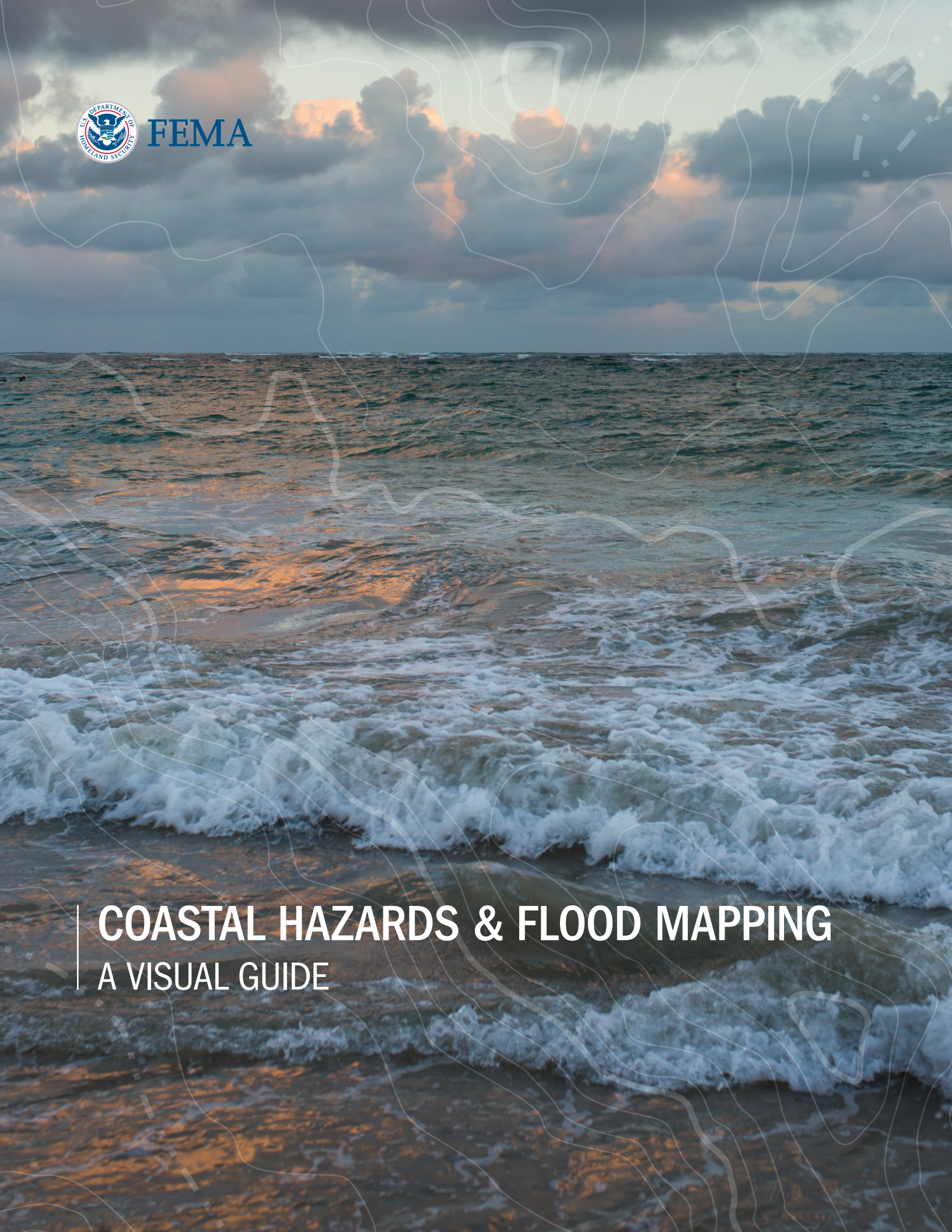


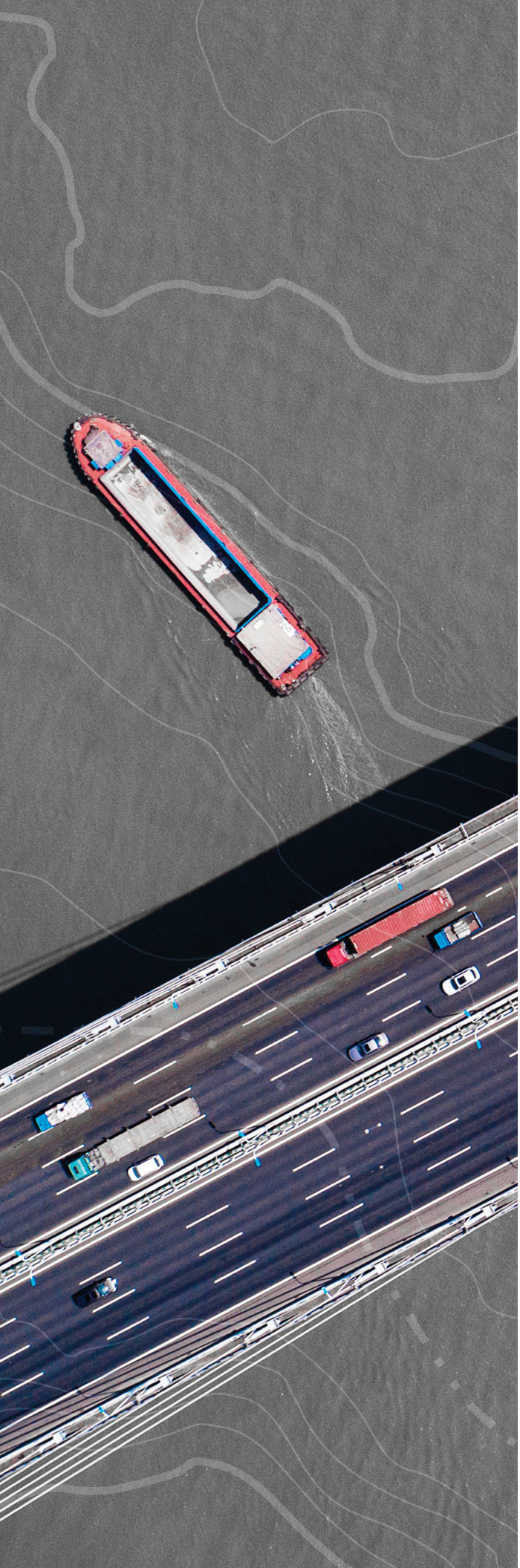
FEMA

COASTAL HAZARDS & FLOOD MAPPING

A VISUAL GUIDE

Coastal communities are special places and home to important resources. But what makes them so distinctive is also what makes them at high risk for floods. Floods are the nation's costliest natural disasters, and coastal communities face many flood risks. These include storm surges, powerful waves, and erosion — all of which can cause extensive damage to homes, businesses, and public spaces.

When a coastal storm approaches, community leaders and members of the media may use technical terms to describe storm-related risks. This visual guide explains these terms and how they relate to information shown on flood maps.



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UNDERSTANDING COASTAL HAZARDS & RISKS

Rising and falling water levels, breaking waves, and shifting sands are common to life along the coast. Typically, these are not concerning — in fact, they are part of what makes coastal living attractive. Tides come in and out daily, waves occur almost nonstop, and shorelines change gradually over time.

These normal coastal features become hazardous when they strengthen in intensity — usually during a storm event — and pose an immediate threat to the lives and livelihoods of coastal populations. The following are commonly used terms to describe these hazards.

Inundation

Flooding; in other words, water covering normally dry land.

