



**PDHonline Course C420 (4 PDH)**

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# **Coastal Highways – Planning & Design Issues**

*Instructor: John Huang, Ph.D., PE and John Poullain, PE*

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**PDH Online | PDH Center**

5272 Meadow Estates Drive  
Fairfax, VA 22030-6658  
Phone: 703-988-0088  
[www.PDHonline.com](http://www.PDHonline.com)

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## Glossary

**AASHTO:** American Association of State Highway and Transportation Officials

**ACCRETION:** The extension of a beach out into the water by deposition of sand. Accretion is often used to refer to a net seaward movement of the shoreline over a specified time.

**AEOLIAN:** Pertaining to the wind, especially used with deposits of wind-blown sand such as sand dunes.

**ALONGSHORE:** Parallel to and near the shoreline; longshore.

**ARMOR LAYER:** Protective layer on the outside or top of a revetment or seawall composed of armor units.

**ASTRONOMICAL TIDE:** The tidal levels and character which would result from gravitational effects, e.g. of the Earth, Sun, and Moon, without any atmospheric influences.

**ATTENUATION:** A lessening of the height or amplitude of a wave with distance.

**BACKSHORE:** The zone of the shore or beach lying between the foreshore and the coastline comprising the berm or berms and acted upon by waves only during severe storms, especially when combined with exceptionally high water.

**BAR:** A submerged or emerged embankment of sand, gravel, or other unconsolidated material built on the sea floor in shallow water by waves and currents.

**BARRIER ISLAND:** An unconsolidated, elongated body of sand or gravel lying above the high-tide level and separated from the mainland by a lagoon or marsh. It is commonly between two inlets, has dunes, vegetated areas, and swampy terrains extending from the beach into the lagoon.

**BATHYMETRY:** The depths of water in oceans, seas, and lakes.

**BAY:** 1) a body of water almost completely surrounded by land but open to some tidal flow communications with the sea. 2) a recess in the shore or an inlet of a sea between two capes or headlands, not so large as a gulf but larger than a cove.

**BEACH:** The zone of unconsolidated material, typically sand, that extends landward from closure depths where sand is moved by waves to the place where there is marked change in material or physiographic form, or to the line of permanent vegetation (usually the effective limit of storm waves).

**BEACH FILL:** Sand placed on a beach; beach nourishment

**BEACH BERM:** A nearly horizontal part of the beach or backshore formed by the deposit of material by wave action. Some beaches have no berms, others have one or several.

**BEACH EROSION:** The carrying away of beach materials by wave action, tidal currents, littoral currents, or wind.

**BEACH FACE** The section of the beach normally exposed to the action of the wave uprush. The foreshore of a beach. (Not synonymous with shoreface.)

**BEACH NOURISHMENT:** The direct placement of large amounts of good quality sand on the beach to widen the beach.

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**BEACH PROFILE:** A cross-section taken perpendicular to a given beach contour; the profile may include the face of a dune or sea wall; extend over the backshore, across the foreshore, and seaward underwater into the nearshore zone.

**BEACH SCARP:** An almost vertical slope along the beach caused by erosion by wave action. It may vary in height from a few cm to a meter or so, depending on wave action and the nature and composition of the beach.

**BEACH WIDTH:** The horizontal dimension of the beach measured normal from some defined location landward of the shoreline.

**BED FORMS:** Any deviation from a flat bed that is readily detectable by eye and higher than the largest sediment size present in the parent bed material; generated on the bed of an alluvial channel by the flow.

**BENCH MARK:** A permanently fixed point of known elevation. A primary bench mark is one close to a tide station to which the tide staff and tidal datum originally are referenced.

**BERM:** 1) On a beach: a nearly horizontal plateau on the beach face or backshore, formed by the deposition of beach material by wave action or by means of a mechanical plant as part of a beach renourishment scheme. Some natural beaches have no berm, others have several. 2) On a structure: a nearly horizontal area, often built to support or key-in an armor layer.

**BERM BREAKWATER:** Rubble mound structure with horizontal berm of armor stones at about sea level, which is allowed to be (re)shaped by the waves.

**BLUFF:** A high, steep bank or cliff.

**BORE:** A broken wave propagating across the surf zone characterized by turbulent white water.

**BOUNDARY CONDITIONS:** Environmental conditions, e.g. waves, currents, drifts, etc. used as boundary input to physical or numerical models.

**BREACH:** Gap in a barrier island or spit or dune caused by a storm.

**BREAKER:** A wave breaking on a shore, over a reef, etc. Breakers may be classified into four types: collapsing, plunging, spilling, and surging.

**BREAKER ZONE:** The zone within which waves approaching the coastline commence breaking caused by the reduced depths.

**BREAKING:** Reduction in wave energy and height. In the surf zone breaking is due to limited water depth.

**BREAKWATER:** A structure protecting a shore area, harbor, anchorage, or basin from waves.

**BULKHEAD:** A structure or partition to retain or prevent sliding of the land. A secondary purpose is to protect the upland against damage from wave action.

**CANYON:** A relatively narrow, deep depression with steep slopes, the bottom of which grades continuously downward. May be underwater (submarine) or on land (subaerial).

**CAUSEWAY:** A raised road across wet or marshy ground, or across water.

**CAUSTIC:** In refraction of waves, the name given to a region of crossed orthogonals and high wave convergence.

**CELERITY:** Wave speed.

**CERC:** Coastal Engineering Research Center. US Army Corps of Engineers laboratory that was the predecessor for the Coastal Hydraulics Laboratory

**CHANNEL:** 1) A natural or artificial waterway of perceptible extent which either periodically or continuously contains moving water, or which forms a connecting link between two bodies of water. 2) The part of a body of water deep enough to be used for navigation through an area otherwise too shallow for navigation. 3) A large strait, as the English Channel. 4) The deepest part of a stream, bay, or strait through which the main volume or current of water flows.

**CHART:** A special-purpose map, esp. one designed for navigation such as a bathymetric chart.

**CLIFF:** A high, steep face of rock; a precipice.

**CLIMATE:** The characteristic weather of a region, particularly regarding temperature and precipitation, averaged over some significant interval of time (years).

