Failure for more information). Flooding can be exacerbated by other hazards such as sea level changes and increased precipitation or severe storms. Additional information regarding severe storms is available in Chapter 11 Severe Weather.

Flooding is a temporary condition of partial or complete inundation on normally dry land from the following (NWS 2019):

- Riverine overbank flooding
- Flash floods
- Alluvial fan floods
- Mudflows or debris floods
- Dam- and levee-break floods
- Local draining or high groundwater levels
- Fluctuating lake levels
- Ice-jams

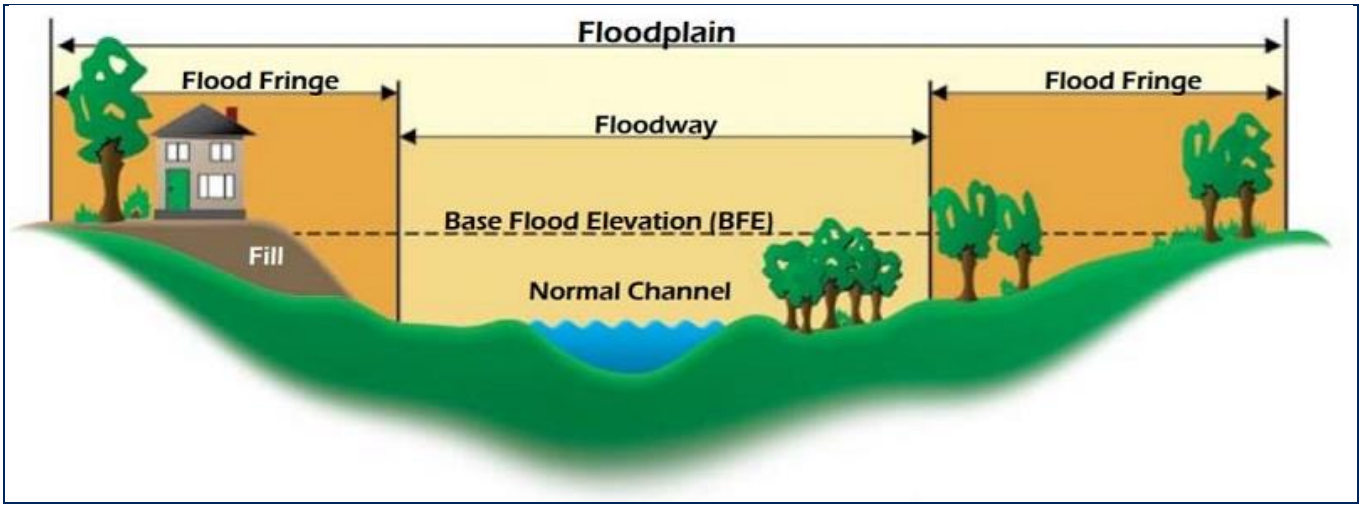
Flooding in Hudson County is primarily attributed to riverine (inland) and coastal (tidal/surge) flooding from the Hackensack River, Hudson River, Kill Van Kull, Passaic River, and Upper New York Bay (FEMA FIS 2013). In addition, Hudson County also experiences urban flooding, which is the result of precipitation and insufficient drainage. Hudson County's flood types of concern discussed in this section are riverine flooding, flash flooding, stormwater/urban flooding, coastal flooding, coastal erosion, and sea level rise.

RIVERINE FLOODING

Riverine floods are the most common flood type. They occur along the channels of rivers, creeks, streams, or ditches. When a channel receives too much water, the excess water flows over its banks and inundates low-lying areas (FEMA 2019). The inundated area is called the floodplain (NWS n.d.). Floodplains are typically flat land adjacent to a watercourse that is subject to periodic inundation. A floodplain is made up of the following components (refer to Figure 9-1) (FEMA 2019, US DHS 2019):

- **Floodway:** the channel of a river or other waterway and the adjacent land areas that are under water or reserved to carry and discharge the overflow of water caused by flooding.
- **Flood Fringe:** the area within the floodplain but outside the floodway; this area extends from the outer banks of a floodway to the river valley, where the elevation begins to rise.

Figure 9-1. Characteristics of a Floodplain



Source: FEMA 2022

Riverine flooding is measured by how frequently a given level of flooding occurs. The 1 percent annual chance flood, also referred to as the base flood or 100-year flood, is a flood with a level that has a 1 percent chance of equaling or exceeding in any given year. Though commonly called the 100-year flood, this flood can occur more than once in a relatively short period of time. Similarly, the flood with a 0.2 percent chance of being equaled or exceeded each year is often called the 500-year flood but can occur more frequently than that (FEMA 2020).

FEMA prepare maps of the expected floodplains along water courses, based on historical riverine and coastal flooding conditions. In FEMA flood maps, the floodplain inundated by the 1 percent annual chance flood is identified as Special Flood Hazard Area (SFHA). This is the area where flood insurance and floodplain management requirements apply (FEMA 2020).

The following are additional definitions relating to flood map:

- **Special Hazard Flood Areas (SFHAs)—**Labeled as Zone A, Zone AO, Zone AH, Zones A1-A30, Zone AE, Zone A99, Zone AR, Zone AR/AE, Zone AR/AO, Zone AR/A1-A30, Zone AR/A, Zone V, Zone VE, and Zones V1-V30.
- **Zone B or Zone X (shaded)—**Moderate flood hazard areas. These are the areas between the limits of the base flood and the 0.2 percent annual chance (or 500-year) flood.
- **Zone C or Zone X (unshaded)—**Areas of minimal flood hazard, outside the SFHA and at higher elevations than the elevation of the 0.2 percent annual chance flood.

Mapped floodplain boundaries may require updating as a result of changes in land use or the amount of impervious surface, the placement of obstructing structures in floodways, changes in precipitation and runoff patterns, improvements in technology for measuring topographic features, or new hydrologic modeling techniques (USGS 2016).

Flooding outside of the SFHA area may include stormwater or urban flooding and flash flooding. Urban and stormwater flooding and future conditions (e.g., sea level rise and rainfall areas) are not reflected in FEMA floodplain mapping. As such, FEMA floodplain maps may underestimate flood risk in many areas.

COASTAL FLOODING

Coastal floods are the submersion of land areas along the ocean coast and other inland waters caused by seawater over and above normal tide action. Hurricanes and tropical storms, severe storms, and Nor'easters cause most of the coastal flooding in Hudson County. Coastal flooding can impact structures and infrastructure, similar to riverine flooding, and can cause beach erosion; loss or submergence of wetlands and other coastal ecosystems; saltwater intrusion; high water tables; loss of coastal recreation areas, beaches, protective sand dunes, parks, and open space; and loss of coastal structures (i.e., sea walls, piers, bulkheads, bridges, buildings) (FEMA 2011).

There are several forces that occur with coastal flooding, including the following:

- *Hydrostatic forces* against a structure are created by standing or slowly moving water. Flooding can cause vertical hydrostatic forces, or flotation. These types of forces are one of the main causes of flood damage.
- *Hydrodynamic forces* on buildings are created when coastal floodwaters move at high velocities. These high-velocity flows are capable of destroying solid walls and dislodging buildings with inadequate foundations. High-velocity flows can also move large quantities of sediment and debris that can cause additional damage. In coastal areas, high-velocity flows are typically associated with one or more of the following:
  - Storm surge and wave run-up flowing landward through breaks in sand dunes or across low-lying areas.
  - Tsunamis.
  - Outflow of floodwaters driven into bay or upland areas.
  - Strong currents parallel to the shoreline, driven by waves produced from a storm.
  - High-velocity flows.

High-velocity flows can be created or exacerbated by the presence of manmade or natural obstructions along the shoreline and by weak points formed by roads and access paths that cross dunes, bridges or canals, channels, or drainage features (FEMA 2011).

- *Waves* can affect coastal buildings from breaking waves, wave run-up, wave reflection and deflection, and wave uplift. The most severe damage is caused by breaking waves. The force created by these types of waves breaking against a vertical surface is often at least 10 times higher than the force created by high winds during a coastal storm.
- *Flood-borne debris* produced by coastal flooding events and storms typically includes decks, steps, ramps, breakaway wall panels, portions of, or entire houses, heating oil and propane tanks, cars, boats, decks and pilings from piers, fences, erosion control structures, and many other types of smaller objects. Debris from floods are capable of destroying unreinforced masonry walls, light wood-frame construction, and small-diameter posts and piles.

In addition to coastal flood events that can cause damage, nuisance flooding can impact low-lying areas of Hudson County along tidal waterways. Nuisance flooding, also known as high tide flooding, causes public inconveniences, such as frequent road closures, overwhelmed storm drains, and compromised infrastructure. The threshold for nuisance

flooding is site specific based on the regional tidal regime and is established by NOAA. Nuisance flooding is 300 percent to 900 percent more frequent than it was 50 years ago (NOAA 2023). As sea level rises, the number of nuisance flooding days and the severity of nuisance flooding will continue to increase. The nearest NOAA tidal gauge to Hudson County is across the Hudson River at the Battery in New York City.

Flash Flooding

Flash floods are defined by the National Weather Service as "a flood caused by heavy or excessive rainfall in a short period of time, generally less than six hours (NWS n.d.). Flash floods are usually characterized by raging torrents after heavy rains that rip through riverbeds, urban streets, or mountain canyons sweeping everything before them. They can occur within minutes or a few hours of excessive rainfall. They can also occur even if no rain has fallen, for instance after a levee or dam has failed, or after a sudden release of water by a debris or ice jam (NSSL n.d.).

Stormwater/Urban Flooding

Stormwater/urban flooding is due to local drainage issues and high groundwater levels. Locally, heavy precipitation may produce flooding in areas other than delineated floodplains or along recognizable channels. If local conditions cannot accommodate intense precipitation through a combination of infiltration and surface runoff, water may accumulate and cause flooding problems. During winter and spring, frozen ground and snow accumulations may contribute to inadequate drainage and localized ponding. Flooding issues of this nature generally occur in areas with flat gradients and generally increase with urbanization which speeds the accumulation of floodwaters because of impervious areas. Shallow street flooding can occur unless channels have been improved to account for increased flows (FEMA 2007).

High groundwater levels can be a concern and cause problems even where there is no surface flooding, due to the soil being unable to absorb any additional moisture from persistent rainfall. Basements are susceptible to high groundwater levels. Seasonally high groundwater is common in many areas, while elsewhere high groundwater occurs only after a long period of above-average precipitation (USGS 2016).

Heavy rainfall that overwhelms a developed area's stormwater infrastructure causing flooding is commonly referred to as urban flooding. Urban flooding can be worsened by aging and inadequate infrastructure and over development of land. The growing number of extreme rainfall events that produce intense precipitation are resulting in increased urban flooding (Center for Disaster Resilience 2018). While coastal, riverine, and lakeshore flooding is mapped and studied by FEMA, urban flooding is not.

NOAA defines urban flooding as the flooding of streets, underpasses, low lying areas, or storm drains (NWS 2009). Urban drainage flooding is caused by increased water runoff due to urban development and inadequate drainage systems. Drainage systems are designed to remove surface water from developed areas as quickly as possible to prevent localized flooding on streets and other urban areas. The systems make use of a closed conveyance system that channels water away from an urban area to surrounding streams. This bypasses the natural processes of water filtration through the ground, containment, and evaporation of excess water. Because drainage systems reduce the amount of time the surface water takes to reach surrounding streams, flooding in those streams can occur more quickly and reach greater depths than prior to development in that area (Harris 2023).

Coastal Erosion

Erosion is the geological process in which earthen materials are worn away and transported by natural forces such as wind or water. Most erosion is performed by liquid water, wind, or ice. Liquid water is the major agent of erosion on Earth. Rain, rivers, floods, and lakes carry away bits of soil and sand and slowly wash away the sediment (National Geographic 2023).

More specifically, coastal erosion is the gradual breakdown and removal of land material into a sea or lake due to physical and chemical processes, such as wind, wave, and tidal action, with contribution from man-made interferences. Coastal erosion can take place at two different rates: gradual erosion, which occurs continually along all coastlines, and sudden or catastrophic erosion primarily due to storm events, which can result in changes to coasts over a very short period of time.

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 that contribute to these coastal hazards include storms such as Nor'easters and hurricanes, decreased sediment supplies, and sea-level rise.

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

Evidence supports that global sea level 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 a significant portion of sea level rise and is a result of warming atmospheric temperatures and subsequent warming of ocean waters. 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).

For the most current information, NASA Earth Observatory reports that the global mean sea level has risen approximately 10.1 centimeters (3.98 inches) since 1992, and over the past 140 years, global sea level has risen between 21 to 24 centimeters (8 to 9 inches). The rate of sea level rise is accelerating, with human interference now dwarfing natural cycles (NASA Earth Observatory 2025).

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 measured 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, such as coastal mapping, marine boundary delineation, coastal zone management, coastal engineering, and sustainable habitat restoration (NOAA 2021).

Short-term variations in sea level typically occur daily 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 can be repeatable cycles, gradual trends, or intermittent differences. Seasonal weather patterns, changes in coastal and ocean circulation, anthropogenic influences, and vertical land motion can influence changes in sea level over time. When estimating sea level trends, a minimum of 30 years of data are used to account for long-term sea level variations and reduce errors in computing sea level trends based on monthly mean sea level (NOAA n.d.).

9.1.2 Location

According to the 2013 preliminary FEMA Flood Insurance Study, flooding in Hudson County is caused primarily by tidal flooding, from such sources as Upper New York Bay, New York Bay, and Kill Van Kul, which in turn affect the riverine sources, such as the Hudson River, Hackensack River, and Passaic River (FEMA FIS 2013). Flooding potential for each type of flooding that affects Hudson County is described in the subsections below.

Riverine Flooding

Flooding potential is influenced by climatology, meteorology, and topography. Extensive development, such as that seen in Hudson County, can impact flooding potential because it leaves fewer natural surfaces available to absorb rainwater. Development forces water directly into streams, rivers, and existing drainage systems, swelling them more than when more natural surface buffered the runoff rate.

Locations of flood zones in Hudson County, as depicted on the FEMA preliminary Digital Flood Insurance Rate Map (DFIRM), are illustrated in Figure 9-2. The total land area in the floodplain, excluding water bodies, is summarized in Table 9-1.

The New Jersey Meadowlands are a large ecosystem of wetlands located in northeastern New Jersey. The Meadowlands stretch mainly along the Hackensack and Passaic Rivers as they flow into Newark Bay. Tributaries of the Hackensack River (Sawmill Creek, Berrys Creek, and Overpeck Creek) also make up the Meadowlands. This area in the State of New Jersey consists of approximately 30.4 square miles of open, undeveloped space, in addition to developed areas. Four communities in Hudson County are located in the Meadowlands and are prone to flooding: Jersey City, Kearny, North Bergen, and Secaucus.