Coastal Flooding

Coastal floods come from sources such as the Atlantic and Pacific Oceans, the Gulf of Mexico and large lakes (such as the Great Lakes), bays, and tidal rivers that are big enough to have large waves or that can be affected by storm surge. Coastal floods can be very dangerous when high waters are combined with the destructive forces of waves. In low-lying coastal areas, storm surge and flooding can reach many miles from the shoreline, flowing up rivers and across flat land.

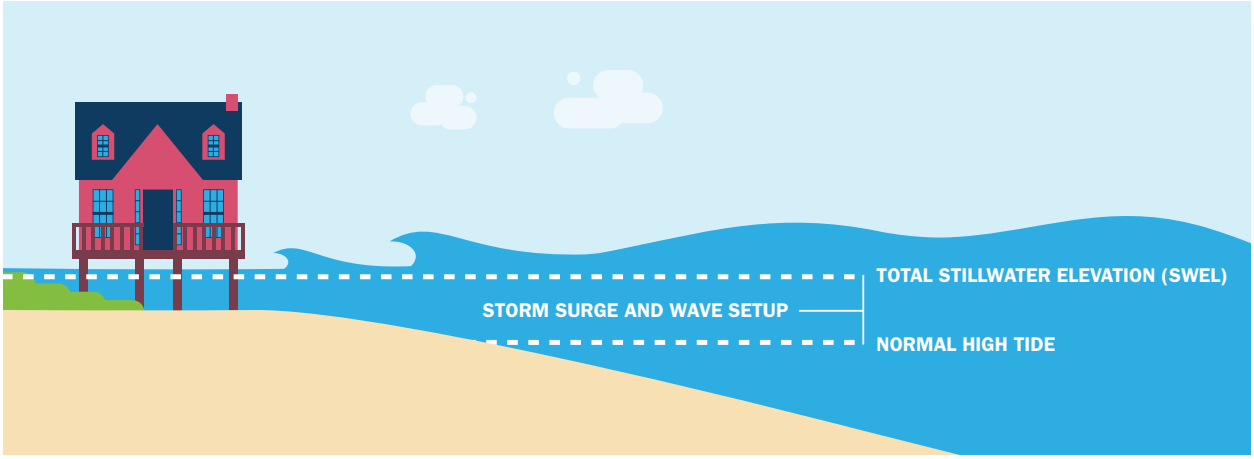
Stillwater Elevation

The elevated water level at the coast is a major component of coastal flooding. Elevated water levels allow floodwaters and waves to travel further inland than they would otherwise. In the context of FEMA coastal flood studies, the elevated water level observed during a flood event is usually called the stillwater elevation.

The stillwater elevation tells us how high floodwaters could rise during a flood event due to storm surge, tides, wave setup, or other factors that cause water levels to increase, such as seasonal effects. The higher the stillwater elevation, the farther inland the impacts of flooding will be felt. The stillwater elevation does not include the additional height of waves that ride on top of the water's surface.

Wave Setup

Wave setup is a process in which waves breaking at the coastline push water out and up in front of them, causing the water level to increase on the coast. Because wave setup increases the water level, the combination of wave setup on top of storm surge is called the total stillwater elevation.



Storm Surge

When a storm approaches the coast, strong winds push water towards land and cause a rise in the water level. This is called storm surge. Storm surge can cause major coastal and inland flooding. The amount of storm surge in an area depends on many things, including the size and strength of the approaching storm, where it is going and how fast it is moving, and the shape of the coastline. Because of this, the same storm can cause different levels of storm surge along the same coastline. Storm surge can be incredibly dangerous because water levels may rise very fast, even before a storm makes landfall.

Storm Tide

Storm tide is the combination of storm surge and the astronomical tide. A storm that approaches the coast during high tide results in a higher storm tide and more flooding. Note that FEMA coastal flood studies do not typically use this term. Storm tide is more commonly used by weather forecasters to describe how high the water may get during a storm.