**CLOSURE DEPTH:** The water depth beyond which repetitive profile surveys (collected over several years) do not detect vertical sea bed changes, generally considered the seaward limit of littoral transport. The depth can be determined from repeated cross-shore profile surveys or estimated using formulas based on wave statistics. Note that this does not imply the lack of sediment motion beyond this depth.

**CNOIDAL WAVE:** A type of wave in shallow water (i.e., where the depth of water is less than 1/8 to 1/10 the wavelength).

**COASTAL AREA:** The land and sea area bordering the shoreline.

**COASTAL CURRENTS:** Those currents near the shore that constitutes a relatively uniform velocity. These currents may be tidal currents, transient wind-driven currents, longshore currents driven by breaking waves in the surf zone, or currents associated with the distribution of mass in local waters.

**COASTAL ENGINEERING:** The planning, design, construction and operation of infrastructure in the wave, tide and sand environment that is unique to the coast. A well established specialty area of civil engineering that focuses on the coastal zone and coastal processes.

**COASTAL PROCESSES:** Collective term covering the action of natural forces on the shoreline and nearshore seabed.

**COASTAL ZONE:** The transition zone where the land meets water, the region that is directly influenced by marine and lacustrine hydrodynamic processes. Extends offshore to the continental shelf break and onshore to the first major change in topography above the reach of major storm waves. On barrier coasts, includes the bays and lagoons between the barrier and the mainland.

**COASTLINE:** Commonly, the line that forms the boundary between the land and the water, esp. the water of a sea or ocean.

**COBBLE:** A rock fragment between 64 and 256 mm in diameter, usually rounded. Also called a cobblestone.

**COHESIVE SEDIMENT:** Sediment containing significant proportion of silts or clays, the electromagnetic properties of which cause the sediment to bind together

**COLLAPSING BREAKER:** Breaking occurs over lower half of wave, with minimal air pocket. Bubbles and foam present.

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**CONTEXT-SENSITIVE DESIGN:** A collaborative, interdisciplinary approach that involves all stakeholders to develop a transportation facility that fits its physical setting and preserves scenic, aesthetic, historic, and environmental resources, while maintaining safety and mobility.

**CONTINENTAL SHELF:** 1) The zone bordering a continent extending from the line of permanent immersion to the depth, usually about 100 m to 200 m, where there is a marked or rather steep descent toward the great depths of the ocean. 2) The area under active littoral processes during the Holocene period. 3) The region of the oceanic bottom that extends outward from the shoreline with an average slope of less than 1:100, to a line where the gradient begins to exceed 1:40 (the continental slope).

**CONTOUR:** A line on a map or chart representing points of equal elevation with relation to a datum. Also called depth contour.

**CORIOLIS EFFECT:** Force due to the Earth's rotation, capable of generating currents. It causes moving bodies to be deflected to the right in the Northern Hemisphere and to the left in the Southern Hemisphere. The "force" is proportional to the speed and latitude of the moving object. It is zero at the equator and maximum at the poles.

**CREST OF WAVE:** 1) The highest part of a wave. 2) That part of the wave above still-water level.

**CREST OF BERM:** The highest, typically seaward, part of a berm. Also called berm edge.

**CRITICAL FLOW:** The flow condition where the specific energy of flow is at a minimum and the Froude number for the flow is one; term from open-channel flow hydraulics. Related terms are sub-critical flow and super-critical flow.

**CROSS-SHORE:** Perpendicular to the shoreline.

**CURRENT:** 1) The flowing of water, 2) That portion of a stream of water which is moving with a velocity much greater than the average or in which the progress of the water is principally concentrated. 3) Ocean currents can be classified in a number of different ways. Some important types include the following: A) Periodic - due to the effect of the tides; such Currents may be rotating rather than having a simple back and forth motion. The currents accompanying tides are known as tidal currents; B) Temporary - due to seasonal winds; C) Permanent or ocean - constitute a part of the general ocean circulation. The term drift current is often applied to a slow broad movement of the oceanic water; D) Nearshore - caused principally by waves breaking along a shore.

**CYCLONE:** A system of winds that rotates about a center of low atmospheric pressure. Rotation is clockwise in the Southern Hemisphere and anti-clockwise in the Northern Hemisphere. In the Indian Ocean, the term refers to the powerful storms called hurricanes in the Atlantic.

**DATUM:** Any permanent line, plane, or surface used as a reference datum to which elevations are referred.

**DEEPWATER:** Water so deep that surface waves are little affected by the ocean bottom. Generally, water deeper than one-half the surface wavelength is considered deep water.

**DEEPWATER WAVES:** A wave in water the depth of which is greater than one-half the wavelength.

**DENSITY:** Mass (in kg) per unit of volume of a substance;  $\text{kg/m}^3$ . For pure water, the density is  $1000 \text{ kg/m}^3$ , for seawater the density is usually more. Density increases with increasing salinity, and decreases with increasing temperature. For stone and sand, usually a density of  $2600 \text{ kg/m}^3$  is assumed. Concrete is less dense, in the order of  $2400 \text{ kg/m}^3$ . Some types of basalt may reach  $2800 \text{ kg/m}^3$ . For sand, including the voids, one may use  $1600 \text{ kg/m}^3$ .

**DENSITY-DRIVEN CIRCULATION:** Variations in salinity create variations in density in estuaries. These variations in density create horizontal pressure gradients, which drive estuarine circulation.

**DESIGN STORM:** A hypothetical extreme storm whose wave's coastal protection structures will often be designed to withstand. The severity of the storm (i.e. return period) is chosen in view of the acceptable level of risk of damage or failure. A design storm consists of a design wave condition, a design water level and a duration.

**DESIGN WAVE:** In the design of harbors, harbor works, etc., the type or types of waves selected as having the characteristics against which protection is desired.

**DESIGN WAVE CONDITION:** Usually an extreme wave condition with a specified return period used in the design of coastal works.