Figure 9-2. FEMA Flood Hazard Areas in Hudson County

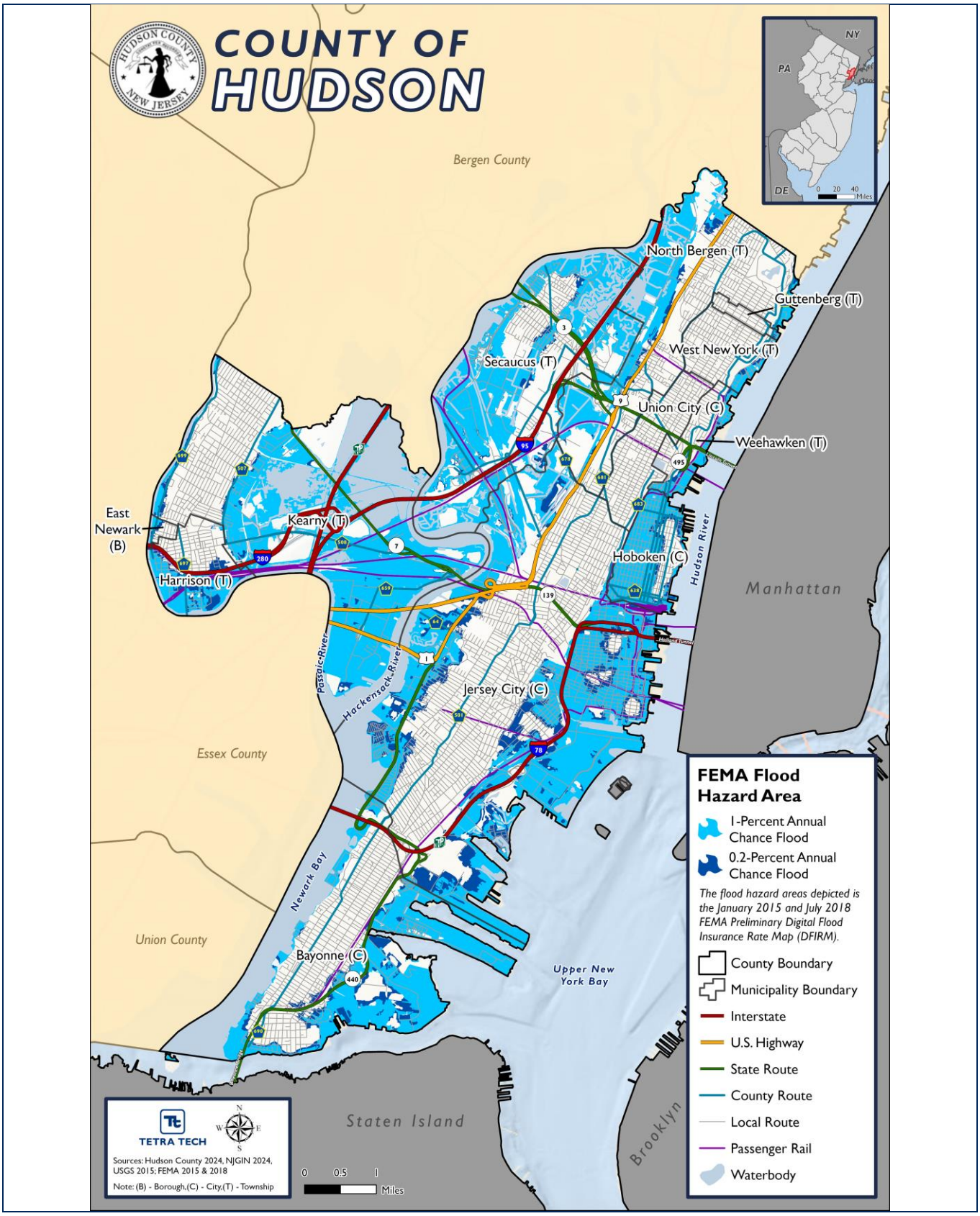


Table 9-1. Number of Acres in Hudson County Exposed to 1 Percent and 0.2 Percent Annual Chance Flood

Jurisdiction	Total Land Area (Excluding Water Bodies) (acres)	Land Area (Excluding Water Bodies) in the 1% Annual Chance Flood Hazard Area		Land Area (Excluding Water Bodies) in the 0.2% Annual Chance Flood Hazard Area	
		Total Area (acres)	% of Jurisdiction Total	Total Area (acres)	% of Jurisdiction Total
Bayonne (C)	3,679	1,568	42.6%	1,849	50.3%
East Newark (B)	63	14	21.9%	23	36.5%
Guttenberg (T)	124	6	4.6%	8	6.5%
Harrison (T)	773	277	35.9%	382	49.5%
Hoboken (C)	794	578	72.7%	644	81.2%
Jersey City (C)	9,348	3,557	38.1%	4,508	48.2%
Kearny (T)	4,691	2,560	54.6%	2,659	56.7%
North Bergen (T)	3,191	971	30.4%	1,064	33.3%
Secaucus (T)	3,546	2,010	56.7%	2,092	59.0%
Union City (C)	824	5	0.6%	5	0.6%
Weehawken (T)	499	168	33.7%	187	37.5%
West New York (T)	635	53	8.3%	69	10.9%
Hudson County (Total)	**28,167**	**11,766**	**41.8%**	**13,489**	**47.9%**

Source: Hudson County 2024

The Hackensack Meadowlands Floodplain Management Plan indicated the following problems areas in Hudson County (New Jersey Meadowlands Commission 2005):

- ***Meadowlands Park, Town of Secaucus*** – Flooding has been reported in the vicinity of the Route 3 access ramps from Meadowlands Parkway, which is located in the western section of the Town of Secaucus. It travels in a north-south direction parallel to the Hackensack River. Flooding occurs on both the northbound and southbound shoulders of the roadway near Block 11, Lot 1. Flooding also occurs along the roadway, blocking traffic, and causing significant delays. Flooding is tidally influenced. Heavy rain events cause the Parkway to flood and back up to Tenth Street.
- ***Penhorn Avenue, Town of Secaucus*** – Penhorn Avenue is located in the southern section of the Town of Secaucus. Flooding occurs along this roadway during moderate to severe storm events. It has been reported that each time it rains, the street floods, and with heavy rainfall, flooding is worse. During rain events, the street is inundated with approximately four feet of water and takes approximately three to four days for the water to drain. In the area of flooding, ground elevation varies from two to eight feet. Penhorn Creek is separated from the Hackensack River, approximately two miles south of Penhorn Avenue.
- ***Fish House Road, Town of Kearny*** – Flooding has been reported in the vicinity of Fish House Road, which is located in the eastern section of the Town of Kearny. Flooding in this area is due primarily to the elevation of the roadway being at or below extreme high tide. Flooding occurs beneath the PATH and CSX bridges adjacent to the Hackensack River and at the industrial building next to the entrance ramp to Route 7. Flooding also occurs under the Newark Turnpike Causeway where the road can be inundated with water up to four feet. Areas under the Amtrak Bridge flood, and water can reach over a foot in depth. The old cobblestone Newark

Turnpike floods, which is now a side street off Route 7. The drainage for this road is tied to the DOT drains by Owens Corning and in the middle of the wide traffic median that eventually drains to the Hackensack River. Two stormwaters catch basins on the Route 7 West exit ramp to Belleville Turnpike are clogged at their outlet.

- ***New Jersey Route 7/Belleville Turnpike, Town of Kearny*** – Route 7/Belleville Turnpike is located in the eastern section of the Town of Kearny. Flooding occurs in the loading docks of several private properties, on the entrance ramp from Belleville Turnpike southbound to Newark-Jersey City Turnpike eastbound, each of the overpasses on Route 7/Belleville Turnpike between Sellers Street and Newark-Jersey City Turnpike, and in front of 720 Route 7/Belleville Turnpike. During heavy rains, tidal blow backs up drains on Belleville Turnpike. The truck yard of the impacted property can be inundated with up to two feet of water, making it difficult for trucks to unload and make deliveries.

COASTAL FLOODING

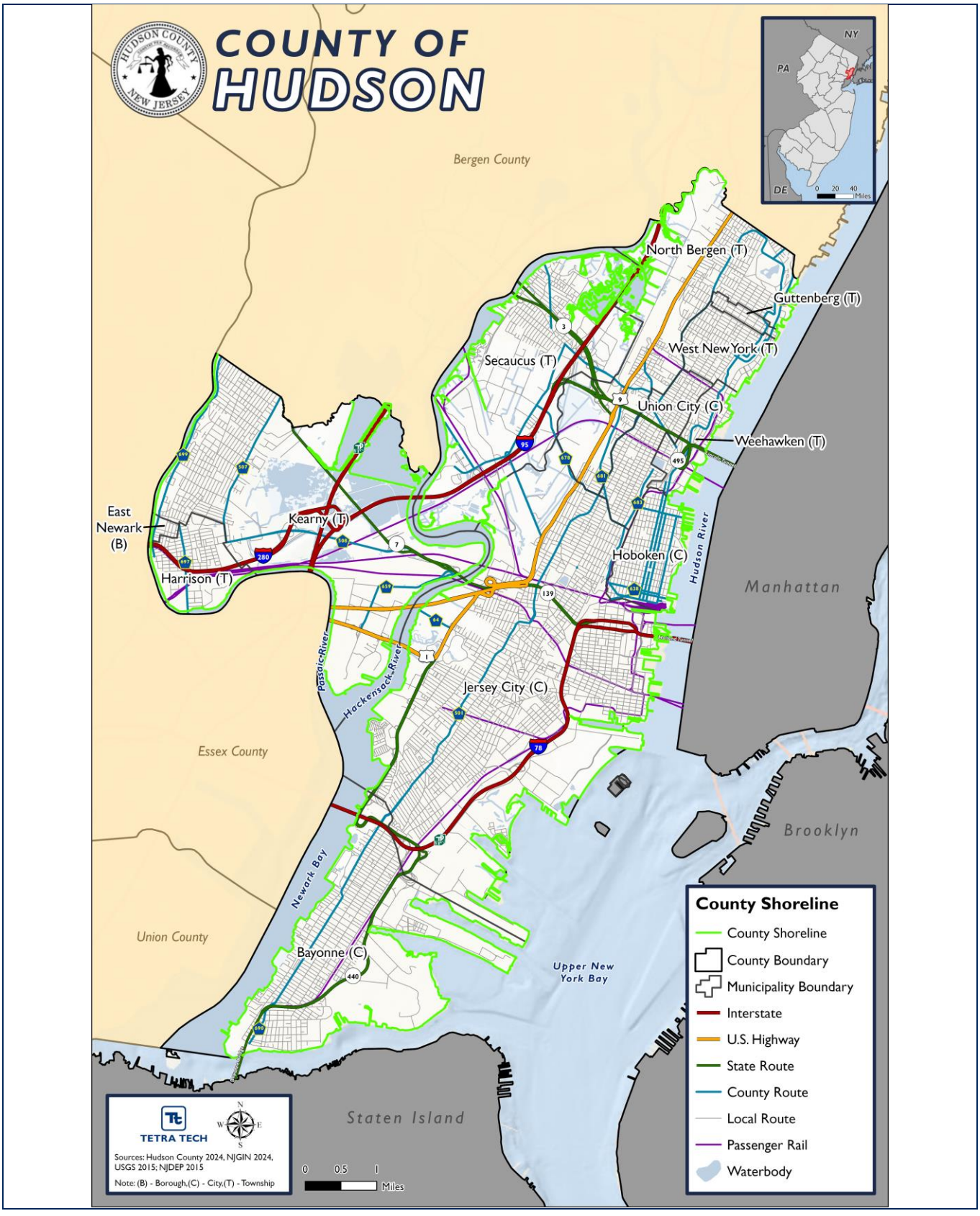
The coastal areas of Hudson County are vulnerable to the damaging impacts of coastal storms. The coastal boundary of New Jersey encompasses the Coastal Area Facility Review Act (CAFRA) zone and the New Jersey Meadowlands District. Hudson County is not located in the CAFRA zone; however, four municipalities in the County (Jersey City, Kearny, North Bergen and Secaucus) are located in the Meadowlands. Figure 9-3 provides a detailed representation of the Hudson County shoreline.

Storm surge also contributes to coastal flooding. Storm surges inundate coastal floodplains by tidal elevation rise in inland bays and harbors and backwater flooding through coastal river mouths. Strong winds can increase in tide levels and water-surface elevations. Storm systems generate large waves that run up and flood coastal areas and adjacent low-lying floodplains. For more on storm surge, refer to Chapter 11 (Severe Weather).

There are no flood control measures that would alter flood hazards due to coastal flooding within Hudson County (FEMA FIS 2013). However, the following projects are in progress:

- USACE NY & NJ Harbor & Tributaries Focus Area Feasibility Study (HATS)
  - The US Army Corps of Engineers (USACE) is investigating measures to manage future flood risk in ways that support the long-term resilience and sustainability of the coastal ecosystem and surrounding communities, and reduce the economic costs and risks associated with flood and storm events (USACE 2019).
- Hoboken Flood-Resilience Project
  - The U.S. Department of Housing and Urban Development has recently released $230 million for construction of a flood-resistance system to protect Hoboken as well as parts of Weehawken and Jersey City. The project calls for construction of flood structures and stormwater control systems to protect areas vulnerable to flooding. The strategically placed system will utilize natural higher ground to maximize protection and will be designed to blend in seamlessly with the urban streetscape. It will provide protection for critical infrastructure such as the North Hudson Sewerage Authority, as well as public safety facilities such as three fire stations and a hospital.

Figure 9-3. Coastline of Hudson County



The 2013 FEMA preliminary Flood Insurance Study, noted the following principal flood problems in Hudson County (FEMA FIS 2013):

- ***Weehawken, Guttenburg, West New York***—Flooding in the Township of Weehawken and Towns of Guttenburg and West New York is caused primarily by tidal flooding of the Hudson River in the low-lying areas along the shore.
- ***Bayonne, Hoboken, Jersey City***—In the Cities of Bayonne, Hoboken, and Jersey City, the most severe flooding events have been due to hurricanes and related storm surge.
- ***Kearny, Harrison—***The Towns of Kearney and Harrison are subject to tidal flooding from the Passaic River, which usually occurs when the annual peak rainfall coincides with high tide.
- ***North Bergen***—In the Township of North Bergen, flooding results from the tidal stages of Newark Bay which affect the Hackensack River, and, in turn, Bellmans Creek, Cromakill Creek, and Penhorn Creek, which wind their way through the Hackensack Estuary. Tidal elevation from the Hackensack River also affects the New Jersey Meadowlands Commission district within the Township of North Bergen.

Hudson 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 saltwater 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 (Hudson County 2024). Figure 9-4 shows the location of the New York-New Jersey Harbor Estuary and its boundaries.