Wave Hazards

Wave hazards are important in coastal flooding. Waves are generated when wind blows across water. The size of waves depends on the speed of the wind and the length of time and distance over which it blows. During a storm, wind speeds tend to be higher and last longer, creating larger, more powerful waves. When these energy-packed waves crash against the coast, they can cause a lot of damage to anything in their way.

How wave hazards affect the coast during a flood depends on the features of the coastline and how the land is developed. Waves behave differently along low-lying shorelines than they do along coastlines edged by cliffs or high bluffs.

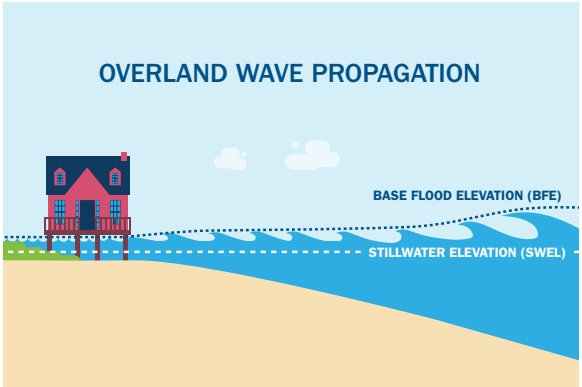
RUNUP AND OVERTOPPING

In areas with higher ground and steeper shorelines, waves break at the shoreline and water washes up the face of the beach, dune, bluff, or structure that it meets. This uprush of water is called wave runup. Wave overtopping occurs when wave runup reaches the top of the dune or bluff and flows or splashes over into the area behind. Because of these actions, even properties located on relatively high ground or behind structures such as seawalls may be at risk of flooding.

OVERLAND WAVE PROPAGATION

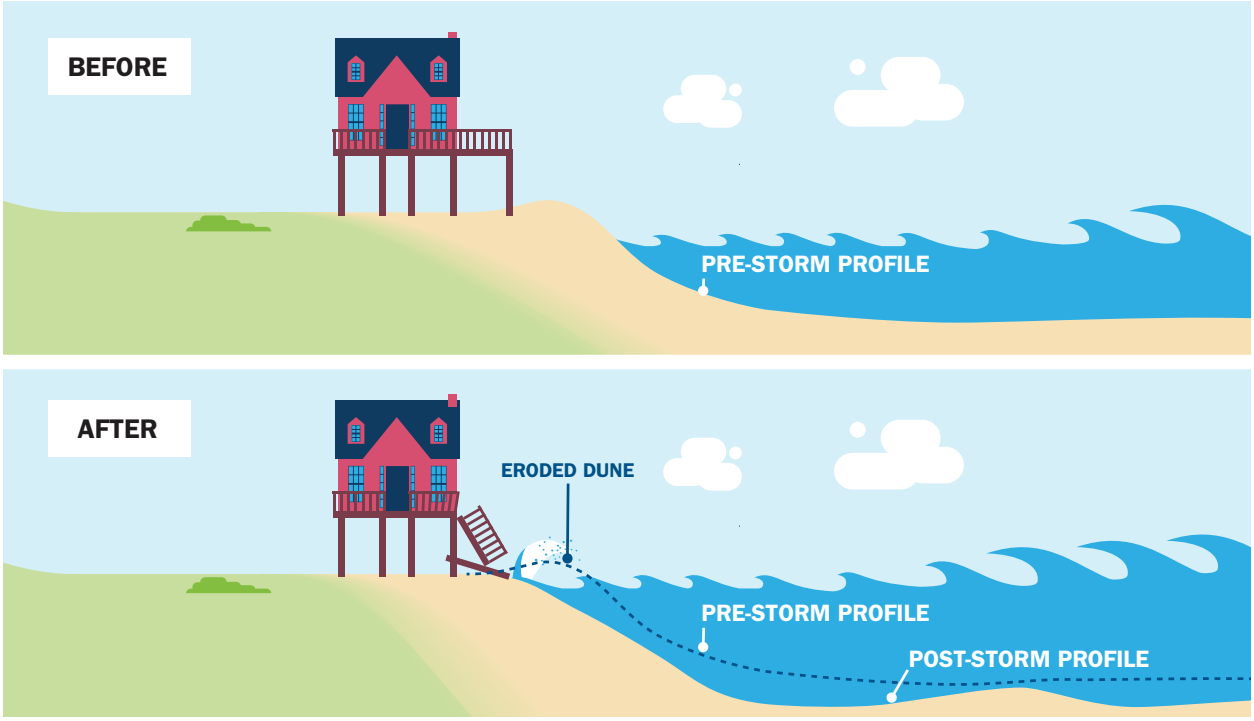
Overland Wave Propagation (or, how waves move over land) — Along low-lying coasts, land that is typically dry may be covered by water during a storm event. Waves move across the surface of the water in a process called overland wave propagation.