**DIFFRACTION:** The phenomenon by which energy is transmitted laterally along a wave crest. When a part of a train of waves is interrupted by a barrier, such as a breakwater, the effect of diffraction is manifested by propagation of waves into the sheltered region within the barrier's geometric shadow.

**DIFFRACTION COEFFICIENT:** Ratio of diffracted wave height to deep water wave height.

**DIURNAL:** Having a period or cycle of approximately one tidal day.

**DIURNAL INEQUALITY:** The difference in height of the two high waters or of the two low waters of each day. Also, the difference in velocity between the two daily flood or ebb currents of each day.

**DIURNAL TIDE:** A tide with one high water and one low water in a tidal day.

**DOWNDRIFT:** The direction of predominant movement of littoral materials.

**DREDGING:** Excavation or displacement of the bottom or shoreline of a water body. Dredging can be accomplished with mechanical or hydraulic machines. Most is done to maintain channel depths or berths for navigational purposes; other dredging is for shellfish harvesting, for cleanup of polluted sediments, and for placement of sand on beaches.

**DRIFT:** 1) Sometimes used as a short form for littoral drift. 2) The speed at which a current runs.

**DUNES:** 1) Ridges or mounds of loose, wind-blown material, usually sand.

**DURATION:** In wave forecasting, the length of time the wind blows in nearly the same direction over the fetch (generating area).

**DYNAMIC EQUILIBRIUM:** Short term morphological changes that do not affect the morphology over a long period.

**EBB:** Period when tide level is falling; often taken to mean the ebb current which occurs during this period.

**EBB TIDAL DELTA:** The bulge of sand formed at the seaward mouth of tidal inlets as a result of interaction between tidal currents and waves. Also called outer bar.

**EBB TIDE:** The period of tide between high water and the succeeding low water; a falling tide.

**EL NIÑO:** Global climatologic phenomenon associated with warm equatorial water which flows southward along the coast of Peru and Ecuador during February and March of certain years. During many El Niño years, storms, rainfall, and other meteorological phenomena in the Western Hemisphere are measurably different than during non-El Niño years.

**EMBAYMENT:** An indentation in the shoreline forming an open bay.

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**EPOCH:** Tidal epoch is about 19 years.

**EROSION:** The wearing away of land by the action of natural forces. On a beach, the carrying away of beach material by wave action, tidal currents, littoral currents, or by deflation.

**ESTUARY:** 1) The region near a river mouth in which the fresh water of the river mixes with the salt water of the sea and which received both fluvial and littoral sediment influx. 2) The part of a river that is affected by tides.

**EUSTATIC SEA LEVEL CHANGE:** Change in the volume of the world's ocean basins and the total amount of ocean water.

**FDEP:** Florida Department of Environmental Protection

**FEMA:** Federal Emergency Management Agency

**FETCH:** The distance or area in which wind blows across the water forming waves. Sometimes used synonymously with fetch length and generating area.

**FETCH-LIMITED:** Situation in which wave energy (or wave height) is limited by the size of the wave generation area (fetch).

**FETCH LENGTH:** The horizontal distance (in the direction of the wind) over which a wind generates seas or creates a wind setup.

**FLOOD:** 1) Period when tide level is rising; often taken to mean the flood current which occurs during this period. 2) A flow beyond the carrying capacity of a channel.

**FLOOD CURRENT:** The tidal current toward shore or up a tidal stream. Usually associated with the increase in the height of the tide.

**FLOOD TIDAL DELTA:** The bulge of sand formed at the landward mouth of tidal inlets as a result of flow expansion.

**FLOOD TIDE:** The period of tide between low water and the succeeding high water; a rising tide.

**FORESHORE:** The part of the shore, lying between the crest of the seaward berm (or upper limit of wave wash at high tide) and the ordinary low-water mark, that is ordinarily traversed by the uprush and backrush of the waves as the tides rise and fall.

**FREEBOARD:** 1) the vertical distance between the water level and the top of a coastal levee or dike. 2) the distance from the waterline to the low-chord of the bottom of a suspended deck such as a bridge deck or offshore platform. or 3) the distance from the crest of the design wave to the low-chord of the bottom of a suspended deck such as a bridge deck or offshore platform.

**FROUDE NUMBER:** The dimensionless ratio of the inertial force to the force of gravity for a given fluid flow. It may be given as  $Fr = V / \sqrt{Lg}$  where  $V$  is a characteristic velocity,  $L$  is a characteristic length, and  $g$  the acceleration of gravity - or as the square root of this number.

**FULLY-ARISEN SEA:** The waves that form when wind blows for a sufficient period of time across the open ocean. The waves of a fully developed sea have the maximum height possible for a given wind speed, fetch and duration of wind.

**GABION:** 1) Steel wire-mesh basket to hold stones or crushed rock to protect a bank or bottom from erosion. 2) Structures composed of masses of rocks, rubble or masonry held tightly together usually by wire mesh so as to form blocks or walls. Sometimes used on heavy erosion areas to retard wave action or as a foundation for breakwaters or jetties.

**GALE:** A wind between a strong breeze and a storm. A continuous wind blowing in degrees of moderate, fresh, strong, or whole gale and varying in velocity from 28 to 47 nautical miles per hour.

**GEOMORPHOLOGY:** 1) That branch of physical geography which deals with the form of the Earth, the general configuration of its surface, the distribution of the land, water, etc. 2) The investigation of the history of geologic changes through the interpretation of topographic forms.

**GEOTEXTILE:** A synthetic fabric which may be woven or non-woven used as a filter.

**GIS:** Geographical Information System

**GLACIER:** A large body of ice moving slowly down a slope of valley or spreading outward on a land surface (e.g., Greenland, Antarctica) and surviving from year to year.

**GLOBAL POSITIONING SYSTEM:** Commonly called GPS. A navigational and positioning system developed by the U.S. Department of Defense, by which the location of a position on or above the Earth can be determined by a special receiver at that point interpreting signals received simultaneously from several of a constellation of special satellites.