Located in the New York and New Jersey Harbor Estuary, Newark Bay is the center of the most urbanized and industrialized parts of the country. Newark Bay is approximately six miles long and one mile wide and is located at the confluence of the Passaic and Hackensack Rivers, between the shores of Newark and Elizabeth to the west, Jersey City and Bayonne to the east, and Staten Island to the south. Newark Bay is linked to Upper and Lower New York Bay by the Kill van Kull and the Arthur Kill. Port Newark is located on the western shore of Newark Bay (Our Newark Bay 2014).

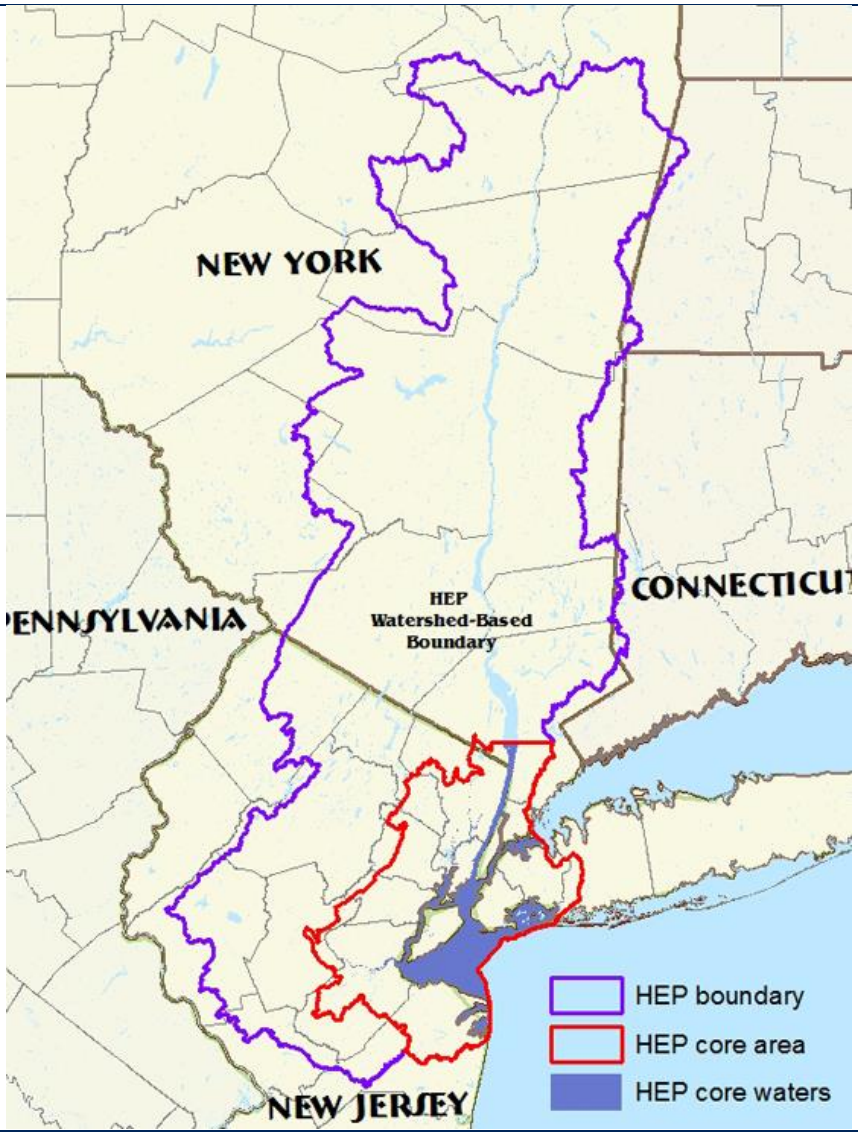
Flash Flooding

Flash flooding, like riverine flooding, occurs throughout the County, primarily along the bodies of water that flow through it. There is no standardized mapping system for flash flooding.

Stormwater/Urban Flooding

Stormwater/urban flooding is not mapped by the state or FEMA but is most likely to occur in highly developed areas with high percentages of impervious surface that contribute to high rates of runoff. Locations that have undersized stormwater components or stormwater components that are prone to becoming clogged or failing often experience stormwater flooding.

Figure 9-4. New York-New Jersey Harbor Estuary



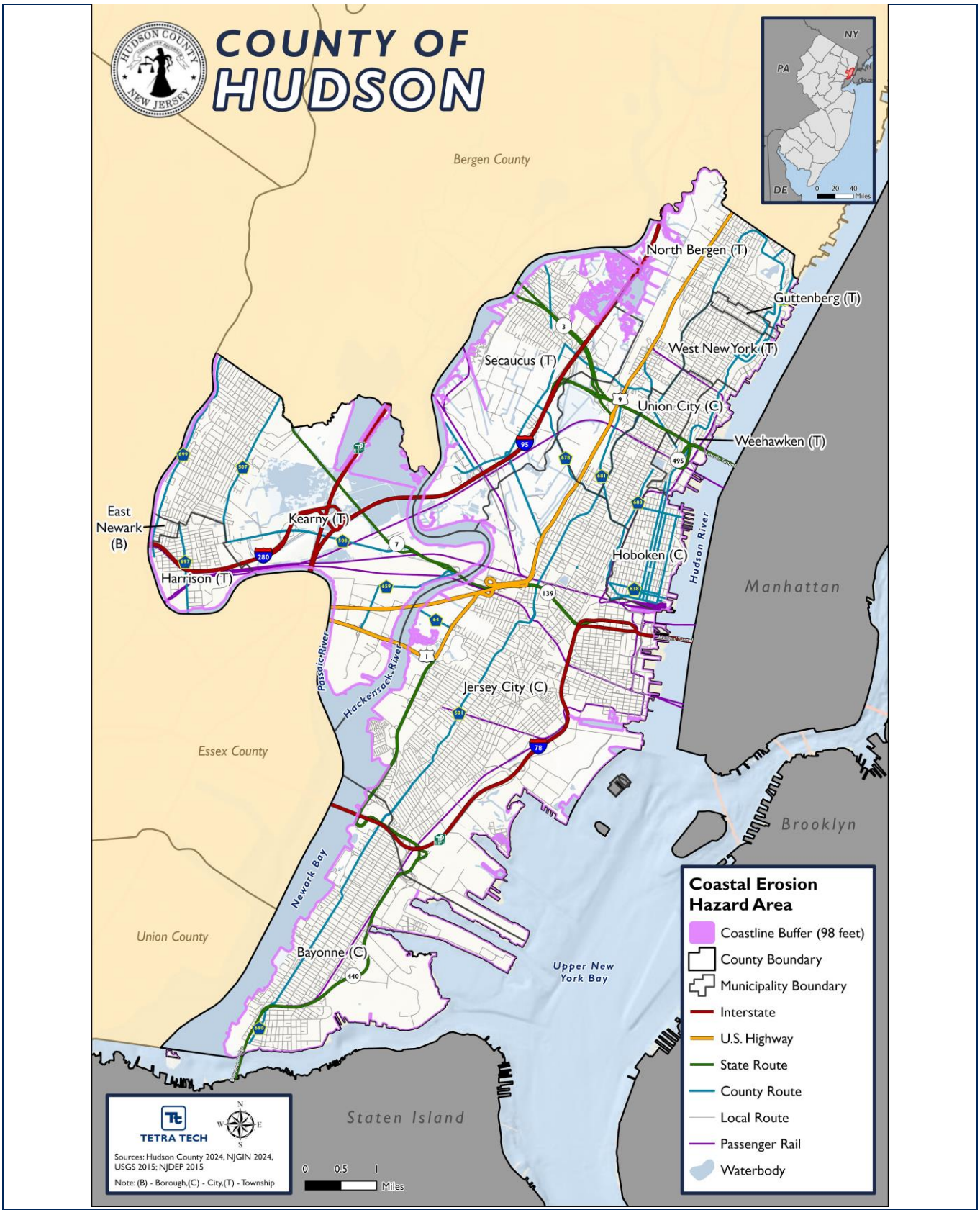
Source: New York-New Jersey Harbor & Estuary Program 2014

COASTAL EROSION

The coastal boundary of the State of New Jersey encompasses the Coastal Area Facility Review Act area and the New Jersey Meadowlands District. The coastal area includes coastal waters to the limit of tidal influence, including the following areas: the Atlantic Ocean (to the limit of the State 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.

Hudson County is considered a coastal county because several municipalities are located along the tidal portion of the Hudson River (the Cities of Jersey City and Hoboken). This map is an essential tool for understanding the geographical layout and identifying areas that may be susceptible to various hazards, such as coastal erosion. Additionally, Figure 9-5 shows the coastal erosion hazard areas.

Figure 9-5. Coastal Erosion Hazard Area



Sea Level Rise

Sea-level rise in New Jersey has resulted in an increase in sea level of roughly 18 inches since the early 1900s. The rate of sea-level rise is anticipated to increase as time goes on, with the rate of increase being tied to the rate of greenhouse gas emissions and the corresponding increase in global temperatures (Rutgers 2020). As sea levels continue to rise, an increase in the frequency and severity of coastal flooding events from coastal storms is expected. Rising sea levels can result in permanent inundation of land that is currently above the high tide line, increase flooding risk from coastal storms, increase erosional rates, reduce the effectiveness of infrastructure, such as stormwater systems, and damage or destroy critical habitats.

Hudson County faces significant risks from sea level rise due to its extensive coastline along the Hudson River and proximity to the Atlantic Ocean. Low-lying urban areas and critical infrastructure are particularly vulnerable to flooding and erosion. Historical data shows that sea levels in New Jersey have risen by approximately 18 inches over the past century, with projections indicating an accelerated rise in the future. This increases the risk of frequent and severe coastal flooding, permanent land inundation, and higher erosion rates, impacting population, buildings, and infrastructure near the shoreline. Figure 9-6 visualizes two potential sea level rise scenarios for Hudson County—1-foot and 3-foot levels.

9.1.3 Extent

Riverine and Flash Flooding

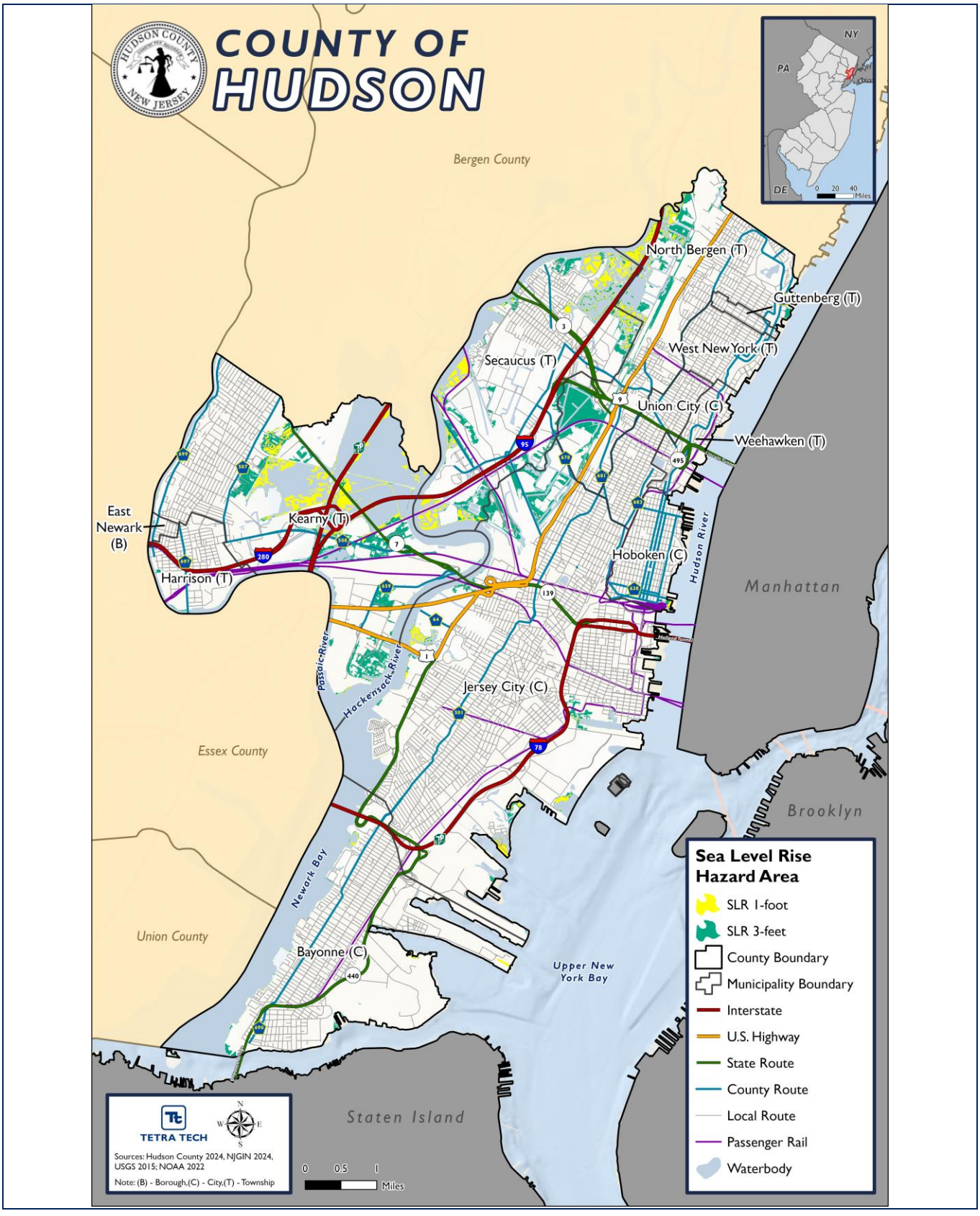
The severity of riverine and flash flooding is determined by a combination of several factors including stream and river basin topography and physiography; precipitation and weather patterns; recent soil moisture conditions; and degree of vegetative clearing and impervious surface. Generally, floods are long-term events that may last for several days. Severity depends not only on the amount of water that accumulates in a period of time, but also on the land's ability to manage this water. One element is the size of rivers and streams in an area; but an equally important factor is the land's absorbency. When it rains, the soil acts as a sponge. When the land is saturated or frozen, infiltration into the ground slows and any more water that accumulates must flow as runoff (Harris 2023).

The frequency and severity of riverine flooding are measured using a discharge probability, which is the probability that a certain river discharge (flow) level will be equaled or exceeded in a given year. Flood studies use historical records to determine the probability of occurrence for the different discharge levels.

In the case of riverine or flash flooding, once a river reaches flood stage, the flood extent or severity categories used by the NWS include minor flooding, moderate flooding, and major flooding. Each category has a definition based on property damage and public threat (NSSL n.d.):

- Minor Flooding causes minimal or no property damage, but possibly some public threat or inconvenience.
- Moderate Flooding results in some inundation of structures and roads near streams. Some evacuations of people and/or transfer of property to higher elevations are necessary.
- Major Flooding causes extensive inundation of structures and roads. Significant evacuations of people and/or transfer of property to higher elevations.