As waves move across the land, features such as high ground, trees, and buildings cause waves to get smaller. If waves cross into open space, like a pond or a golf course, strong winds may cause them to grow larger. The larger the wave, the greater the potential for damage to a structure or shoreline.



Erosion

On coasts, erosion refers to the wearing away of beaches, dunes, or bluffs by the forces of waves, flowing water, and/or winds. During storm events, a lot of erosion can happen in a short time, causing stark changes to the coastline. Erosion cuts into dunes and bluffs, causing roads and buildings built upon them to collapse. Smaller dunes may be completely washed away, allowing water and waves to flow inland and flood the areas behind them.



Sea Level Rise

An increase in sea level caused by a change in the volume of the world's oceans and changes in local ground elevations. Sea level rise leads to increased frequency and depth of flooding in coastal areas.

Tsunami

A series of enormous ocean waves, caused by underwater earthquakes or landslides, that send surges of water onto land. A tsunami can start locally or can travel hundreds of miles over the open ocean to cause extensive damage when it encounters land. A tsunami can come ashore like a wall of water and affect an area with multiple waves over many hours. The second or third wave is often stronger and deeper than the first. States work with FEMA and other federal agencies to help coastal communities understand their tsunami risk.

COASTAL FLOOD MAPS: KEY TERMS & DEFINITIONS

To help communities better understand their flood risks, FEMA provides communities with Flood Insurance Rate Maps (FIRMs), also known as flood maps. Flood maps show the Special Flood Hazard Area (SFHA) — the area that would be affected by a 1-percent-annual-chance flood (or base flood). Properties within the SFHA are at a high risk of flooding, with at least a 26-percent chance of flooding over the course of a 30-year mortgage.