**GORGE:** 1) The deepest portion of an inlet, the throat. 2) A narrow, deep valley with nearly vertical rock walls.

**GRAVITY WAVE:** A wave whose velocity of propagation is controlled primarily by gravity. Water waves more than 5 cm long are considered gravity waves. Waves longer than 2.5 cm and shorter than 5 cm are in an indeterminate zone between capillary and gravity waves.

**GROIN:** Narrow, roughly shore-normal structure built to reduce longshore currents, and/or to trap and retain littoral material. Most groins are of timber or rock and extend from a seawall, or the backshore, well onto the foreshore and rarely even further offshore.

**GULF:** 1) A relatively large portion of the ocean or sea extending far into land; the largest of various forms of inlets of the sea. 2) The Gulf of Mexico.

**HEADLAND:** A promontory extending out into a body of water

**HEADLAND BREAKWATER:** A rock breakwater constructed to function as a headland by retaining an adjacent sandy pocket beach.

**HIGH TIDE:** The maximum elevation reached by each rising tide.

**HIGH WATER:** Maximum height reached by a rising tide. The height may be solely due to the periodic tidal forces or it may have superimposed upon it the effects of prevailing meteorological conditions. Nontechnically, also called the high tide.

**HIGHER HIGH WATER:** The higher of the two high waters of any tidal day. The single high water occurring daily during periods when the tide is diurnal is considered to be a higher high water.

**HINDCASTING:** In wave prediction, the retrospective forecasting of waves using measured wind information.

**HOLOCENE:** An epoch of the quaternary period, from the end of the Pleistocene, about 12,000 to 20,000 years ago, to the present time. This is the geologic time period of the most recent rise in eustatic sea level in response to global warming.

**HURRICANE:** An intense tropical cyclone in which winds tend to spiral inward toward a core of low pressure, with maximum surface wind velocities that equal or exceed 33.5 m/sec (75 mph or 65 knots) for several minutes or longer at some points. Tropical storm is the term applied if



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maximum winds are less than 33.5 m/sec but greater than a whole gale (63 mph or 55 knots). Term is used in the Atlantic, Gulf of Mexico, and eastern Pacific.

**HYDROGRAPH:** 1) The graph of the variation of SWL with time. 2) the graph of discharge with time.

**ICE AGE:** A loosely-used synonym of glacial epoch, or time of extensive glacial activity; specifically of the latest period of widespread continental glaciers, the Pleistocene Epoch.

**INLET:** 1) A short, narrow waterway connecting a bay, lagoon, or similar body of water with a large parent body of water. 2) An arm of the sea (or other body of water) that is long compared to its width and may extend a considerable distance inland.

**INLET GORGE:** Generally, the deepest region of an inlet channel.

**INSHORE:** In beach terminology, the zone of variable width extending from the low water line through the breaker zone. Also inshore zone or shoreface.

**IRREGULAR WAVES:** Waves with random wave periods (and in practice, also heights), which are typical for natural wind-induced waves.

**JETTY:** 1) (United States usage) On open seacoasts, a structure extending into a body of water, which is designed to prevent shoaling of a channel by littoral materials and to direct and confine the stream or tidal flow. Jetties are built at the mouths of rivers or tidal inlets to help deepen and stabilize a channel. 2) (British usage) Wharf or pier.

**JONSWAP SPECTRUM:** Wave spectrum typical of growing deep water waves developed from field experiments and measurements of waves and wave spectra in the Joint North Sea Wave Project.

**KEY:** A cay, esp. one of the low, insular banks of sand, coral, and limestone off the southern coast of Florida.

**KINETIC ENERGY (OF WAVES):** In a progressive oscillatory wave, a summation of the energy of motion of the particles within the wave.

**KNOT:** The unit of speed used in navigation equal to 1 nautical mile (6,076.115 ft or 1,852 m) per hour.

**LAGGING OF TIDE:** The periodic retardation in the time of occurrence of high and low water due to changes in the relative positions of the moon and sun.

**LAGOON:** A shallow body of water, like a pond or sound, partly or completely separated from the sea by a barrier island or reef. Sometimes connected to the sea via an inlet.

**LEEWARD:** The direction toward which the wind is blowing; the direction toward which waves are traveling.

**LITTORAL:** Of or pertaining to a shore, especially of the sea.

**LITTORAL CELL:** A reach of the coast that is isolated sedimentologically from adjacent coastal reaches and that features its own sources and sinks. Isolation is typically caused by protruding headlands, submarine canyons, inlets, and some river mouths that prevent littoral sediment from one cell to pass into the next. Cells may range in size from a multi-hundred meter pocket beach in a rocky coast to a barrier island many tens of kilometers long.

**LITTORAL TRANSPORT** The movement of beach material in the littoral zone by waves and currents. Includes movement parallel (longshore drift) and sometimes also perpendicular (cross-shore transport) to the shore. Also known as littoral drift.

**LITTORAL TRANSPORT RATE:** Rate of transport of sedimentary material parallel or perpendicular to the shore in the littoral zone. Usually expressed in cubic meters (cubic yards) per year. Commonly synonymous with longshore transport rate.

**LITTORAL ZONE:** In beach terminology, an indefinite zone extending seaward from the shoreline to just beyond the breaker zone.

**LONGSHORE:** Parallel to and near the shoreline; alongshore.

**LONGSHORE BAR:** A sand ridge or ridges, running roughly parallel to the shoreline and extending along the shore outside the trough, that may be exposed at low tide or may occur below the water level in the offshore.

**LONGSHORE CURRENT:** The littoral current in the breaker zone moving essentially parallel to the shore, usually generated by waves breaking at an angle to the shoreline.

**LONGSHORE DRIFT:** Movement of (beach) sediments approximately parallel to the coastline.

**LOW TIDE:** The minimum elevation reached by each falling tide.

**LOW WATER:** The minimum height reached by each falling tide. Nontechnically, also called low tide.

**LOWER LOW WATER:** The lower of the two low waters of any tidal day. The single low water occurring daily during periods when the tide is diurnal is considered to be a lower low water.

