Flooding and Erosion Basics

Long Island is truly an island, surrounded by seawater. Its shorelines are continually impacted by the movement of sand by both wind and waves. The processes that Long Island's shorelines are experiencing are, of course, natural; however, when they impinge on our buildings, roads, and other infrastructure, people and places are put at risk. In order to prepare for, and adapt to, coastal risks, we all need to understand and assess the physical forces and how they are affecting coastal features.

Flooding and erosion are ubiquitous along Long Island's shorelines. Their impacts can be the result of one of many forces, or can be a compounded issue. The following describes the causes of flooding and erosion so that shoreline managers can understand the impacts and choose an appropriate mitigation strategy.

Flooded parking lot in Northport, NY.
Credit: Trustee Dave Weber via MyCoast NY

CAUSES OF COASTAL FLOODING ON LONG ISLAND

Coastal flooding occurs when low-lying land is submerged by seawater.

Tidal

Long Island experiences two high tides and two low tides within a 24-hour period. Tides occur as a result of the gravitational pull of both the sun and the moon on the Earth. When the sun, moon, and Earth are aligned, the pull is the strongest and results in extreme tidal ranges including higher-than-normal high tides and lower-than-normal low tides. Shorelines are more likely to experience tidal flooding during spring tides, which align with the occurrences of new and full moons, or twice every month.

Storm surge

Long Island is impacted by both East Coast Winter Storms (nor'easters) and tropical systems (hurricanes), which both bring storm surges to the shorelines. These low-pressure system storms produce an abnormal rise in water levels that is pushed towards the shore by strong winds. As the storm interacts with the shoreline, the surge moves onshore, resulting in flooding.

Sea level rise

Sea levels around Long Island have been rising since the end of the last Ice Age; however, since the Industrial Revolution, sea levels have been rising at an accelerated pace. Global sea level rise is predominantly a result of land-based ice melt entering the oceans and the thermal expansion of seawater as it warms. Other factors can contribute to the local rate of sea level rise, such as land subsidence or groundwater pumping. Due to sea level rise, Long Island is experiencing more flooding during normal high tides, unrelated to storm events; this chronic flooding is expected to become more common and get worse as sea levels continue to rise.

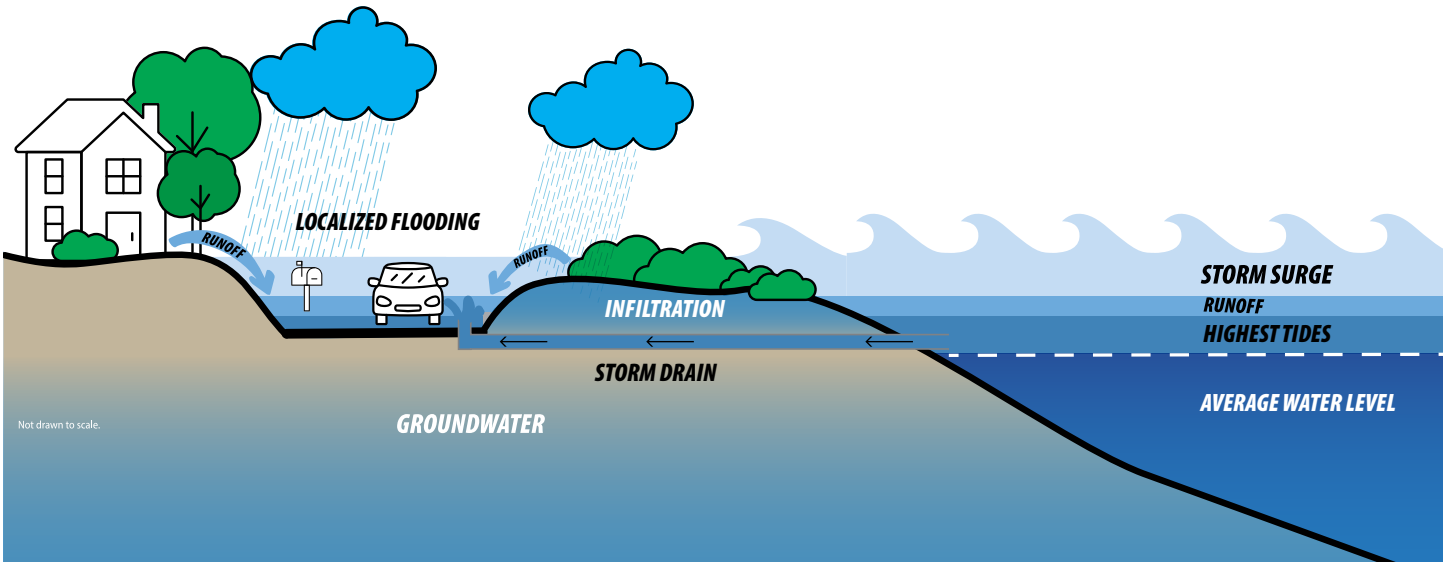
STORMWATER FLOODING ON LONG ISLAND

Stormwater runoff occurs when precipitation runs off lawns, streets, and other land surfaces.