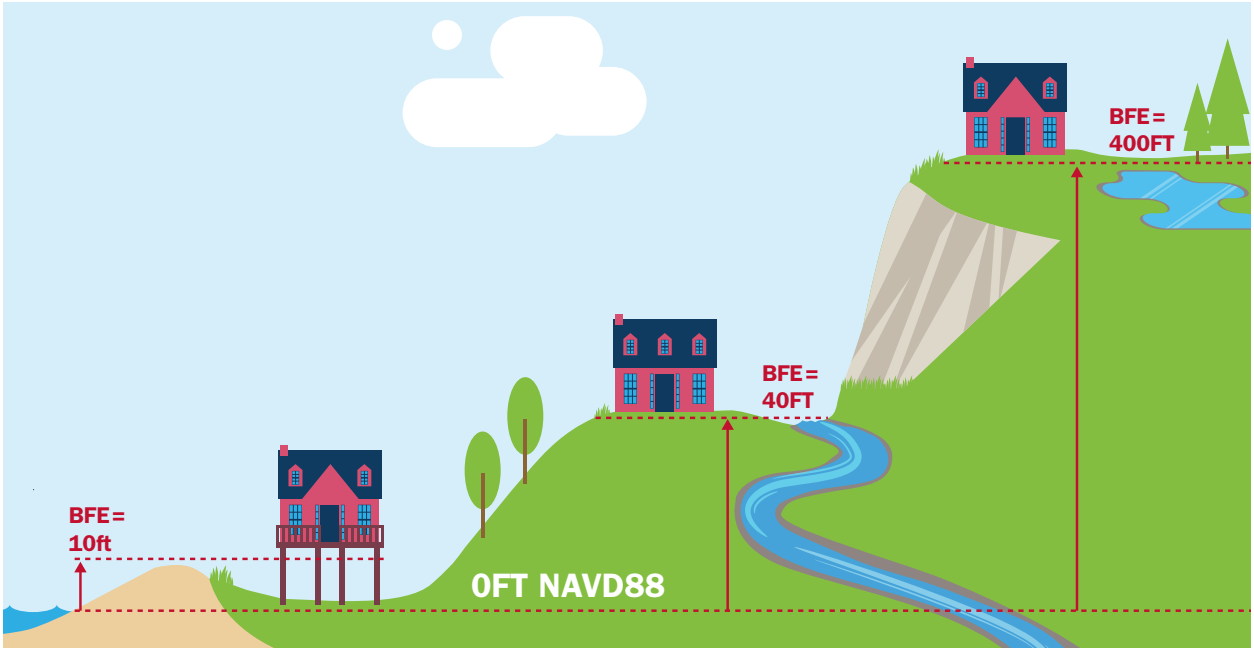
Flood maps for coastal regions include a number of common terms and definitions that are important for better understanding your risk. The most common terms are listed below.

Base Flood

A flood that has a 1-percent chance of occurring during any given year. The area at risk from the base flood is called the SFHA. Properties within the SFHA are at a high risk of flooding, with at least a 26-percent chance of flooding over the course of a 30-year mortgage.

Base Flood Elevation

The Base Flood Elevation (BFE) is how high floodwater is likely to rise during a 1-percent-annual-chance flood event. BFEs are measured from a reference point called NAVD88, which is approximately equal to sea level, and vary widely across geographies.



Coastal Zones

COASTAL SPECIAL FLOOD HAZARD AREA (COASTAL SFHA)

The portion of the SFHA where the base flood is from a coastal flooding source. On the FIRM, the coastal SFHA is designated by Zones VE (which are unique to coastal areas), AE, and AO. SFHAs typically have multiple BFEs that vary along the coast and change as you move inland.

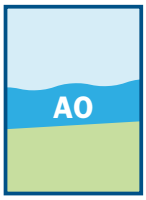
COASTAL HIGH HAZARD AREA (CHHA)

A Coastal High Hazard Area (CHHA) is identified as Zone V or Zone VE on FEMA flood maps. These parts of the coastal SFHA are called “V zones” and they show areas where waves and fast-moving water can cause extensive damage during the base flood event. In V zones, wave heights are larger than 3 feet. “Zone VE” means that a detailed study has been done for the area, and BFEs have been calculated. The label “Zone V” means that a detailed study has not been done for the area. BFE data is not available, but wave hazards are still expected.

Structures in areas mapped as Zone V and Zone VE are subject to stricter building requirements because of the higher risk of damage from strong waves.

ZONE AE

Zone AE is used to label parts of the SFHA on flood maps in coastal and non-coastal areas. In coastal areas, AE zones indicate areas that have at least a 1-percent-annual-chance of being flooded and wave heights are less than 3 feet. For Zone AE, detailed analyses have been performed and BFEs have been calculated.