**LUNAR TIDE:** The portion of the tide that can be attributed directly to attraction to the moon.

**MANAGED RETREAT:** The deliberate setting back (moving landward) of the existing line of sea defense in order to obtain engineering or environmental advantages - also referred to as managed landward realignment. Sometimes refers to moving roads and utilities landward in the face of shore retreat.

**MARSH:** 1) A tract of soft, wet land, usually vegetated by reeds, grasses and occasionally small shrubs. 2) Soft, wet area periodically or continuously flooded to a shallow depth, usually characterized by a particular subclass of grasses, cattails and other low plants.

**MEAN HIGH WATER:** The average height of the high waters over a 19-year period. For shorter periods of observations, corrections are applied to eliminate known variations and reduce the results to the equivalent of a mean 19-year value. All high water heights are included in the average where the type of tide is either semidiurnal or mixed. Only the higher high water heights are included in the average where the type of tide is diurnal. So determined, mean high water in the latter case is the same as mean higher high water.

**MEAN HIGHER HIGH WATER:** The average height of the higher high waters over a 19-year period. For shorter periods of observation, corrections are applied to eliminate known variations and reduce the result to the equivalent of a mean 19-year value.

**MEAN LOW WATER:** The average height of the low waters over a 19-year period. For shorter periods of observations, corrections are applied to eliminate known variations and reduce the results to the equivalent of a mean 19-year value. All low water heights are included in the average where the type of tide is either semidiurnal or mixed. Only lower low water heights are included in the average where the type of tide is diurnal. So determined, mean low water in the latter case is the same as mean lower low water.

**MEAN LOWER LOW WATER:** The average height of the lower low waters over a 19-year period. For shorter periods of observations, corrections are applied to eliminate known variations and reduce the results to the equivalent of a mean 19-year value. Frequently abbreviated to lower low water.

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**MEAN SEA LEVEL:** The average height of the surface of the sea for all stages of the tide over a 19-year period, usually determined from hourly height readings. Not necessarily equal to mean tide level.

**MEAN TIDE LEVEL:** A plane midway between mean high water and mean low water

**MHHW:** Mean Higher High Water

**MHW:** Mean High Water

**MINIMUM DURATION:** The time necessary for steady-state wave conditions to develop for a given wind velocity over a given fetch length.

**MIXED TIDE:** A type of tide in which the presence of a diurnal wave is conspicuous by a large inequality in either the high or low water heights, with two high waters and two low waters usually occurring each tidal day. In strictness, all tides are mixed, but the name is usually applied without definite limits to the tide intermediate to those predominantly semidiurnal and those predominantly diurnal.

**MLLW:** Mean Lower Low Water

**MLW:** Mean Low Water

**MONOCHROMATIC WAVES:** A series of waves generated in a laboratory, each of which has the same length and period.

**MORPHODYNAMICS:** 1) The mutual interaction and adjustment of the seafloor topography and fluid dynamics involving the motion of sediment. 2) The coupled suite of mutually interdependent hydrodynamic processes, seafloor morphologies, and sequences of change.

**MORPHOLOGY:** River/estuary/lake/seabed form and its change with time.

**MSL:** Mean Sea Level

**NAVD 88:** North American Vertical Datum of 1988

**NEAP TIDE:** Tide of decreased range occurring semimonthly as the result of the moon being in quadrature. The neap range of the tide is the average semidiurnal range occurring at the time of neap tides and is most conveniently computed from the harmonic constants. The neap range is typically 10 to 30 percent smaller than the mean range where the type of tide is either semidiurnal or mixed. While, technically of no practical significance where the type of tide is diurnal, the term is commonly used to refer to the portion of the lunar month with reduced tide range. The average height of the high waters of the neap tide is called neap high water or high water neaps, and the average height of the corresponding low water is called neap low water or low water neaps.

**NEARSHORE:** 1) In beach terminology an indefinite zone extending seaward from the shoreline well beyond the breaker zone. 2) The zone which extends from the swash zone to the position marking the start of the offshore zone, typically at water depths of the order of 20 m.

**NEARSHORE CURRENT:** A current in the nearshore zone.

**NGVD:** National Geodetic Vertical Datum

**NOAA:** National Oceanic and Atmospheric Administration

**NOS:** National Ocean Service. A part of NOAA. The successor to the USC&GS.

**NUMERICAL MODELING:** Refers to analysis of coastal processes using computational models.

**OCEANOGRAPHY:** The study of the sea, embracing and indicating all knowledge pertaining to the sea's physical boundaries, the chemistry and physics of seawater, marine biology, and marine geology.

**OFFSHORE:** 1) In beach terminology, the comparatively flat zone of variable width, extending from the shoreface to the edge of the continental shelf. It is continually submerged. 2) The direction seaward from the shore. 3) The zone beyond the nearshore zone where sediment motion induced by waves alone effectively ceases and where the influence of the sea bed on wave action is small in comparison with the effect of wind. 4) The breaker zone directly seaward of the low tide line.

**ONSHORE:** A direction landward from the sea.

**ORBITAL VELOCITY:** The flow of water accompanying the orbital movement of the water particles in a wave. Not to be confused with wave-generated littoral currents.

**OSCILLATORY WAVE:** A wave in which each individual particle oscillates about a point with little or no permanent change in mean position. The term is commonly applied to progressive oscillatory waves in which only the form advances, the individual particles moving in closed or nearly closed orbits.

**OUTCROP:** A surface exposure of bare rock not covered by soil or vegetation.

**OVERTOPPING:** Passing of water over the top of a structure as a result of wave runup or surge action.

**OVERWASH:** 1) The part of the uprush that runs over the crest of a berm or structure or barrier island and does not flow directly back to the ocean or lake. 2) The effect of waves overtopping a coastal defense, often carrying sediment landwards which is then lost to the beach system.

**PARTICLE VELOCITY:** The velocity induced by wave motion with which a specific water particle moves within a wave.

**PASS:** In hydrographic usage, a navigable channel through a bar, reef, or shoal, or between closely adjacent islands. On the Gulf of Mexico coast, inlets are often known as passes.

**PEAK PERIOD:** The wave period determined by the inverse of the frequency at which the wave energy spectrum reaches its maximum.