Stormwater infiltrates the ground through soil; however, the large quantity of impervious surfaces such as roads, homes, and parking lots prevents this process and can lead to increased flooding. As stormwater moves along the ground it conveys a variety of trash and pollutants to the local waterbodies. This can exacerbate marine debris and increase nutrient levels that decrease groundwater/surface water quality. Communities have used a variety of engineered systems to manage stormwater in the past, as a result of climate change impacts such as extreme weather events and sea level rise, local conveyance systems are increasingly becoming overwhelmed. Some considerations for adapting to stormwater issues include upgrading infrastructure and installing check valves to reduce back flow from high tides, conserving existing floodplains, and implementing natural landscaping or permeable pavement options.

COMPOUND FLOODING

Flooding can be much worse if two or more causes occur together. When this happens the impacts are compounded. For example, Superstorm Sandy in 2012 brought a significant storm surge to Long Island but because peak surge coincided with high tide, the impacts were greater. Other considerations that may compound flood impacts include sea level rise, rainfall, groundwater elevation, and soil saturation.



Compound Flooding: In this example, high tides, runoff, and storm surge combine and compound to increase localized flooding; other factors can amplify these main drivers. This high tide backflow can happen without rain, which is called nuisance flood events. Impervious surface leads to increased runoff. High groundwater levels can reduce infiltration. Sea level rise is increasing the average water level over time, and climate change is contributing to more frequent and intense storms. Compound flooding is unique in each community based on elevation, development, infrastructure, and weather conditions.

CAUSES OF EROSION ON LONG ISLAND

Erosion is defined as the removal of beach, dune, and/or bluff sediments (i.e., clays, sand, rocks) by the physical forces of wave action, tides, currents, precipitation, wind, or a combination of these.

Sediment transport

Waves, wind, and currents will move sand both along and across the shoreline. This occurs naturally due to seasonal changes in wave energy and/or storms, typically the shoreline returns to its original width. However, on occasion, more sand is removed from an area than is supplied and the imbalance results in erosion. Sometimes this process reverses naturally and sand is accreted in the area; however, more likely, a significant erosion problem exists which can be mediated by mechanical beach nourishment. This erosion control method is a temporary fix and will likely need to be repeated on a regular basis.

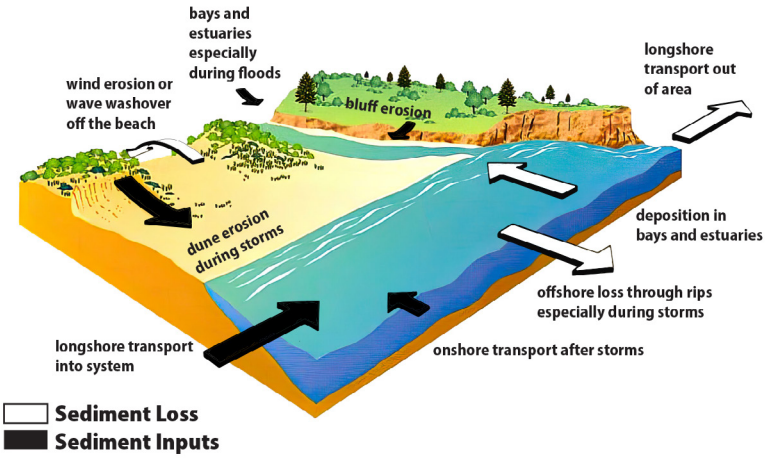
Note: structures placed along the shoreline, such as groins or bulkheads, can alter natural sediment transport, resulting in erosion in areas.

Waves

Large storm events can result in an increase in wave energy impacting the shoreline. Larger storm waves, typically on top of storm surge, can reach further inland and result in significant erosion in a shorter period of time. These waves may cover the dry beach and reach the dunes, as they find low areas, or are strong enough, waves can move over the dune line resulting in overwash. If this occurs on a barrier island, it can result in a breach, when the ocean meets the back bay. Often the eroded sediment from the shoreline may return from the offshore bar; however, some sand may have been moved so far offshore that it is permanently removed from the system.

Groundwater

An increase in the saturation of soil, caused by rainfall, flooding, or our own irrigation systems, results in "slumping", making these sites more susceptible to erosion of coastal features, such as bluffs.



Sediment Movement on Long Island: Different factors, like those shown in the graphic, have an influence on how sediment moves; this can result in sediment losses or inputs. If the amount of sediment lost is greater than input into a system, erosion will occur.

Woody debris from an eroded shoreline on Fire Island, NY.
Credit: Kathleen Fallon

WHAT YOU CAN DO

Dealing with coastal flooding and erosion can be overwhelming, however many resources exist to assist you when preparing for and mitigating coastal hazards. The local National Weather Service Forecast Office issues flooding and coastal storm advisories and municipal emergency managers can assist with plans, preparations, and recovery.

RESOURCES

NOAA Tides & Currents: https://tidesandcurrents.noaa.gov/tide_predictions.html?gid=1407

NHC Storm Surge Risk Maps:
https://experience.arcgis.com/experience/203f772571cb48b1b8b50fdcc3272e2c

NOAA Sea Level Rise Viewer: https://coast.noaa.gov/slr/

NOAA's Understanding Stormwater Inundation: https://coast.noaa.gov/stormwater-floods/understand/

NYSG's An Introduction to Erosion:
https://seagrant.sunysb.edu/cprocesses/pdfs/CoastalErosionOnLI-0318.pdf

NWS NY: https://www.weather.gov/okx/

NOTES

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