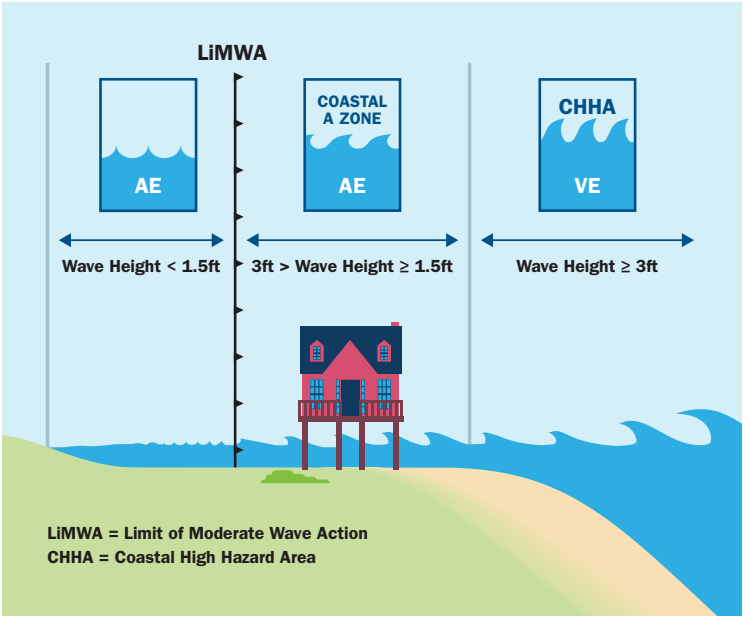


ZONE AO

Zone AO shows areas at risk of flooding during the base flood, where water 1 to 3 feet deep flows over sloping ground. On coastal maps, Zone AO usually marks areas at risk of flooding from wave overtopping, where waves are expected to wash over the crest of a dune or bluff and flow into the area beyond. In AO zones, flood depth is expressed as a height above natural ground. Homes and other buildings in these areas are still vulnerable to flooding from waves, even if they are on higher ground or behind a wall or other structure.

Limit of Moderate Wave Action (LiMWA)

Flood maps in coastal areas may include a line called the Limit of Moderate Wave Action (LiMWA). The LiMWA marks the inland limit of the "Coastal A Zone," a term referenced by building codes and standards. The Coastal A Zone is the part of the coastal SFHA where wave heights can be between 1.5 and 3 feet during the base flood event. Because of the higher risk of damage to homes and other structures from waves in the Coastal A Zone, FEMA encourages the practice of building to Zone V standards within this area. Many local building codes require that buildings in the Coastal A Zone be built to Zone V standards. However, the LiMWA does not impose any additional National Flood Insurance Program (NFIP) regulations.

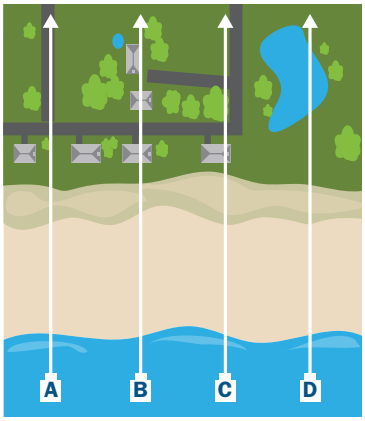


Primary Frontal Dune (PFD)

A Primary Frontal Dune (PFD) is the first line of defense against coastal flooding. The dune is a mound or ridge of sand that generally runs parallel to the shoreline along the back of the beach. PFDs act as a "sacrificial area" by providing a large amount of sand for waves to crash into before the waves reach developed areas and cause damage to buildings and roads. On flood maps, PFDs are mapped as Zone V or VE. FEMA regulations do not allow any man-made changes to the dune that could make coastal floods even more damaging.

Transects

Transects are straight lines that begin out in the water and cut across the land. Transects are strategically placed to represent segments of the coast with similar features. Transects are marked on flood maps and can be used to identify the physical location for the wave hazard analyses. Overland wave modeling shows how waves behave as they move along the transect and interact with land.



FEMA

For more information about how to read and use a FIRM in coastal regions, visit arcg.is/1bD1m8.

For more information about FEMA's Coastal Flood Risk Study Process, visit fema.gov/coastal-flood-risk-study-process.