**PEBBLES:** Beach material usually well-rounded and between about 4 mm to 64 mm diameter.

**PENINSULA:** An elongated body of land nearly surrounded by water and connected to a larger body of land by a neck or isthmus.

**PHASE:** In surface wave motion, a point in the period to which the wave motion has advanced with respect to a given initial reference point, e.g. the crest of the wave is a phase of the wave.

**PHYSICAL MODELING:** Refers to the investigation of coastal or hydraulic processes using a scaled model.

**PIER:** A structure, usually of open construction, extending out into the water from the shore, to serve as a landing place, recreational facility, etc., rather than to afford coastal protection. In the Great Lakes, a term sometimes applied to jetties.

**PILE:** A long, heavy timber or section of concrete or metal that is driven or jetted into the earth or seabed to serve as a support or protection.

**PINEAPPLE EXPRESS:** Occurs when the jet stream dips into the vicinity of Hawaii (thus the "pineapple") and carries a fast, moisture laden storm system to Washington, Oregon, and

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California. Unlike tropical events, these winter storms do not behave as cyclonic systems; instead they are characterized by high winds that drive waves onto coastal areas.

PLANFORM: The outline or shape of a body of water as determined by the still-water line.

PLEISTOCENE: An epoch of the Quaternary Period characterized by several glacial ages.

PLUNGING BREAKER: Crest curls over air pocket; breaking is usually with a crash.

POCKET BEACH: A beach, usually small and curved, in a coastal embayment between two headland littoral barriers.

POTENTIAL ENERGY OF WAVES: In a progressive oscillatory wave, the energy resulting from the elevation or depression of the water surface from the undisturbed level.

PROTOTYPE: In laboratory usage, the full-scale structure, concept, or phenomenon used as a basis for constructing a scale model or copy.

RANDOM WAVES: The laboratory simulation of irregular sea states that occur in nature.

RANGE OF TIDE: The difference in height between consecutive high and low waters. The mean range is the difference between mean high water and mean low water. The great diurnal range or diurnal range is the difference in height between mean higher high water and mean lower low water. Where the type of tide is diurnal, the mean range is the same as the diurnal range.

RAYLEIGH DISTRIBUTION: A model probability distribution, commonly used in analysis of waves.

RECESSION: Landward movement of the shoreline. A net landward movement of the shoreline over a specified time.

REEF: Offshore consolidated rock. Often refers to coral fringing reefs in tropical waters.

REFLECTED WAVE: That part of an incident wave that is returned seaward when a wave impinges on a steep beach, barrier, or other reflecting surface.

REFLECTION: The process by which the energy of the wave is returned seaward.

REFRACTION: The process by which the direction of a wave moving in shallow water at an angle to the contours is changed: the part of the wave advancing in shallower water moves more slowly than that part still advancing in deeper water, causing the wave crest to bend toward alignment with the underwater contours.

REFRACTION COEFFICIENT: The ratio of the refracted wave height at any point to the deepwater wave height.

REFRACTION DIAGRAM: A drawing showing positions of wave crests and/or orthogonals in a given area for a specific deepwater wave period and direction.

REGULAR WAVES: Waves with a single height, period, and direction.

RETURN PERIOD: Average period of time between occurrences of a given event.

REVTMENT: A layer or layers of stone, concrete, etc., to protect an embankment, or shore structure, against erosion by wave action or currents.

RIP CURRENT: A strong surface current flowing seaward from the shore that is part of a nearshore circulation cell driven by incident wave energy. A rip current is often miscalled a rip tide.

**RIPRAP:** A protective layer or facing of quarystone, usually well graded within a wide size limit, randomly placed to prevent erosion, scour, or sloughing of an embankment or bluff; also the stone so used.

**RISK:** Chance or probability of failure due to all possible environmental inputs and all possible mechanisms.

**ROCK:** An aggregate of one or more minerals

**RUBBLE:** Rough, irregular fragments of broken rock.

**RUBBLE-MOUND STRUCTURE:** A mound of random-shaped and random-placed stones protected with a cover layer of selected stones

**RUNUP:** The upper level reached by a wave on a beach or coastal structure, relative to still-water level.

**SALIENT:** Coastal formation of beach material developed by wave refraction and diffraction and long shore drift comprising of a bulge in the coastline towards an offshore island or breakwater, but not connected to it as in the case of a tombolo.

**SALINITY:** Number of grams of salt per thousand grams of sea water, usually expressed in parts per thousand.

**SAND:** Sediment particles, often largely composed of quartz, with a diameter of between 0.062 mm and 2 mm, generally classified as fine, medium, coarse or very coarse. Beach sand may sometimes be composed of organic sediments such as calcareous reef debris or shell fragments.

**SAND BAR:** A submerged or emerged embankment of sand built on the sea floor in shallow water by waves and currents.

**SAND BYPASSING:** Hydraulic or mechanical movement of sand from the accreting updrift side to the eroding downdrift side of an inlet or harbor entrance. The hydraulic movement may include natural movement as well as movement caused by man.

**SAND DUNE:** A dune formed of sand.

**SAND SPIT:** A narrow sand embankment, created by an excess of deposition at its seaward terminus, with its distal end (the end away from the point of origin) terminating in open water.

**SCOUR:** Removal of underwater material by waves and currents, especially at the base or toe of a structure.

**SCOUR PROTECTION:** Protection against erosion of the seabed.

**SEA:** 1) Waves caused by wind at the place and time of observation. 2) State of the ocean or lake surface, in regard to waves.

**SEA CLIFF:** A cliff situated at the seaward edge of the coast.

**SEA LEVEL RISE:** The long-term trend in mean sea level.

**SEA STATE:** Description of the sea surface with regard to wave action.

**SEAS:** Waves caused by wind at the place and time of observation.

**SEAWALL:** A structure, often concrete or stone, built along a portion of a coast to prevent erosion and other damage by wave action. Often it retains earth against its shoreward face. A seawall is typically more massive and capable of resisting greater wave forces than a bulkhead.