Figure 9-6. Sea Level Rise in Hudson County



Coastal Flooding

Evidence supports that global sea level 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 percent 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 2024).

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 n.d.).

Short-term variations in sea level typically occur daily 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 can 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, and vertical land motion can 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 n.d.).

Sea-level rise in the State of New Jersey has resulted in an increase in sea level of roughly 16 inches in the past century. The rate of sea-level rise is anticipated to increase as time goes on, with the rate of increase being tied to the rate of greenhouse gas emissions and the corresponding increase in global temperatures (Rutgers 2024). As sea levels continue to rise, an increase in the frequency and severity of coastal flooding events from coastal storms is expected. Rising sea levels can result in permanent inundation of land that is currently above the high tide line, increase flooding risk from coastal storms, increase erosional rates, reduce the effectiveness of infrastructure, such as stormwater systems, and damage or destroy critical habitats.

Stormwater/Urban Flooding

Currently, there is no measurement used to further define the frequency and severity of stormwater/urban flooding.

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 (NJOEM 2024). Many factors determine whether a community exhibits greater long-term erosion or accretion, including the following (Woods Hole Sea Grant 2003):

- 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.
- Human interference with sediment supply (e.g., revetments, seawalls, jetties).

Such erosion can be intensified by human activities and effects, such as boat wakes, shoreline hardening, or dredging. Natural recovery after erosive episodes can take months or years (CCRM 2017). If a dune or beach does not recover quickly enough via natural processes, coastal and upland property could be exposed to further damage in subsequent events. Coastal erosion can cause the destruction of buildings and infrastructure (NJOEM 2024).

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 “2 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, including 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

Severa; methods are used to measure sea level rise, including tide gauges and satellite altimetry. Tide gauges provide long-term data on sea level changes at specific coastal locations by measuring the height of the sea relative to a fixed point on land (NOAA n.d.). These gauges have been in use for over a century and offer valuable historical data.

Additionally, satellite altimetry has been used since the early 1990s to measure sea level on a global scale. Satellites equipped with radar altimeters measure the distance between the satellite and the sea surface, providing highly accurate and comprehensive data on sea level changes 2. This method offers nearly global coverage and helps in understanding planet-wide trends.

9.1.4 Previous Occurrences

FEMA Major Disaster and Emergency Declarations

Between 1954 and 2023, Hudson County was included in nine major disaster (DR) or emergency (EM) declarations for flood-related events (FEMA 2024). Table 9-2 lists these declarations.

Table 9-2. FEMA Declarations for Flood Events in Hudson County (1954 to 2023)

Event Date	Declaration Date	Declaration Number	Description
September 4, 1971	September 4, 1971	DR-310-NJ	Heavy Rains, Flooding
December 10-17, 1992	December 18, 1992	DR-973-NJ	Coastal Storm, High Tides, Heavy Rain, Flooding
September 16-18, 1999	September 17, 1999	EM-3148-NJ	Hurricane Floyd
August 26 – September 5, 2011	August 27, 2011 August 31, 2011	EM-3332-NJ DR-4021-NJ	Hurricane Irene
October 26-November 8, 2012	October 28, 2012 October 30,2012	EM-3354-NJ DR-4086-NJ	Hurricane Sandy
September 1 – 3, 2021	September 2, 2021 September 5, 2021	EM-3573-NJ DR-4614-NJ	Remnants of Hurricane Ida

Sources: FEMA 2024

USDA Declarations

The Secretary of Agriculture from the U.S. Department of Agriculture (USDA) is authorized to designate counties as disaster areas to make emergency loans to producers suffering losses in those counties and in contiguous counties. Between 2019 and 2023, Hudson County was not included in any USDA flood-related agricultural disaster declarations (USDA 2024).

Previous Events

Known hazard events that impacted Hudson County between August 2019 and December 2023 are discussed in Table 9-3. For events prior to 2019, refer to the 2020 Hudson County HMP.

Table 9-3. Flood Events in Hudson County (2019 to 2023)

Event Date	FEMA Declaration or State Proclamation Number	Hudson County included in declaration?	Location Impacted	Description
May 29, 2019	N/A	N/A	Secaucus	Low pressure moving along a nearly stationary boundary triggered an area of convection that moved across the region during the evening of May 29th, resulting in isolated flash flooding across northeast New Jersey. Patterson Plank Road was flooding Route 3 in Secaucus.
July 17, 2019	N/A	N/A	Union City	Showers and thunderstorms developed in a sub-tropical environment ahead of the remnants of Post Tropical Cyclone Barry, resulting in flash flooding across portions of urban northeast New Jersey. Several streets flooded in Hoboken with water at least halfway up car tires, including Madison Street between 9th and 10th Streets and 1st Street.
July 22, 2019	N/A	N/A	Harrison	Flow parallel to a stalled frontal boundary across the region allowed showers and thunderstorms to train across the area during the afternoon and evening hours. These storms developed in an environment with precipitable water values around 2.25 inches and produced widespread 1–2-inch rainfall amounts across the region. Numerous roads were closed and water rescues were conducted in Harrison, East Newark, and Kearny, including along Frank E. Rodgers Boulevard South in Harrison and along Passaic Avenue in both East Newark and Kearny.
August 7, 2019	N/A	N/A	Hoboken, West End, and Bayonne	Showers and thunderstorms developed across northeast New Jersey ahead of a cold front during the afternoon of August 7th. These storms developed in an environment with precipitable water values close to 2 inches. Multiple rounds of showers and storms exacerbated the flash flood threat, with many locations receiving 1-3 inches of rain, much of which fell in only a few hours. All lanes of Tonnelle Avenue (NJ Routes 1&9) were closed in Jersey City due to flooding.
August 18, 2019	N/A	N/A	Union City	Showers and thunderstorms developed during the afternoon hours as a warm front slowly approached the region from the south. With precipitable water values near 2 inches and relatively slow storm movement, isolated flash flooding was reported in Hudson County.
July 1, 2020	N/A	N/A	East Newark	Energy rotating around an upper-level low over the northeast resulted in the development of scattered showers and thunderstorms. With light steering flow, this resulted in slow moving convection and isolated flash flooding. Multiple water rescues were conducted due to flash flooding on Frank E Rodgers Boulevard South of Bergen Street in Harrison.
July 3, 2020	N/A	N/A	Kearny	A backdoor cold front slowly sank across the area through the day, eventually settling just southwest of the region by evening. Moderate to strong instability ahead of this front aided in the development of showers and thunderstorms across northeast New Jersey during the early evening hours. Most of this rain fell in less than an hour, resulting in isolated flash flooding. A water rescue was conducted at the intersection of Passaic Avenue and Bergen Avenue near K-Mart in Kearny.

Event Date	FEMA Declaration or State Proclamation Number	Hudson County included in declaration?	Location Impacted	Description
July 10, 2020	N/A	N/A	Hoboken and Union City	Tropical Storm Fay tracked northward along the New Jersey coast before passing west of New York City. Several rounds of heavy rain occurred over the New York City metro area as the storm approached. This rain developed in a tropical airmass, with precipitable water values over 2 inches, resulting in numerous reports of flash flooding. There was flooding under a railroad overpass on Grove Street near Newark Street in Jersey City. Water was up to the car doors.
July 22, 2020	N/A	N/A	Hoboken and Union City	Following a warm frontal passage in the morning, an increasingly hot and humid airmass built across the area during the day, with precipitable water values rising above 2 inches by evening based on the 00Z sounding from Upton, NY. A line of convection moving into the region from the west during the early evening hours resulted in flash flooding across portions of urban northeast New Jersey. A car was stranded in flood waters at the intersection of 9th Street and Madison Street in Hoboken.
July 24, 2020	N/A	N/A	Bayonne and Greenville	A cold front slowly sank south across the area during the morning. With plenty of instability in place, showers and thunderstorms developed along the front and slowly moved south across northeast New Jersey during the morning hours. Flooding reported on West 55th Street in Bayonne with manhole covers lifted.
August 4, 2020	N/A	N/A	Countywide	The center of Isaias passed about 65 miles west of New York City at 3 pm on August 4, 2020, with tropical storm force winds east of the center of circulation. The highest sustained wind speeds across northeastern New Jersey ranged from 35 to 50 mph, with gusts 60 to 70 mph, resulting in widespread wind damage and power outages. Rainfall amounts of 1/2 to 4 inches were observed across northeastern NJ, resulting in some localized flooding issues.
June 8, 2021	N/A	N/A	East Newark	A passing shortwave combined with a surface trough resulted in the development of showers and thunderstorms across northeast New Jersey during the early afternoon hours. These thunderstorms developed in an environment with weak steering flow and high precipitable water values, resulting in several reports of flash flooding. Roads impassable and underwater with multiple roads closed due to flooding around the town of Harrison, including Frank E. Rodgers Boulevard.
July 2, 2021	N/A	N/A	Greenville, Kearny and Jersey City Airport	Low pressure meandering along a stalled frontal boundary produced scattered showers and thunderstorms across the region. With light upper-level flow, these storms were generally slow moving, resulting in flash flooding across portions of urban northeast New Jersey. Numerous roads were closed due to flooding in Jersey City.
July 10, 2021	N/A	N/A	Union City	Isolated showers and thunderstorms developed late in the day along a weak frontal boundary. One of these storms was able to produce a quick 0.5-1 inch of rain, resulting in isolated flash flooding in Hudson County. Water rescues were conducted near Tonnelle Avenue in North Bergen due to flooding.

Event Date	FEMA Declaration or State Proclamation Number	Hudson County included in declaration?	Location Impacted	Description
July 17, 2021	N/A	N/A	East Newark	Showers and thunderstorms developed in the vicinity of a stalled frontal boundary. With weak steering flow and precipitable water values approaching 2 inches on the 12Z Upton sounding, this resulted in widespread flash flooding across portions of urban northeast New Jersey during the mid to late afternoon hours. Frank E. Rogers Boulevard was flooded near Pete Higgins Boulevard in Harrison.
August 21, 2021	N/A	N/A	Hoboken and East Newark	Showers and thunderstorms streaming northward well ahead of approaching Hurricane Henri resulted in flash flooding across portions of northeast New Jersey. Madison Street in Hoboken was closed due to flash flooding.
August 27, 2021	N/A	N/A	Jersey City Airport	A backdoor cold front approaching the area sparked a few widely scattered thunderstorms. With weak upper-level flow resulting in slow storm motions and wet antecedent conditions as a result of rainfall associated with Tropical Storm Henri less than a week earlier, this resulted in isolated flash flooding in northeast New Jersey.
September 1 – 3, 2021	DR-4614-NJ EM-3573-NJ	Yes	Harrison, East Newark, Kearny and Jersey City	Extremely heavy rainfall associated with the remnants of Hurricane Ida overspread northeast New Jersey during the evening of September 1 and continued through the early morning hours of September 2. Rainfall totals ranged from 5-8+ inches across much of the region, with much of that rain falling in just a few hours. This resulted in widespread flash flooding leading to numerous road closures and water rescues in addition to extensive river flooding. Eight people died as a result of the flash flooding and one person remains missing.
May 27, 2022	N/A	N/A	Harrison	Several rounds of thunderstorms moved along a warm front of an approaching low-pressure system on May 27th and into the 28th. These thunderstorms produced heavy rainfall over Northeast New Jersey resulting in several rounds of localized flash flooding. Water rescue at the intersection of Johnston Avenue and Passaic Avenue.
April 30, 2023	N/A	N/A	Hoboken	Already saturated grounds from 1 to 3 inches of rain the previous day's set the stage for a localized flash flooding event to unfold on April 30th when an additional 2 to 3 inches of rainfall fell over a period of several hours. Marin Blvd and Grove St. closed due to flooding.

Sources: NOAA NCEI 2024, FEMA 2024

9.1.5 Probability of Future Occurrences

Probability Based on Previous Occurrences

Information on previous flood occurrences in the County was used to calculate the probability of future occurrence of such events, as summarized in Table 9-4. Based on historical records and input from the Steering Committee, the probability of occurrence for flood in the County is considered "frequent."

Table 9-4. Probability of Future Flood Events in Hudson County

Hazard Type	Number of Occurrences Between 1996 and 2023	Percent Chance of Occurring in Any Given Year
Coastal Flood	16	59%
Flash Flood	107	100%
Flood	26	96%
Total	**149**	**100%**

Sources: NOAA NCEI 2024

Notes: Due to limitations in data, not all Flood events occurring between 1954 and 1996 are accounted for in the tally of occurrences. As a result, the number of hazard occurrences is calculated using the number of occurrences between 1996 and 2023. The NCEI database categorizes flood events into types that do not correspond to the flood types outlined in this profile. Coastal flood, flash flood, and flood events likely represent other types of flooding discussed in this profile, such as riverine flooding and stormwater/urban flooding.

Effect of Climate Change on Future Probability

A warmer atmosphere means storms have the potential to be more intense and occur more often. In New Jersey, extreme storms typically include coastal nor'easters, snowstorms, spring and summer thunderstorms, tropical storms, and on rare occasions hurricanes. Most of these events occur in the warmer months between April and October, with nor'easters occurring between September and April. The State will experience more intense rain events, less snow, and more rainfall. The State could also experience an increase in the number of flood events (NJDEP 2020).

Projections of climate change for New Jersey predict more intense rainfall events and increases in total annual precipitation (see Section 3.4.4). By 2050, annual precipitation in New Jersey could increase by 4 to 11 percent (NJDEP 2020). By the end of this century, heavy precipitation events are projected to occur two to five times more often and with more intensity than in the last century.

9.1.6 Cascading Impacts on Other Hazards

Flooding can elevate the risk of dam or levee failures. A failure may occur if water levels exceed a dam's storage capacity or flood velocities damage equipment. Additionally, flooding can increase the likelihood of a landslide occurring if the water destabilizes slopes. More intense flood events may also amplify potential debris flows or associated damage from landslides.

Depending on a flood's severity and the substances in its path, floodwaters can be contaminated by pollutants such as sewage, human and animal feces, pesticides, fertilizers, oil, asbestos, and rusting building materials. After flooding

events, excess moisture and standing water contribute to the growth of mold in buildings. Mold may present a health risk to building occupants, especially those with already compromised immune systems such as infants, children, the elderly and pregnant women. Common public health risks associated with flood events also include unsafe food, contaminated drinking or washing water, more disease-carrying organisms (i.e., mosquitos), carbon monoxide poisoning, and even mental stress and fatigue (CDC 2024).

Floods of any type have the potential to result in water and power utilities failures. Such failures may impact public and private use, as well as cause disruption to critical infrastructure. Oversaturated soils from periods of heavy rain and flooding may cause utility poles to tip over or fall completely, interrupting the power grid for a potentially large area, especially if the transformer is impacted.

9.2 Vulnerability and Impact Assessment

To assess Hudson County's risk to the flood hazard, a spatial analysis was conducted using the best available spatially delineated flood hazard areas. The 1 and 0.2 percent annual chance flood events were examined to determine the assets located in the hazard areas and to estimate potential loss using the FEMA HAZUS-MH v6.1 model.