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**SEDIMENT:** 1) Loose, fragments of rocks, minerals or organic material which are transported from their source for varying distances and deposited by air, wind, ice and water. Other sediments are precipitated from the overlying water or form chemically, in place. Sediment includes all the unconsolidated materials on the sea floor. 2) The fine grained material deposited by water or wind.

**SEDIMENT SINK:** Point or area at which beach material is irretrievably lost from a coastal cell, such as an estuary, or a deep channel in the seabed.

**SEDIMENT SOURCE:** Point or area on a coast from which beach material is supplied, such as an eroding cliff, or river mouth.

**SEDIMENT TRANSPORT:** The main agencies by which sedimentary materials are moved are: gravity (gravity transport); running water (rivers and streams); ice (glaciers); wind; the sea (currents and longshore drift).

**SEMIDIURNAL:** Having a period or cycle of approximately one-half of a tidal day (12.4 hours). The predominating type of tide throughout the world is semidiurnal, with two high waters and two low waters each tidal day. The tidal current is said to be semidiurnal when there are two flood and two ebb periods each day.

**SETBACK:** A required open space, specified in shoreline master programs, measured horizontally upland from a perpendicular to the ordinary high water mark.

**SHALLOW WATER:** 1) Commonly, water of such a depth that surface waves are noticeably affected by bottom topography. 2) More strictly, in hydrodynamics with regard to progressive gravity waves, water in which the depth is less than  $1/25$  the wavelength.

**SHALLOW WATER WAVE:** A progressive wave which is in water less than  $1/25$  the wave length in depth.

**SHINGLE:** flat or flattish pebbles.

**SHOAL:** 1) (noun) A detached area of any material except rock or coral. The depths over it are a danger to surface navigation. Similar continental or insular shelf features of greater depths are usually termed banks. 2) (verb) To become shallow gradually. 3) To cause to become shallow. 4) To proceed from a greater to a lesser depth of water.

**SHOALING:** Decrease in water depth. The transformation of wave profile as they propagate inshore.

**SHOALING COEFFICIENT:** The ratio of the height of a wave in water of any depth to its height in deep water with the effects of refraction, friction, and percolation eliminated.

**SHORE:** The narrow strip of land in immediate contact with the sea, including the zone between high and low water lines. A shore of unconsolidated material is usually called a beach. Also used in a general sense to mean the coastal area (e.g., to live at the shore).

**SHOREFACE:** The narrow zone seaward from the low tide shoreline, covered by water, over which the beach sands and gravels actively oscillate with changing wave conditions.

**SHORELINE:** The intersection of a specified plane of water with the shore or beach (e.g., the high water shoreline would be the intersection of the plane of mean high water with the shore or beach). The line delineating the shoreline on National Ocean Service nautical charts and surveys approximates the mean high water line.

**SIGNIFICANT WAVE HEIGHT:** The primary measure of energy in a sea state. that is calculated either as the average height of the one-third highest waves or via energy density spectral analysis methods.

**SOLITARY WAVE:** A wave consisting of a single elevation (above the original water surface), whose height is not necessarily small compared to the depth, and neither followed nor preceded by another elevation or depression of the water surfaces.

**SORTING:** Process of selection and separation of sediment grains according to their grain size (or grain shape or specific gravity).

**SPILLING BREAKER:** Bubbles and turbulent water spill down front face of wave. The upper 25 percent of the front face may become vertical before breaking. Breaking generally occurs over quite a distance.

**SPIT:** A small point of land or a narrow shoal projecting into a body of water from the shore.

**SPRING RANGE:** The average semidiurnal range occurring at the time of spring tides and most conveniently computed from the harmonic constants. It is larger than the mean range where the type of tide is either semidiurnal or mixed, and is of no practical significance where the type of tide is diurnal.

**SPRING TIDE:** A tide that occurs at or near the time of new or full moon (syzygy) and which rises highest and falls lowest from the mean sea level.

**STACK:** An isolated, pillar-like rocky island isolated from a nearby headland by wave erosion; a needle or chimney rock.

**STILLWATER LEVEL:** Commonly abbreviated to SWL. The surface of the water if all wave and wind action were to cease.

**STONE:** Quarried or artificially-broken rock for use in construction.

**STORM SURGE:** A rise in average (typically over several minutes) water level above the normal astronomical tide level due to the action of a storm. Storm surge results from wind stress, atmospheric pressure reduction, and wave setup.

**STORM SURGE HYDROGRAPH:** Graph of the variation in the rise in SWL with time due to a storm.

**SUBSIDENCE:** Sinking or downwarping of a part of the earth's surface.

**SUPER-CRITICAL FLOW:** Flow for which the Froude number is greater than unity; surface disturbances will not travel upstream.

**SURF:** 1) Collective term for breakers. 2) The wave activity in the area between the shoreline and the outermost limit of breakers. 3) In literature, the term surf usually refers to the breaking waves on shore and on reefs when accompanied by a roaring noise caused by the larger waves breaking. 4) the recreational riding of waves.

**SURF ZONE:** The zone of wave action extending from the water line (which varies with tide, surge, set-up, etc.) out to the most seaward point of the zone (breaker zone) at which waves approaching the coastline commence breaking, typically in water depths of between 5 to 10 meters.

**SURGING BREAKER:** Wave peaks up, but bottom rushes forward from under wave, and wave slides up beach face with little or no bubble production. Water surface remains almost plane except where ripples may be produced on the beachface during runback.

**SWASH:** The rush of water up onto the beach face following the breaking of a wave.

**SWASH ZONE:** The zone of wave action on the beach, which moves as water levels vary, extending from the limit of run-down to the limit of runup.



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**SWELL:** Wind-generated waves that have traveled out of their generating area. Swell characteristically exhibits a more regular and longer period and has flatter crests than waves within their fetch (seas).

**SWL:** Still Water Level

**T-GROIN:** A groin built in the shape of a letter "T" with the trunk section connected to land.

**TECTONIC FORCES:** Forces generated from within the earth that result in uplift, movement, or deformation of part of the earth's crust.

**TERMINAL GROIN:** A groin, often at the end of a barrier spit, intended to prevent sediment passage into the channel beyond.

**TIDAL BENCH MARK:** A bench mark whose elevation has been determined with respect to mean sea level at a nearby tide gauge; the tidal bench mark is used as reference for that tide gauge.

**TIDAL CURRENT:** The alternating horizontal movement of water associated with the rise and fall of the tide caused by the astronomical tide-producing forces.

**TIDAL INLET:** 1) An inlet maintained by tidal flow. 2) Loosely, any inlet in which the tide ebbs and flows.

**TIDAL PERIOD:** The interval of time between two consecutive, like phases of the tide.

**TIDAL PRISM:** 1) The total amount of water that flows into a bay or out again with movement of the tide, excluding any fresh water flow. 2) The volume of water between mean low and mean high tide.

**TIDAL RANGE:** The difference in height between consecutive high and low (or higher high and lower low) waters.

**TIDAL SHOALS:** Shoals that accumulate near inlets due to the transport of sediments by tidal currents associated with the inlet.

**TIDAL WAVE:** 1) The wave motion of the tides. 2) In popular usage, any unusually high and destructive water level along a shore. It usually refers to storm surge or tsunamis.

**TIDE:** The periodic rising and falling of the water that results from gravitational attraction of the Moon and Sun and other astronomical bodies acting upon the rotating Earth. Although the accompanying horizontal movement of the water resulting from the same cause is also sometimes called the tide, it is preferable to designate the latter as tidal current, reserving the name tide for the vertical movement.

**TOE:** Lowest part of a revetment or seawall slope, generally forming the transition to the seabed.

**TOMBOLO:** A bar or spit that connects or "ties" an island to the mainland or to another island. Also applied to sand accumulation between land and a detached breakwater.

**TROPICAL STORM:** A tropical cyclone with maximum winds less than 34 m/sec (75 mile per hour). Less strength when compared with hurricane or typhoon (winds greater than 34 m/sec).

**TROUGH:** A long and broad submarine depression with gently sloping sides.

**TROUGH OF WAVE:** The lowest part of a waveform between successive crests. Also, that part of a wave below still-water level.

**TSUNAMI:** A long-period wave caused by an underwater disturbance such as a volcanic eruption or earthquake. Commonly miscalled "tidal wave."

**TYPHOON:** The term typhoon is applied to tropical cyclones in the western Pacific Ocean. Known as a hurricane in the Atlantic Ocean, Gulf of Mexico, and eastern Pacific Ocean.

**USACE:** US Army Corps of Engineers

**USC&GS:** US Coast and Geodetic Survey

**UPDRIFT:** The direction opposite that of the predominant movement of littoral materials.

**VELOCITY OF WAVES:** The speed at which an individual wave advances.

**VISCOSITY:** That molecular property of a fluid that enables it to support tangential stresses for a finite time and thus to resist deformation. Resistance to flow.

**V-ZONE:** FEMA's estimates of where coastal waves greater than 3 feet high will exist during the 100-year storm.

**WAVE:** A ridge, deformation, or undulation of the surface of a liquid.

**WAVE AMPLITUDE:** The magnitude of the displacement of a wave from a mean value. An ocean wave has an amplitude equal to the vertical distance from still-water level to wave crest. For a sinusoidal wave, the amplitude is one-half the wave height.

**WAVE CELERITY:** The speed of wave propagation.

**WAVE CLIMATE:** The seasonal and annual distribution of wave height, period and direction.

**WAVE DIRECTION:** The direction from which a wave approaches.

**WAVE DIRECTIONAL SPECTRUM:** Distribution of wave energy as a function of wave frequency and direction.

**WAVE FORECASTING:** The theoretical determination of future wave characteristics, usually from observed or predicted meteorological phenomena.

**WAVE FREQUENCY:** The inverse of wave period.

**WAVE GROUP:** A series of waves in which the wave direction, wavelength, and wave height vary only slightly.

**WAVE HEIGHT:** The vertical distance between a crest and the preceding trough.

**WAVE PERIOD:** The time for a wave crest to traverse a distance equal to one wavelength. The time for two successive wave crests to pass a fixed point.

**WAVE RAY:** On a wave-refraction diagram, a line drawn perpendicularly to the wave crests; also known as orthogonals.

**WAVE SETUP:** Superelevation of the water surface over normal surge elevation due to onshore mass transport of the water by wave action alone.

**WAVE SPECTRUM:** In ocean wave studies, a graph, table, or mathematical equation showing the distribution of wave energy as a function of wave frequency. The spectrum may be based on observations or theoretical considerations.

**WAVE STEEPNESS:** The ratio of wave height to wavelength.

**WAVE TRAIN:** A series of waves from the same direction.

**WAVE TRANSFORMATION:** Change in wave energy due to the action of physical processes.

**WAVE TROUGH:** The lowest part of a wave form between successive crests. Also that part of a wave below still-water level.

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**WAVE VELOCITY:** The speed at which an individual wave advances.

**WAVELENGTH:** The horizontal distance between similar points on two successive waves measured perpendicular to the crest.

**WEIR:** A low dam or wall across a stream to raise the upstream water level.

**WELL-SORTED:** Clastic sediment or rock that consists of particles all having approximately the same size. Example: sand dunes.

**WETLANDS:** Lands whose saturation with water is the dominant factor determining the nature of soil development and the types of plant and animal communities that live in the soil and on its surface (e.g. Mangrove forests).

**WHITECAP:** On the crest of a wave, the white froth caused by wind.

**WIND SEA:** Wave conditions directly attributable to recent winds, as opposed to swell.

**WIND SETUP:** On reservoirs and smaller bodies of water: 1) the vertical rise in the still-water level on the leeward side of a body of water caused by wind stresses on the surface of the water; 2) the difference in still-water levels on the windward and the leeward sides of a body of water caused by wind stresses on the surface of the water.

**WIND STRESS:** The way in which wind transfers energy to the sea surface.

**WIND WAVES:** 1) Waves being formed and built up by the wind. 2) Loosely, any wave generated by wind.

**WINDWARD:** The direction from which the wind is blowing