There are no NJDEP-identified shoreline types in Hudson County characterized as vulnerable to erosion. However, to estimate exposure to long-term coastal erosion for purposes of this risk assessment, the entire shoreline was analyzed. To generate the extent of the estimated coastal erosion hazard area (CEHA), an erosion rate of 0.5 meters per year was multiplied by 60 to include all structure types and developed/undeveloped areas (annual erosion rate of 0.5 meters x 60 years = 30 meters or approximately 98 feet). Therefore, population, buildings, and infrastructure within 98 feet of the shoreline are identified as vulnerable to long-term coastal erosion.

These results are summarized below.

9.2.1 Life, Health, and Safety

The impact of flooding on life, health, and safety is dependent upon several factors including the severity of the event and whether or not adequate warning time is provided to residents. Hazard exposure represents the population living in or near floodplain areas that could be impacted should a flood event occur. Additionally, exposure should not be limited to only those who reside in a defined hazard zone, but all individuals who may be affected by the hazard event (e.g., people are at risk while traveling in flooded areas, or their access to emergency services is compromised during an event). The degree of that impact will vary and is not strictly measurable.

The total number of injuries and casualties resulting from flooding is generally limited based on advance weather forecasting, blockades, and warnings. Therefore, injuries and deaths generally are not anticipated if proper warning and precautions are in place. Ongoing mitigation efforts should help to avoid the most likely cause of injury, which results from people trying to cross flooded roadways or channels during a flood.

Overall Population

Riverine Flooding

To estimate population exposure to the 1 and 0.2 percent annual chance flood events, the DFIRM flood boundaries were used. Based on the spatial analysis, there are an estimated 96,295 residents living in the Special Flood Hazard Area (SFHA, or 1 percent annual chance floodplain), or 13.3 percent of the County's total population. There are an estimated 127,377 residents living in the 0.2 percent annual chance floodplain, or 17.6 percent of the County's total population. The City of Hoboken has the greatest number of residents living in the 1 percent annual chance flood hazard area with approximately 43,257 residents. The City of Jersey City has the highest number of residents living in the 0.2 percent annual chance flood area, approximately 56,099 people. Table 9-5 summarizes the population exposed to the flood hazard by jurisdiction.

Table 9-5. Estimated Hudson County Population Exposed to the 1 and 0.2 Percent Flood Hazard Area

Jurisdiction	Total Population	Population Exposed to the 1 Percent Annual Chance Flood Event Hazard Area		Population Exposed to the 0.2 Percent Annual Chance Flood Event Hazard Area	
		Number of People	Percent Total	Number of People	Percent Total
Bayonne (C)	71,686	4,846	6.8%	7,616	10.6%
East Newark (B)	2,594	6	0.2%	47	1.8%
Guttenberg (T)	12,017	318	2.6%	1,100	9.2%
Harrison (T)	19,450	1,371	7.0%	2,297	11.8%
Hoboken (C)	60,419	43,257	71.6%	51,051	84.5%
Jersey City (C)	292,449	38,984	13.3%	56,099	19.2%
Kearny (T)	41,999	1,298	3.1%	1,547	3.7%
North Bergen (T)	63,361	197	0.3%	457	0.7%
Secaucus (T)	22,181	4,848	21.9%	5,795	26.1%
Union City (C)	68,589	0	0.0%	0	0.0%
Weehawken (T)	17,197	1,008	5.9%	1,044	6.1%
West New York (T)	52,912	162	0.3%	324	0.6%
Hudson County (Total)	**724,854**	**96,295**	**13.3%**	**127,377**	**17.6%**

Source: U.S. Census Bureau 2020; FEMA 2015, 2018

The Hazus riverine model estimates the potential shelter needs as a result of a 1 percent annual chance flood event. This data estimates 103,364 persons may be displaced, and 5,411 people may seek short-term shelter. These statistics, by jurisdiction, are presented in Table 9-6. The estimated displaced population and number of persons seeking short-term shelter differs from the number of persons exposed to the 1 percent annual chance flood, because the displaced population numbers take into consideration that not all residents will be significantly impacted enough to be displaced or to require short-term shelter during a flood event.

Table 9-6. Persons Displaced or Seeking Short-Term Shelter, 1 Percent Annual Chance Flood Event

Jurisdiction	Total Population (2020 Decennial)	1% Annual Chance Flood Impacts on People	
		Displaced Population	Persons Seeking Short-Term Shelter
Bayonne (C)	71,686	3,197	615
East Newark (B)	2,594	14	14
Guttenberg (T)	12,017	287	87
Harrison (T)	19,450	1,455	161
Hoboken (C)	60,419	35,218	1,183
Jersey City (C)	292,449	51,447	2,668
Kearny (T)	41,999	1,585	204
North Bergen (T)	63,361	1,622	107
Secaucus (T)	22,181	4,507	287
Union City (C)	68,589	50	27
Weehawken (T)	17,197	1,955	9
West New York (T)	52,912	2,027	49
Hudson County (Total)	**724,854**	**103,364**	**5,411**

Source: Hazus v6.1; U.S. Census Bureau 2020; FEMA 2015,2018

Coastal Erosion

Coastal erosion and sea level rise threaten coastal communities by damaging homes and infrastructure, increasing flooding risks, and disrupting local economies. These processes can lead to displacement, costly repairs, and loss of natural barriers, necessitating significant adaptation efforts to protect vulnerable areas. Table 9-7 shows the population in the coastal erosion hazard area by jurisdiction. There are overall 2,736 persons located in the coastal erosion hazard area; the City of Jersey City has the greatest population of 1,009 persons, or 0.3 percent, of the jurisdictional total.

Sea Level Rise

Table 9-8 shows population in the 1- and 3-foot sea level rise hazard areas. In Hudson County, 231 people are located within the 1-foot hazard area, with City of Jersey City having 196 and Town of Weehawken having 35. For the 3-foot sea level rise hazard area, Hudson County has 628 people, with Town of Secaucus having the highest number at 223.

Socially Vulnerable Population

Research has shown that some populations, while they may not have more hazard exposure, may experience exacerbated impacts and prolonged recovery if/when impacted. This is due to many factors including their physical and financial ability to react or respond during a hazard. Of the population exposed, the most vulnerable include the economically disadvantaged and the population over the age of 65.

Table 9-7. Population in the Coastal Erosion Hazard Area

Jurisdiction	Total Population (2020 Decennial)	Population in the Coastal Erosion Hazard Area	
		Number of Persons	% of Jurisdiction Total
Bayonne (C)	71,686	788	1.1%
East Newark (B)	2,594	6	0.2%
Guttenberg (T)	12,017	215	1.8%
Harrison (T)	19,450	8	<0.1%
Hoboken (C)	60,419	127	0.2%
Jersey City (C)	292,449	1,009	0.3%
Kearny (T)	41,999	0	0.0%
North Bergen (T)	63,361	24	<0.1%
Secaucus (T)	22,181	486	2.2%
Union City (C)	68,589	0	0.0%
Weehawken (T)	17,197	44	0.3%
West New York (T)	52,912	29	0.1%
Hudson County (Total)	**724,854**	**2,736**	**0.4%**

Table 9-8. Population in the 1- and 3-foot Sea Level Rise Hazard Area

Jurisdiction	Total Population (2020 Decennial)	Population in the 1ft Sea Level Rise Hazard Area		Population in the 3ft Sea Level Rise Hazard Area	
		Number of Persons	% of Jurisdiction Total	Number of Persons	% of Jurisdiction Total
Bayonne (C)	71,686	0	0.0%	0	0.0%
East Newark (B)	2,594	0	0.0%	0	0.0%
Guttenberg (T)	12,017	0	0.0%	0	0.0%
Harrison (T)	19,450	0	0.0%	0	0.0%
Hoboken (C)	60,419	0	0.0%	0	0.0%
Jersey City (C)	292,449	196	0.1%	196	0.1%
Kearny (T)	41,999	0	0.0%	100	0.2%
North Bergen (T)	63,361	0	0.0%	74	0.1%
Secaucus (T)	22,181	0	0.0%	223	1.0%
Union City (C)	68,589	0	0.0%	0	0.0%
Weehawken (T)	17,197	35	0.2%	35	0.2%
West New York (T)	52,912	0	0.0%	0	0.0%
Hudson County (Total)	**724,854**	**231**	**<0.1%**	**628**	**0.1%**

Source: U.S. Census Bureau 2020; NOAA 2022

Socially vulnerable populations face heightened risks and challenges in adapting to and recovering from the impacts of coastal erosion and sea level rise. Economically disadvantaged individuals may struggle to afford necessary adaptations, such as repairs after storms. Elderly populations are more likely to require medical attention, which may be limited during extreme weather events due to isolation and evacuation difficulties. Limited warning time for extreme weather events exacerbates the vulnerability of these populations. Those at risk due to inadequate warning include individuals lacking internet access, non-English speakers, and those who do not regularly use communication tools like cell phones or social media.

Economically disadvantaged populations are more vulnerable because they are likely to evaluate their risk and make decisions to evacuate based on the net economic impact on their family. The population over the age of 65 is more vulnerable because they are more likely to seek or need medical attention, which may not be available due to isolation during a flood event, and they may have more difficulty evacuating. Special consideration should be taken when planning for disaster preparation, response, and recovery for these vulnerable groups.

Riverine Flooding

Table 9-9 and Table 9-10 presents the estimated socially vulnerable populations living in the 1 and 0.2 percent annual chance flood hazard areas. There are 9,051 persons over the age of 65 years, 6,502 persons under the age of 5 years, 7,259 non-English speakers, 6,407 persons with a disability, and 10,290 living in poverty located in the 1 percent annual chance flood hazard area. There are 12,297 persons over the age of 65 years, 8,622 persons under the age of 5 years, 10,062 non-English speakers, 8,686 persons with a disability, and 14,126 living in poverty located in the 0.2 percent annual chance flood hazard area.

Coastal Erosion

Table 9-11 presents the estimated socially vulnerable populations located in the coastal erosion hazard area. Of the 2,736 persons located in this hazard area, there are 343 persons over the age of 65 years, 175 persons under the age of 5 years, 266 non-English speakers, 231 persons with a disability, and 318 persons living in poverty.

Sea Level Rise

Table 9-12 and Table 9-13 display the estimated socially vulnerable populations located in the 1- and 3-foot sea level rise hazard area. Of the 231 persons located in this 1-foot hazard area, there are 25 persons over the age of 65 years, 15 persons under the age of 5 years, 21 non-English speakers, 17 persons with a disability, and 31 persons living in poverty. Of the 628 persons located in this 3-foot hazard area, there are 83 persons over the age of 65 years, 35 persons under the age of 5 years, 67 non-English speakers, 50 persons with a disability, and 60 persons living in poverty.

Table 9-9. Estimated Vulnerable Persons Located in the 1 Percent Annual Chance Flood Hazard

Jurisdiction	Estimated Number of Vulnerable Persons Located in the 1 Percent Annual Chance Flood Hazard Area									
	Persons Over 65	% of Total	Persons Under 5	% of Total	Non-English Speaking Persons	% of Total	Persons with a Disability	% of Total	Persons in Poverty	% of Total
Bayonne (C)	673	6.8%	345	6.8%	382	6.7%	463	6.7%	568	6.7%
East Newark (B)	0	0.0%	0	0.0%	1	0.2%	0	0.0%	1	0.2%
Guttenberg (T)	42	2.6%	21	2.6%	53	2.6%	35	2.6%	49	2.6%
Harrison (T)	145	7.0%	83	7.0%	288	7.0%	101	7.0%	191	7.0%
Hoboken (C)	2,762	71.6%	2,935	71.6%	1,870	71.6%	2,201	71.6%	3,229	71.6%
Jersey City (C)	4,355	13.3%	2,729	13.3%	3,875	13.3%	2,985	13.3%	5,749	13.3%
Kearny (T)	169	3.1%	83	3.1%	173	3.1%	98	3.1%	131	3.1%
North Bergen (T)	32	0.3%	11	0.3%	34	0.3%	19	0.3%	22	0.3%
Secaucus (T)	733	21.9%	230	21.8%	470	21.9%	426	21.8%	245	21.8%
Union City (C)	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Weehawken (T)	120	5.9%	58	5.8%	74	5.9%	62	5.8%	73	5.8%
West New York (T)	20	0.3%	7	0.3%	39	0.3%	17	0.3%	32	0.3%
Hudson County (Total)	**9,051**	**10.4%**	**6,502**	**13.9%**	**7,259**	**7.8%**	**6,407**	**10.5%**	**10,290**	**10.3%**

Source: US Census Bureau, ACS 5-Year Estimates; FEMA 2015,2018

Table 9-10. Estimated Vulnerable Person Located in the 0.2 Percent Annual Chance Flood Hazard

Jurisdiction	Estimated Number of Vulnerable Persons Located in the 0.2 Percent Annual Chance Flood Hazard Area									
	Persons Over 65	% of Total	Persons Under 5	% of Total	Non-English Speaking Persons	% of Total	Persons with a Disability	% of Total	Persons in Poverty	% of Total
Bayonne (C)	1,058	10.6%	542	10.6%	601	10.6%	728	10.6%	894	10.6%
East Newark (B)	5	1.6%	1	0.9%	8	1.7%	3	1.4%	11	1.7%
Guttenberg (T)	148	9.1%	74	9.1%	184	9.1%	122	9.1%	171	9.1%
Harrison (T)	243	11.8%	139	11.7%	483	11.8%	170	11.8%	321	11.8%
Hoboken (C)	3,260	84.5%	3,464	84.5%	2,207	84.5%	2,598	84.5%	3,811	84.5%
Jersey City (C)	6,267	19.2%	3,927	19.2%	5,576	19.2%	4,296	19.2%	8,274	19.2%
Kearny (T)	201	3.7%	99	3.7%	207	3.7%	117	3.7%	157	3.7%
North Bergen (T)	75	0.7%	27	0.7%	79	0.7%	44	0.7%	53	0.7%
Secaucus (T)	876	26.1%	275	26.0%	562	26.1%	509	26.1%	293	26.1%
Union City (C)	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Weehawken (T)	124	6.1%	60	6.0%	76	6.0%	64	6.0%	76	6.1%
West New York (T)	40	0.6%	14	0.6%	79	0.6%	35	0.6%	65	0.6%
Hudson County (Total)	**12,297**	**14.2%**	**8,622**	**18.4%**	**10,062**	**10.8%**	**8,686**	**14.2%**	**14,126**	**14.2%**

Source: US Census Bureau, ACS 5-Year Estimates; FEMA 2015,2018

Table 9-11. Estimated Number of Vulnerable Persons Located in the Coastal Erosion Hazard Area

Jurisdiction	Estimated Number of Vulnerable Persons Located in the Coastal Erosion Hazard Area									
	Persons Over 65	% of Total	Persons Under 5	% of Total	Non-English Speaking Persons	% of Total	Persons with a Disability	% of Total	Persons in Poverty	% of Total
Bayonne (C)	109	1.1%	56	1.1%	62	1.1%	75	1.1%	92	1.1%
East Newark (B)	0	0.0%	0	0.0%	1	0.2%	0	0.0%	1	0.2%
Guttenberg (T)	29	1.8%	14	1.7%	36	1.8%	24	1.8%	33	1.8%
Harrison (T)	0	0.0%	0	0.0%	1	<0.1%	0	0.0%	1	<0.1%
Hoboken (C)	8	0.2%	8	0.2%	5	0.2%	6	0.2%	9	0.2%
Jersey City (C)	112	0.3%	70	0.3%	100	0.3%	77	0.3%	148	0.3%
Kearny (T)	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
North Bergen (T)	4	<0.1%	1	<0.1%	4	<0.1%	2	<0.1%	2	<0.1%
Secaucus (T)	73	2.2%	23	2.2%	47	2.2%	42	2.2%	24	2.1%
Union City (C)	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Weehawken (T)	5	0.2%	2	0.2%	3	0.2%	2	0.2%	3	0.2%
West New York (T)	3	<0.1%	1	<0.1%	7	0.1%	3	0.1%	5	<0.1%
Hudson County (Total)	**343**	**0.4%**	**175**	**0.4%**	**266**	**0.3%**	**231**	**0.4%**	**318**	**0.3%**

Source: U.S. Census Bureau, American Community Survey 5-Year Estimates; NJDEP 2015

Table 9-12. Estimated Number of Vulnerable Persons Located in the 1-Foot Sea Level Rise Hazard Area

Jurisdiction	Estimated Number of Vulnerable Persons Located in the 1-Foot Sea Level Rise Hazard Area									
	Persons Over 65	% of Total	Persons Under 5	% of Total	Non-English Speaking Persons	% of Total	Persons with a Disability	% of Total	Persons in Poverty	% of Total
Bayonne (C)	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
East Newark (B)	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Guttenberg (T)	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Harrison (T)	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Hoboken (C)	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Jersey City (C)	21	0.1%	13	0.1%	19	0.1%	15	0.1%	29	0.1%
Kearny (T)	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
North Bergen (T)	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Secaucus (T)	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Union City (C)	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Weehawken (T)	4	0.2%	2	0.2%	2	0.2%	2	0.2%	2	0.2%
West New York (T)	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Hudson County (Total)	**25**	**<0.1%**	**15**	**<0.1%**	**21**	**<0.1%**	**17**	**<0.1%**	**31**	**<0.1%**

Source: U.S. Census Bureau, American Community Survey 5-Year Estimates; NOAA 2022

Table 9-13. Estimated Number of Vulnerable Persons Located in the 3-Foot Sea Level Rise Hazard Area

Jurisdiction	Estimated Number of Vulnerable Persons Located in the 3-Foot Sea Level Rise Hazard Area									
	Persons Over 65	% of Total	Persons Under 5	% of Total	Non-English Speaking Persons	% of Total	Persons with a Disability	% of Total	Persons in Poverty	% of Total
Bayonne (C)	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
East Newark (B)	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Guttenberg (T)	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Harrison (T)	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Hoboken (C)	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Jersey City (C)	21	0.1%	13	0.1%	19	0.1%	15	0.1%	29	0.1%
Kearny (T)	13	0.2%	6	0.2%	13	0.2%	7	0.2%	10	0.2%
North Bergen (T)	12	0.1%	4	0.1%	12	0.1%	7	0.1%	8	0.1%
Secaucus (T)	33	1.0%	10	0.9%	21	1.0%	19	1.0%	11	1.0%
Union City (C)	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Weehawken (T)	4	0.2%	2	0.2%	2	0.2%	2	0.2%	2	0.2%
West New York (T)	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Hudson County (Total)	**83**	**0.1%**	**35**	**0.1%**	**67**	**0.1%**	**50**	**0.1%**	**60**	**0.1%**

Source: U.S. Census Bureau, American Community Survey 5-Year Estimates; NOAA 2022

9.2.2 General Building Stock

Riverine Flood

After considering the population exposed and potentially vulnerable to the flood hazard, the built environment was evaluated. Exposure includes those buildings located in the flood hazard zone. Potential damage is the modeled loss that could occur to the exposed inventory, including structural and content replacement cost values. Table 9-14 summarizes these results county-wide.

There are 19,099 buildings located in the 1 percent annual chance flood hazard area with more than an estimated $34 billion of replacement cost value (i.e., building and content replacement costs). In total, this represents approximately 37.1 percent of the County's total general building stock inventory. In addition, there are 24,372 buildings located in the 0.2 percent annual chance flood boundary with more than an estimated $42 billion of building stock and contents exposed. This represents approximately 45.8 percent of the County's total general building stock inventory.

Table 9-15 displays the buildings by general occupancy located within the 1 or 0.2 percent annual chance flood hazard areas. For the 1 percent annual chance flood hazard area, the City of Hoboken (9,480) and the City of Jersey City (4,362) have the highest number of residential buildings at risk. The City of Jersey City also has the highest commercial (480) and government, religion, agricultural, and education (343) buildings at risk. The City of Bayonne leads in industrial buildings (713) at risk of the 1 percent annual chance flood event.

For the 0.2 percent annual chance flood hazard area, the City of Hoboken has the highest number of residential buildings (11,188) at risk. The City of Jersey City has the highest number of commercial buildings (697) and government, religion, agricultural, and education buildings (474) are at risk. The City of Bayonne, again, leads to industrial buildings (834) at risk.

The Hazus flood model estimated potential damage to the buildings in Hudson County at the structure level using the custom structure inventory developed for this HMP and the depth grid generated using the effective 2020 DFIRM data. The potential damage estimated by Hazus to the general building stock inventory associated with the 1 percent annual chance flood is approximately $4.9 million or 5.3 percent of the total building replacement cost value. The City of Hoboken has the greatest estimated building loss, with approximately $1.6 billion (22.9 percent of the total replacement cost value). Refer to Table 9-16 for the estimated losses by jurisdiction, which also shows the estimated losses for residential, commercial, and other occupancy structures, respectively.

Overall, the data highlights the varying degrees of flood risk across different jurisdictions and building types in Hudson County.

Table 9-14. General Building Stock Located in the 1 and 0.2 Percent Annual Chance Flood Hazard Areas—All Occupancies

Jurisdiction	Jurisdiction Total Buildings		1 Percent Annual Chance Flood Event Hazard Area				0.2 Percent Annual Chance Flood Event Hazard Area			
			Number of Buildings		Replacement Cost Value		Number of Buildings		Replacement Cost Value	
	Count	Replacement Cost Value	Count	% of Jurisdiction Total	Value	% of Jurisdiction Total	Count	% of Jurisdiction Total	Value	% of Jurisdiction Total
Bayonne (C)	9,264	$11,278,964,959	1,337	14.4%	$3,501,216,916	31.0%	1,797	19.4%	$4,420,576,417	39.2%
East Newark (B)	434	$300,712,303	8	1.8%	$43,390,431	14.4%	25	5.8%	$93,204,278	31.0%
Guttenberg (T)	2,574	$1,062,772,505	68	2.6%	$41,289,646	3.9%	226	8.8%	$118,507,013	11.2%
Harrison (T)	2,646	$2,812,269,922	217	8.2%	$1,071,231,981	38.1%	366	13.8%	$1,477,174,316	52.5%
Hoboken (C)	14,289	$6,922,849,652	10,062	70.4%	$5,092,647,894	73.6%	11,862	83.0%	$5,842,559,000	84.4%
Jersey City (C)	38,336	$29,829,276,781	5,445	14.2%	$8,118,476,100	27.2%	7,796	20.3%	$12,722,594,832	42.7%
Kearny (T)	7,207	$9,630,626,567	679	9.4%	$5,861,291,044	60.9%	756	10.5%	$6,011,791,207	62.4%
North Bergen (T)	6,002	$9,906,706,329	138	2.3%	$2,759,111,340	27.9%	196	3.3%	$3,128,929,820	31.6%
Secaucus (T)	3,844	$12,075,088,549	968	25.2%	$7,109,209,274	58.9%	1,142	29.7%	$7,726,223,145	64.0%
Union City (C)	1,729	$4,009,712,429	0	0.0%	$0	0.0%	0	0.0%	$0	0.0%
Weehawken (T)	2,112	$1,638,112,105	159	7.5%	$551,145,081	33.6%	174	8.2%	$582,429,832	35.6%
West New York (T)	4,594	$3,076,856,343	18	0.4%	$161,847,732	5.3%	32	0.7%	$264,887,890	8.6%
Hudson County (Total)	**93,031**	**$92,543,948,444**	**19,099**	**20.5%**	**$34,310,857,438**	**37.1%**	**24,372**	**26.2%**	**$42,388,877,751**	**45.8%**

Source: NJOIT 2024; Microsoft BING 2019; RS Means 2024; FEMA 2015,2018

Table 9-15. Buildings in the 1 and 0.2- Percent Annual Chance Flood Hazard Areas, by General Occupancy Class

	1 Percent Annual Chance Flood Event Hazard Area				0.2 Percent Annual Chance Flood Event Hazard Area			
	Residential	Commercial	Industrial	Other[a]	Residential	Commercial	Industrial	Other[a]
Bayonne (C)	516	29	713	79	811	65	834	87
East Newark (B)	1	0	7	0	7	2	16	0
Guttenberg (T)	62	0	0	6	214	0	0	12
Harrison (T)	154	20	35	8	258	32	49	27
Hoboken (C)	9,480	367	27	188	11,188	440	27	207
Jersey City (C)	4,362	480	260	343	6,277	697	348	474
Kearny (T)	193	42	341	103	230	60	352	114
North Bergen (T)	16	35	62	25	37	51	75	33
Secaucus (T)	717	90	86	75	857	112	95	78
Union City (C)	0	0	0	0	0	0	0	0
Weehawken (T)	113	20	8	18	117	23	10	24
West New York (T)	11	3	0	4	22	4	0	6
Hudson County (Total)	**15,625**	**1,086**	**1,539**	**849**	**20,018**	**1,486**	**1,806**	**1,062**

Source: NJOIT 2024; Microsoft BING 2019; FEMA 2015, 2018

a. Other = Government, Religion, Agricultural, and Education

Table 9-16. General Building Stock Potential Loss to the 1 Percent Chance Flood Event

Jurisdiction	Total Replacement Cost Value	1 Percent Annual Chance Flood Event Impact on Buildings				
		Estimated Loss for All Occupancies	Percent of Total	Estimated Loss for Residential Properties	Estimated Loss for Commercial Properties	Estimated Loss for All Other Occupancies
Bayonne (C)	$11,278,964,959	$657,353,608	5.8%	$21,701,703	$91,043,354	$544,608,550
East Newark (B)	$300,712,303	$1,183,795	0.4%	$113,992	$0	$1,069,803
Guttenberg (T)	$1,062,772,505	$2,876,408	0.3%	$2,725,565	$0	$150,843
Harrison (T)	$2,812,269,922	$95,772,781	3.4%	$12,985,761	$1,993,398	$80,793,621
Hoboken (C)	$6,922,849,652	$1,586,776,135	22.9%	$1,084,632,529	$173,634,944	$328,508,662
Jersey City (C)	$29,829,276,781	$1,271,032,294	4.3%	$254,282,402	$220,138,789	$796,611,103
Kearny (T)	$9,630,626,567	$847,639,139	8.8%	$10,566,957	$7,483,966	$829,588,216
North Bergen (T)	$9,906,706,329	$171,637,138	1.7%	$14,022,080	$26,650,611	$130,964,447
Secaucus (T)	$12,075,088,549	$100,115,856	0.8%	$21,323,066	$2,911,556	$75,881,235
Union City (C)	$4,009,712,429	$0	0.0%	$0	$0	$0
Weehawken (T)	$1,638,112,105	$145,935,985	8.9%	$46,906,401	$57,042,098	$41,987,486
West New York (T)	$3,076,856,343	$9,725,935	0.3%	$8,211,141	$39,386	$1,475,407
Hudson County (Total)	**$92,543,948,444**	**$4,890,049,073**	**5.3%**	**$1,477,471,596**	**$580,938,102**	**$2,831,639,375**

Source: Hazus v6.1; NJOIT 2024; Microsoft BING 2019; RS Means 2024; FEMA 2015, 2018; Tetra Tech 2020

NFIP Statistics

Participating in the NFIP is voluntary. Communities that choose to participate agree to adopt and implement local floodplain management regulations that protect lives and reduce risk from future flooding. In return, the federal government makes flood insurance available to property owners throughout the community. To join, a community must complete an application; adopt a resolution of intent to participate and cooperate with FEMA; and adopt and submit a floodplain management ordinance that meets or exceeds the minimum NFIP criteria. The ordinance must adopt any FEMA-approved flood mapping for the community (FEMA 2020, FEMA 2022).

FEMA provided a list of residential properties with NFIP policies, past claims, and multiple claims. Properties with multiple claims are defined as repetitive loss (RL) properties or severe repetitive loss (SRL) properties, based on definitions from two FEMA programs as follows:

- The NFIP defines RL properties as structures that meet either of the following qualifiers:
  - Two or more claims of more than $1,000 paid by NFIP within any rolling 10-year period since 1978
  - Two or more claims (building payments only) that, on average, equal or exceed 25 percent of the current value of the property
- FEMA's Flood Mitigation Assistance (FMA) grant program defines RL properties as structures covered by a contract for flood insurance made available under the NFIP that meet both of the following qualifiers:
  - Has incurred flood-related damage on two occasions, in which the cost of the repair, on average, equaled or exceeded 25 percent of the market value of the structure at the time of each flood event
  - At the time of the second incidence of flood-related damage, the contract for flood insurance contained increased cost of compliance coverage.
- The NFIP defines SRL properties as residential properties covered under an NFIP flood insurance policy that satisfies the third condition below and either of the first two:
  - Four or more separate claim payments for the property (including building and contents) over $5,000 each have occurred, and the cumulative amount of such claim's payments exceeded $20,000.
  - At least two separate claim payments for the property (building payments only) have occurred, and the cumulative amount of the building portion of such claims exceeded the current value of the property.
  - For either of the above, at least two of the referenced claims must have occurred within any 10-year- period and must have occurred more than 10 days apart.
- The FMA program defines SRL properties as structures covered by a contract for flood insurance that meets one of two qualifiers:
  - Four or separate claims payments (includes building and contents) have been made under flood insurance coverage with the amount of each such claim exceeding $5,000, and with the cumulative amount of such claim payments exceeding $20,000.
  - At least two separate claim payments (includes only building) have been made under such coverage, with the cumulative amount of such claims exceeding the market value of the insured structured.

Table 9-17 summarizes the NFIP policies, claims and repetitive loss statistics for Hudson County. Table 9-18 summarizes the occupancy classes of the repetitive loss and severe repetitive loss properties in the County.

Table 9-17. NFIP Claims, Payments, and Repetitive Loss Statistics for Hudson County

Jurisdiction	Total Claims	Total Payments	Number of NFIP RL Properties	Number of FMA RL Properties	Number of NFIP SRL Properties	Number of FMA SRL Properties
Bayonne (C)	166	$3,921,678.99	16	—	—	—
East Newark (B)	1	$22,487.84	—	—	—	—
Guttenberg (T)	4	$68,572.50	—	—	—	—
Harrison (T)	39	$5,473,793.49	3	—	—	—
Hoboken (C)	2,210	$56,236,694.42	274	23	—	23
Jersey City (C)	1,808	$54,583,071.35	220	21	1	21
Kearny (T)	277	$30,527,497.26	12	3	—	3
North Bergen (T)	146	$5,488,320.98	15	5	—	5
Secaucus (T)	85	$888,793.45	7	—	—	—
Union City (C)	—	—	—	—	—	—
Weehawken (T)	110	$7,537,473.53	4	—	—	—
West New York (T)	15	$2,477,495.63	1	—	—	—
Hudson County (Total)	**10,586**	**$368,462,870.51**	**612**	**56**	**2**	**56**

Source: FEMA NFIP 2024

Table 9-18. Summary of Repetitive Loss Properties by Jurisdiction

	Single Family	2-4 Family	Business	Other Residential	Other Non-Residential
Repetitive Loss Properties					
Bayonne (C)	8	5	2	1	1
East Newark (B)	0	0	0	0	0
Guttenberg (T)	0	0	0	0	0
Harrison (T)	0	3	0	0	0
Hoboken (C)	28	94	12	141	6
Jersey City (C)	62	131	5	26	8
Kearny (T)	2	0	8	0	5
New Jersey Meadowlands Commission	36	16	4	6	1
North Bergen (T)	6	3	1	0	5
Secaucus (T)	5	2	0	0	1
Union City (C)	0	0	0	0	0
Weehawken (T)	0	4	0	0	0
West New York (T)	0	0	0	0	1
Hudson County (Total)	147	258	32	174	28

	Single Family	2-4 Family	Business	Other Residential	Other Non-Residential
Severe Repetitive Loss Properties					
Bayonne (C)	0	0	0	0	1
East Newark (B)	0	0	0	0	0
Guttenberg (T)	0	0	0	0	0
Harrison (T)	0	0	0	0	0
Hoboken (C)	2	7	1	13	0
Jersey City (C)	5	13	0	0	3
Kearny (T)	0	0	1	0	2
New Jersey Meadowlands Commission	2	1	0	0	1
North Bergen (T)	1	0	0	0	5
Secaucus (T)	0	0	0	0	0
Union City (C)	0	0	0	0	0
Weehawken (T)	0	0	0	0	0
West New York (T)	0	0	0	0	0
Hudson County (Total)	**10**	**21**	**2**	**13**	**12**

Source: FEMA NFIP 2024

COASTAL EROSION

Coastal erosion can undermine the foundations of buildings and infrastructure, leading to structural failure and increased flooding risks. As shorelines retreat, structures previously considered safe may become exposed to these hazards. Sea level rise exacerbates this vulnerability by increasing the frequency and intensity of coastal flooding and storm surges.

The potential damage represents the modeled loss to the exposed inventory, measured by the structural and content replacement cost value. As shown in Table 9-19, there are 507 buildings in the coastal erosion hazard area, accounting for approximately 0.5 percent of the County's total general building stock. The replacement cost value for these buildings is an estimated $841 million, which constitutes 0.9 percent of the County's total inventory replacement cost value. The City of Jersey City has the greatest amount of exposure, with approximately 162, or 4.0 percent, of all buildings within the jurisdictional total, which compromise 1.4 percent, or $410 million, of total estimated building value, located in the coastal erosion hazard area.

Table 9-20 presents the buildings categorized by general occupancy class within the coastal erosion hazard area. Hudson County has a total of 350 residential buildings, 29 commercial buildings, 46 industrial buildings, and 82 buildings classified under government, religious, agricultural, and educational categories. The City of Jersey City has the highest number of residential (113), commercial (14), and buildings classified under government, religious, agricultural, and educational categories (27) in this hazard area. The City of Bayonne has the highest number of industrial buildings (23) in this hazard area.

Table 9-19. Buildings in the Coastal Erosion Hazard Area

Jurisdiction	Jurisdiction Total Buildings		Buildings in the Coastal Erosion Hazard Area			
			Number of Buildings		Replacement Cost Value	
	Count	Replacement Cost Value	Count	% of Jurisdiction Total	Value	% of Jurisdiction Total
Bayonne (C)	9,264	$11,278,964,959	124	1.3%	$88,224,248	0.8%
East Newark (B)	434	$300,712,303	5	1.2%	$4,126,221	1.4%
Guttenberg (T)	2,574	$1,062,772,505	46	1.8%	$34,863,446	3.3%
Harrison (T)	2,646	$2,812,269,922	6	0.2%	$14,415,680	0.5%
Hoboken (C)	14,289	$6,922,849,652	42	0.3%	$32,240,069	0.5%
Jersey City (C)	38,336	$29,829,276,781	162	0.4%	$409,691,419	1.4%
Kearny (T)	7,207	$9,630,626,567	14	0.2%	$34,753,579	0.4%
North Bergen (T)	6,002	$9,906,706,329	10	0.2%	$9,490,484	0.1%
Secaucus (T)	3,844	$12,075,088,549	80	2.1%	$102,828,107	0.9%
Union City (C)	1,729	$4,009,712,429	0	0.0%	$0	0.0%
Weehawken (T)	2,112	$1,638,112,105	11	0.5%	$88,393,934	5.4%
West New York (T)	4,594	$3,076,856,343	7	0.2%	$21,819,698	0.7%
Hudson County (Total)	**93,031**	**$92,543,948,444**	**507**	**0.5%**	**$840,846,886**	**0.9%**

Source: NJ Office of Information Technology, Office of GIS 2024; Microsoft BING 2019; RS Means 2024; NJDEP 2015

Table 9-20. Buildings in the Coastal Erosion Hazard Area by General Occupancy Class

Jurisdiction	Buildings in the Coastal Erosion Hazard Area by General Occupancy Class			
	Residential	Commercial	Industrial	Other[a]
Bayonne (C)	84	1	23	16
East Newark (B)	1	0	4	0
Guttenberg (T)	42	0	0	4
Harrison (T)	1	2	2	1
Hoboken (C)	28	1	2	11
Jersey City (C)	113	14	8	27
Kearny (T)	0	3	7	4
North Bergen (T)	2	1	0	7
Secaucus (T)	72	1	0	7
Union City (C)	0	0	0	0
Weehawken (T)	5	4	0	2
West New York (T)	2	2	0	3
Hudson County (Total)	**350**	**29**	**46**	**82**

Source: NJ Office of Information Technology, Office of GIS 2024; Microsoft BING 2019; NJDEP 2015

a. Other = Government, Religion, Agricultural, and Education

Sea Level Rise

Table 9-21 and Table 9-22 summarize the exposed inventory and replacement cost value for the 1- and 3-foot sea level rise hazard areas. In the 1-foot sea level rise hazard area, there are 62 buildings, which represent about 0.1 percent of the County's total general building stock. The replacement cost value for these buildings is estimated at $328 million, accounting for 0.4 percent of the County's total inventory replacement cost value. Jersey City has the highest exposure in this area, with approximately 34 buildings, or 0.1 percent of all buildings within the jurisdiction, valued at $140 million, which constitutes 0.5 percent of the total estimated building value in this hazard area.

In the 3-foot sea level rise hazard area, there are 257 buildings, making up approximately 0.3 percent of the County's total general building stock. The replacement cost value for these buildings is estimated at $2.3 billion, which is 2.5 percent of the County's total inventory replacement cost value. Kearny has the highest exposure in this area, with approximately 112 buildings, or 1.6 percent of all buildings within the jurisdiction, valued at $1 billion, which constitutes 10.9 percent of the total estimated building value in this hazard area.

Table 9-23 summarizes the buildings categorized by general occupancy class within the 1- and 3-foot sea level rise hazard areas. In the 1-foot hazard area, Hudson County has a total of 26 residential buildings, five commercial buildings, 12 industrial buildings, and 19 buildings classified under government, religious, agricultural, and educational categories. The City of Jersey City has the highest number of residential (22), and buildings classified under government, religious, agricultural, and educational categories (eight) in this hazard area. The Town of Weehawken has the highest number of industrial buildings (four) in this hazard area. Lastly, the Town of Kearny leads in industrial buildings (seven) in this hazard area.

Table 9-21. Buildings in the 1-Foot Sea Level Rise Hazard Area

Jurisdiction	Jurisdiction Total Buildings		Buildings in the 1ft Sea Level Rise Hazard Area			
			Number of Buildings		Replacement Cost Value	
	Count	Replacement Cost Value	Count	% of Jurisdiction Total	Value	% of Jurisdiction Total
Bayonne (C)	9,264	$11,278,964,959	5	0.1%	$59,094,143	0.5%
East Newark (B)	434	$300,712,303	0	0.0%	$0	0.0%
Guttenberg (T)	2,574	$1,062,772,505	0	0.0%	$0	0.0%
Harrison (T)	2,646	$2,812,269,922	0	0.0%	$0	0.0%
Hoboken (C)	14,289	$6,922,849,652	4	<0.1%	$2,060,236	<0.1%
Jersey City (C)	38,336	$29,829,276,781	34	0.1%	$140,144,489	0.5%
Kearny (T)	7,207	$9,630,626,567	9	0.1%	$44,362,548	0.5%
North Bergen (T)	6,002	$9,906,706,329	1	<0.1%	$81,119	<0.1%
Secaucus (T)	3,844	$12,075,088,549	0	0.0%	$0	0.0%
Union City (C)	1,729	$4,009,712,429	0	0.0%	$0	0.0%
Weehawken (T)	2,112	$1,638,112,105	8	0.4%	$80,707,277	4.9%
West New York (T)	4,594	$3,076,856,343	1	<0.1%	$1,898,197	0.1%
Hudson County (Total)	**93,031**	**$92,543,948,444**	**62**	**0.1%**	**$328,348,009**	**0.4%**

Source: NJ Office of Information Technology, Office of GIS 2024; Microsoft BING 2019; RS Means 2024; NOAA 2022

Table 9-22. Buildings in the 3-Foot Sea Level Rise Hazard Area

Jurisdiction	Jurisdiction Total Buildings		Buildings in the 3ft Sea Level Rise Hazard Area			
			Number of Buildings		Replacement Cost Value	
	Count	Replacement Cost Value	Count	% of Jurisdiction Total	Value	% of Jurisdiction Total
Bayonne (C)	9,264	$11,278,964,959	7	0.1%	$59,855,481	0.5%
East Newark (B)	434	$300,712,303	0	0.0%	$0	0.0%
Guttenberg (T)	2,574	$1,062,772,505	0	0.0%	$0	0.0%
Harrison (T)	2,646	$2,812,269,922	2	0.1%	$7,111,706	0.3%
Hoboken (C)	14,289	$6,922,849,652	7	<0.1%	$238,858,943	3.5%
Jersey City (C)	38,336	$29,829,276,781	45	0.1%	$163,146,651	0.5%
Kearny (T)	7,207	$9,630,626,567	112	1.6%	$1,049,228,371	10.9%
North Bergen (T)	6,002	$9,906,706,329	27	0.4%	$436,117,207	4.4%
Secaucus (T)	3,844	$12,075,088,549	48	1.2%	$253,642,170	2.1%
Union City (C)	1,729	$4,009,712,429	0	0.0%	$0	0.0%
Weehawken (T)	2,112	$1,638,112,105	8	0.4%	$80,707,277	4.9%
West New York (T)	4,594	$3,076,856,343	1	<0.1%	$1,898,197	0.1%
Hudson County (Total)	**93,031**	**$92,543,948,444**	**257**	**0.3%**	**$2,290,566,003**	**2.5%**

Source: NJ Office of Information Technology, Office of GIS 2024; Microsoft BING 2019; RS Means 2024; NOAA 2022

Table 9-23. Buildings in the 1- and 3-Foot Sea Level Rise Hazard Area by General Occupancy Class

Jurisdiction	Buildings in the 1ft Sea Level Rise Hazard Area by General Occupancy Class			
	Residential	Commercial	Industrial	Government, Religion, Agricultural, and Education
1-Foot Sea Level Rise				
Bayonne (C)	0	0	2	3
East Newark (B)	0	0	0	0
Guttenberg (T)	0	0	0	0
Harrison (T)	0	0	0	0
Hoboken (C)	0	0	0	4
Jersey City (C)	22	1	3	8
Kearny (T)	0	0	7	2
North Bergen (T)	0	0	0	1
Secaucus (T)	0	0	0	0
Union City (C)	0	0	0	0
Weehawken (T)	4	4	0	0
West New York (T)	0	0	0	1
Hudson County (Total)	26	5	12	19

Jurisdiction	Buildings in the 1ft Sea Level Rise Hazard Area by General Occupancy Class			
	Residential	Commercial	Industrial	Government, Religion, Agricultural, and Education
3-Foot Sea Level Rise				
Bayonne (C)	0	0	2	5
East Newark (B)	0	0	0	0
Guttenberg (T)	0	0	0	0
Harrison (T)	0	0	2	0
Hoboken (C)	0	0	1	6
Jersey City (C)	22	1	5	17
Kearny (T)	15	7	69	21
North Bergen (T)	6	4	15	2
Secaucus (T)	33	1	6	8
Union City (C)	0	0	0	0
Weehawken (T)	4	4	0	0
West New York (T)	0	0	0	1
Hudson County (Total)	**80**	**17**	**100**	**60**

Source: NJ Office of Information Technology, Office of GIS 2024; Microsoft BING 2019; NOAA 2022

Within the 3-foot sea level rise hazard area, Hudson County has a total of 80 residential buildings, 17 commercial buildings, 100 industrial buildings, and 60 buildings classified under government, religious, agricultural, and educational categories. The Town of Secaucus has the highest number of residential buildings (33) in this hazard area. The Town of Kearny leads in commercial (seven), industrial (69), and buildings classified under government, religious, agricultural, and educational categories (21) in this hazard area.

9.2.3 Community Lifelines and Other Critical Facilities

Critical services during and after a flood may not be available if critical facilities are damaged or if transportation routes to access critical facilities are impacted. Roads that are blocked or damaged can isolate residents and prevent access throughout the planning area to many service providers who need to reach vulnerable populations or make repairs. Utilities such as overhead power, cable, and phone lines could also be vulnerable due to utility poles damaged by standing water, the surge of water from a dam failure event, or the effects of coastal erosion. Loss of these utilities could create additional isolation issues for the inundation zones (refer to Chapter 6 Dam Failure).

Riverine Flood

Community lifeline exposure to the 1 percent and 0.2 percent annual chance flood hazard event boundary was examined. Table 9-24 and Table 9-25 summarizes the number of community lifelines exposed to the 1 percent and 0.2 percent flood inundation areas by jurisdiction. Of the 393 community lifelines located in the 1 percent annual chance flood event boundary, Transportation has the majority of facilities (111). Out of the 461 community lifelines located in the 0.2 percent annual chance flood event boundary, Transportation has the majority of facilities (127).

Table 9-24. Number of Facilities in the 1 Percent Annual Chance Flood Hazard Area, by Lifeline Category

Jurisdiction	Number of Facilities in the 1 Percent Annual Chance Flood Hazard Area, by Lifeline Category									Total Facilities in Hazard Area	
	Communications	Energy	Food, Hydration, Shelter	Hazardous Materials	Health & Medical	Safety & Security	Transportation	Water Systems	Other Critical Facilities	Count	% of Jurisdiction Total
Bayonne (C)	0	6	0	3	0	3	6	8	2	28	24.1%
East Newark (B)	0	0	0	0	0	0	1	0	0	1	11.1%
Guttenberg (T)	0	0	0	0	0	0	0	0	0	0	0.0%
Harrison (T)	1	2	0	1	0	1	0	1	1	7	15.6%
Hoboken (C)	1	3	23	5	7	19	12	4	30	104	74.3%
Jersey City (C)	1	15	4	19	3	27	50	7	11	137	31.6%
Kearny (T)	3	10	0	7	0	5	20	6	0	51	47.7%
North Bergen (T)	0	3	0	1	2	0	5	5	2	18	18.0%
Secaucus (T)	3	1	1	2	3	4	9	4	5	32	38.1%
Union City (C)	0	0	0	0	0	0	1	0	0	1	1.1%
Weehawken (T)	0	0	1	0	0	1	7	2	2	13	28.3%
West New York (T)	0	0	0	0	0	0	0	1	0	1	2.1%
Hudson County (Total)	**9**	**40**	**29**	**38**	**15**	**60**	**111**	**38**	**53**	**393**	**31.7%**

Source: Hudson County 2024; HIFLD 2024; NJGIN 2024; FEMA 2015, 2018

Table 9-25. Number of Facilities in the 0.2 Percent Annual Chance Flood Hazard Area, by Lifeline

Jurisdiction	Number of Facilities in the 0.2 Percent Annual Chance Flood Hazard Area, by Lifeline Category									Total Facilities in Hazard Area	
	Communications	Energy	Food, Hydration, Shelter	Hazardous Materials	Health & Medical	Safety & Security	Transportation	Water Systems	Other Critical Facilities	Count	% of Jurisdiction Total
Bayonne (C)	0	9	0	3	0	3	11	8	3	37	31.9%
East Newark (B)	0	0	0	0	0	0	1	0	0	1	11.1%
Guttenberg (T)	0	0	0	0	0	0	0	0	0	0	0.0%
Harrison (T)	1	2	0	2	0	1	0	1	1	8	17.8%
Hoboken (C)	1	3	25	5	7	23	12	4	38	118	84.3%
Jersey City (C)	1	15	4	19	3	32	58	12	25	169	38.9%
Kearny (T)	3	10	0	7	0	5	20	7	0	52	48.6%
North Bergen (T)	0	3	0	1	2	0	7	10	2	25	25.0%
Secaucus (T)	3	1	1	2	4	4	9	4	6	34	40.5%
Union City (C)	0	0	0	0	0	0	1	0	0	1	1.1%
Weehawken (T)	0	0	1	0	0	1	8	3	2	15	32.6%
West New York (T)	0	0	0	0	0	0	0	1	0	1	2.1%
Hudson County (Total)	**9**	**43**	**31**	**39**	**16**	**69**	**127**	**50**	**77**	**461**	**37.2%**

Source: Hudson County 2024; HIFLD 2024; NJGIN 2024; FEMA 2015, 2018

COASTAL EROSION

Table 9-26 summarizes the number of community lifelines exposed to the coastal erosion hazard area by jurisdiction. Of the 44 community lifelines located in this hazard area, Transportation has the majority of facilities (36).

SEA LEVEL RISE

Table 9-27 and Table 9-28 summarizes the number of community lifelines exposed to the 1- and 3-foot sea level rise hazard areas by jurisdiction. Of the 29 community lifelines located in the 1-foot hazard area, Transportation has the majority of facilities (22). Out of the 44 community lifelines located in the 3-foot hazard area, Transportation has the majority of facilities (32).

9.2.4 Economy

Flood events can significantly impact the local and regional economy. This includes but is not limited to general building stock damages and associated tax loss, impacts to utilities and infrastructure, business interruption, impacts on tourism, and impacts on the tax base to Hudson County. In areas that are directly flooded, renovations of commercial and industrial buildings may be necessary, disrupting associated services. Refer to the 'Impact on Buildings' subsection earlier which discusses direct impacts to buildings in Hudson County. Other economic components such as loss of facility use, functional downtime and socio-economic factors are less measurable with a high degree of certainty.

Flooding can cause extensive damage to public utilities and disruptions to delivery of services. Loss of power and communication may occur, and drinking water and wastewater treatment facilities may be temporarily out of operation.

Debris management may also be a large expense after a flood event. HAZUS-MH estimates the amount of debris generated from the 1 percent annual chance event. The model breaks down debris into three categories: (1) finishes (dry wall, insulation, etc.); (2) structural (wood, brick, etc.) and (3) foundations (concrete slab and block, rebar, etc.). The distinction is made because of the different types of equipment needed to handle the debris. Table 9-29 summarizes the debris Hazus version 6.1 estimates for these events. As a result of the 1 percent annual chance event, Hazus v6.1 estimates approximately 69,255 tons of debris will be generated in total.

9.2.5 Natural, Historic and Cultural Resources

NATURAL

The environmental impacts of a flood can include significant water quality and debris-disposal issues. Floodwaters can back up sanitary sewer systems and inundate wastewater treatment plants, causing raw sewage to contaminate the flooded waterway. The contents of unsecured containers of oil, fertilizers, pesticides, and other chemicals get added to floodwaters. Hazardous materials may be released and distributed widely across the floodplain. After floodwaters subside, contaminated and flood-damaged building materials and contents must be properly disposed of. Contaminated sediment must be removed from buildings, yards, and properties. In addition, severe erosion caused by flooding can negatively impact local ecosystems. The erosion of sediment can deteriorate riverbanks, causing additional flooding into locations that may not otherwise have experienced flooding conditions.

Table 9-26. Number of Facilities in the Coastal Erosion Hazard Area, by Lifeline

Jurisdiction	Number of Facilities in Coastal Erosion Hazard Area, by Lifeline Category									Total Facilities in Hazard Area	
	Communications	Energy	Food, Hydration, Shelter	Hazardous Materials	Health & Medical	Safety & Security	Transportation	Water Systems	Other Critical Facilities	Count	% of Jurisdiction Total
Bayonne (C)	0	1	0	0	0	0	4	1	0	6	5.2%
East Newark (B)	0	0	0	0	0	0	1	0	0	1	11.1%
Guttenberg (T)	0	0	0	0	0	0	0	0	0	0	0.0%
Harrison (T)	0	0	0	0	0	0	0	1	0	1	2.2%
Hoboken (C)	0	0	0	0	0	0	7	0	1	8	5.7%
Jersey City (C)	0	0	0	0	0	0	10	1	0	11	2.5%
Kearny (T)	0	0	0	0	0	0	8	0	0	8	7.5%
North Bergen (T)	0	0	0	0	0	0	1	0	0	1	1.0%
Secaucus (T)	0	1	0	0	0	0	2	1	0	4	4.8%
Union City (C)	0	0	0	0	0	0	0	0	0	0	0.0%
Weehawken (T)	0	0	0	0	0	0	3	0	1	4	8.7%
West New York (T)	0	0	0	0	0	0	0	0	0	0	0.0%
Hudson County (Total)	**0**	**2**	**0**	**0**	**0**	**0**	**36**	**4**	**2**	**44**	**3.6%**

Source: Hudson County 2024; HIFLD 2024; NJGIN 2024; NJDEP 2015

Table 9-27. Number of Facilities in the 1-Foot Sea Level Rise Hazard Area, by Lifeline

Jurisdiction	Number of Facilities in 1ft Sea Level Rise Hazard Area, by Lifeline Category									Total Facilities in Hazard Area	
	Communications	Energy	Food, Hydration, Shelter	Hazardous Materials	Health & Medical	Safety & Security	Transportation	Water Systems	Other Critical Facilities	Count	% of Jurisdiction Total
Bayonne (C)	0	0	0	0	0	0	2	0	0	2	1.7%
East Newark (B)	0	0	0	0	0	0	1	0	0	1	11.1%
Guttenberg (T)	0	0	0	0	0	0	0	0	0	0	0.0%
Harrison (T)	0	0	0	0	0	0	0	0	0	0	0.0%
Hoboken (C)	0	0	0	0	0	0	3	0	0	3	2.1%
Jersey City (C)	0	0	0	0	0	0	5	0	0	5	1.2%
Kearny (T)	3	0	0	0	0	0	6	0	0	9	8.4%
North Bergen (T)	0	0	0	0	0	0	1	0	0	1	1.0%
Secaucus (T)	2	0	0	2	0	0	2	0	0	6	7.1%
Union City (C)	0	0	0	0	0	0	0	0	0	0	0.0%
Weehawken (T)	0	0	0	0	0	0	2	0	0	2	4.3%
West New York (T)	0	0	0	0	0	0	0	0	0	0	0.0%
Hudson County (Total)	**5**	**0**	**0**	**2**	**0**	**0**	**22**	**0**	**0**	**29**	**2.3%**

Source: Hudson County 2024; HIFLD 2024; NJGIN 2024; NOAA 2022

Table 9-28. Number of Facilities in the 3-Foot Sea Level Rise Hazard Area, by Lifeline

Jurisdiction	Number of Facilities in 3ft Sea Level Rise Hazard Area, by Lifeline Category									Total Facilities in Hazard Area	
	Communications	Energy	Food, Hydration, Shelter	Hazardous Materials	Health & Medical	Safety & Security	Transportation	Water Systems	Other Critical Facilities	Count	% of Jurisdiction Total
Bayonne (C)	0	0	0	0	0	0	2	0	0	2	1.7%
East Newark (B)	0	0	0	0	0	0	1	0	0	1	11.1%
Guttenberg (T)	0	0	0	0	0	0	0	0	0	0	0.0%
Harrison (T)	0	0	0	0	0	0	0	0	0	0	0.0%
Hoboken (C)	0	0	0	0	0	0	3	0	0	3	2.1%
Jersey City (C)	0	1	0	0	0	0	8	0	0	9	2.1%
Kearny (T)	3	1	0	0	0	0	10	3	0	17	15.9%
North Bergen (T)	0	0	0	0	0	0	3	0	0	3	3.0%
Secaucus (T)	2	0	0	2	0	0	3	0	0	7	8.3%
Union City (C)	0	0	0	0	0	0	0	0	0	0	0.0%
Weehawken (T)	0	0	0	0	0	0	2	0	0	2	4.3%
West New York (T)	0	0	0	0	0	0	0	0	0	0	0.0%
Hudson County (Total)	**5**	**2**	**0**	**2**	**0**	**0**	**32**	**3**	**0**	**44**	**3.6%**

Source: Hudson County 2024; HIFLD 2024; NJGIN 2024; NOAA 2022

Table 9-29. Estimated Debris Generated from the 1 Percent Annual Chance Flood Event

Jurisdiction	1 Percent Annual Chance Flood Event			
	Total (tons)	Finish (tons)	Structure (tons)	Foundation (tons)
Bayonne (C)	3,153	2,309	511	333
East Newark (B)	0	0	0	0
Guttenberg (T)	329	298	18	13
Harrison (T)	186	148	26	12
Hoboken (C)	30,127	25,058	3,196	1,873
Jersey City (C)	12,194	10,576	1,186	432
Kearny (T)	522	512	5	4
North Bergen (T)	2,518	1,797	468	254
Secaucus (T)	1,143	960	112	71
Union City (C)	3	3	0	0
Weehawken (T)	18,098	4,168	10,461	3,470
West New York (T)	982	795	108	79
Hudson County (Total)	**69,255**	**46,623**	**16,090**	**6,542**

Source: Hazus v6.1; NJOIT 2024; Microsoft BING 2019; RS Means 2024; FEMA 2015, 2018; Tetra Tech 2020

HISTORIC

Historic places, community facilities, and religious institutions are all vulnerable to impacts from flooding. Historic buildings face structural damage during flooding events. Restoration of flood-damaged historic buildings that are subject to landmark laws can pose significant challenges. These laws often require adherence to strict preservation standards, which can complicate and prolong the recovery process.

CULTURAL

Cultural resources, such as community facilities and religious institutions, face significant risks of damage because they are not easily replaceable. These facilities often serve multiple functions, acting as communal spaces for different groups, which makes their loss particularly impactful. Flood events can lead to closures of these vital community spaces.

Parks and recreational areas, although often designed with flooding in mind, are also vulnerable. Flood events can lead to closures of parks, recreation areas, and community spaces, disrupting residents' lives and hindering access to critical community services.

9.3 Future Changes That May Affect Risk

Understanding future changes that affect vulnerability can assist in planning for future development and ensure establishment of appropriate mitigation, planning, and preparedness measures. The following sections examine potential conditions that may affect hazard vulnerability.

9.3.1 Potential or Planned Development

As Hudson County communities grow, flood events may increase in frequency and severity due to land use changes, the construction of more structures, and the expansion of impervious surfaces. Specific areas of recent and new development are indicated in the jurisdictional annexes in Volume II of this plan. The ability of new development to withstand flooding impacts can be enhanced through land use practices and consistent enforcement of codes and regulations for new construction. New development changes the landscape, where buildings, roads, and other infrastructure replace open land and vegetation. This transformation of pervious surfaces (including vegetation) to impervious surfaces increases runoff and the potential for flooding. Proper planning and implementation of green infrastructure can help mitigate these effects by promoting natural water absorption and reducing the risk of flood events.

9.3.2 Projected Changes in Population

If population growth occurs outside the SFHA, risk exposure remains the same. However, if it grows within the SFHA, risk exposure increases. Any changes in the density of population can create issues for local residents during evacuation of a flood event.

The New Jersey Department of Labor and Workforce Development produced populations projections by County from 2014 to 2019, 2024, 2029, and 2034. According to these projections, Hudson County is projected to have an increase in population in the upcoming years. These projection totals include a population of 747,400 by 2029, and 766,500 by 2034 (State of New Jersey 2017).

9.3.3 Climate Change

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

9.3.4 Other Identified Conditions

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