

**भारतीय मानक ब्यूरो**

**(उपभोक्ता मामले, खाद्य एवं सार्वजनिक वितरण मंत्रालय, भारत सरकार)**

**BUREAU OF INDIAN STANDARDS**

***(Ministry of Consumer Affairs, Food & Public Distribution, Govt. of India)***

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| **व्यापक परिचालन मसौदा** |

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| **हमारा संदर्भ : डब्ल्यूआरडी 28/ T-1** | **14 अगस्त 2024** |

**तकनीकी समिति: तटीय क्षेत्र जल प्रबंधन अनुभागीय समिति, डब्ल्यूआरडी 28**

**प्राप्तकर्ता :**

1. **जल संसाधन विभाग परिषद,** **डब्ल्यूआरडी के सभी सदस्य**
2. **तटीय क्षेत्र जल प्रबंधन अनुभागीय समिति, डब्ल्यूआरडी 28 के सभी सदस्य**
3. **रुचि रखने वाले अन्य निकाय।**

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| **WIDE CIRCULATION DRAFT** |

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| Our Reference: :**WRD28 /T-1** |  **14 AUGUST 2024** |

**TECHNICAL COMMITTEE: COASTAL COMMITTEE ZONE WATER MANAGEMENT SECTIONAL, WRD 28**

**ADDRESSED TO:**

1. All Members of Water Resources Department Council, WRD
2. All Members of Coastal Zone Water Management Sectional Committee, WRD 28
3. All others interested.

Dear Sir/ Madam,

Please find enclosed the following draft:

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| **Doc No.** | **Title** |
| **WRD 28 (24783)WC** | *GLOSSARY OF TERMS RELATED TO COASTAL ENGINEERING (ICS: 93.010)* |

Kindly examine the attached draft and forward your views stating any difficulties which you are likely to experience in your business or profession, if this is finally adopted as National Standard.

 **Last Date for Comments: ----**

Comments if any, may please be made in the enclosed format and emailed at wrd@bis.gov.in or sent at the above address. Additionally, comments may be sent online through the BIS e-governance portal, [www.manakonline.in](http://www.manakonline.in).

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|  **Yours faithfully,** |
| Sd/- |
| **(DUSHYANT PRAJAPATI)****Scientist ‘E’ & Head** **(Water Resources Department)** |
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Thanking you,

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**Encl: As above**

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**Doc. No.: WRD 28 (24783) WC**

**Title: GLOSSARY OF TERMS RELATED TO COASTAL ENGINEERING**

LAST DATE FOR COMMENT: **---**

*NAME OF THE COMMENTATOR/ORGANIZATION*: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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*भारतीय मानक मसौदा*

 *तटीय इंजीनियरिंग से संबंधित परिभाषिक शब्दावली*

***Draft Indian Standard***

**GLOSSARY OF TERMS RELATED TO COASTAL ENGINEERING Part 1**

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| **Coastal Zone Water Management Last date for Comments:** **Sectional Committee, WRD 28 14/10/2024**   |

**FOREWORD**

(*Formal Clause of the foreword will be added later*)

Coastal engineering stands at the intersection of natural forces and human activities, playing a pivotal role in the sustainable development and management of coastal zones. As coastal regions continue to witness dynamic changes influenced by factors such as climate change, population growth, and urbanization, the need for standardized terminology becomes increasingly essential. This serves as a comprehensive reference document aimed at establishing a common language within the field.

Developed with the collaboration of experts and drawing inspiration from reputed sources such as the Coastal Engineering Manual, EurOtop Manual, Manual on climate change adaptation guidelines for coastal protection and management in India and reports published by the Asian Development Bank and UNESCO, this glossary strives to create a unified understanding of the diverse terms used in coastal engineering practices. By aligning with international standards and incorporating regional insights, this document seeks to bridge the gap between theoretical knowledge and practical applications in the context of India's unique coastal landscape.

In preparing this standard, due consideration has been given to the specific challenges and opportunities posed by India's expansive coastline. The incorporation of insights from various reports and publications in India ensures that the glossary is not only aligned with global best practices but also tailored to address the nuances of coastal engineering in the Indian context.

***Draft Indian Standard***

**GLOSSARY OF TERMS RELATED TO COASTAL ENGINEERING**

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| **Coastal Zone Water Management Last date for Comments:** **Sectional Committee, WRD 28 14/10/2024**   |

**1 SCOPE**

This standard covers the definitions of standard terms related to coastal engineering**.**

**2 STANDARD TERMS USED IN COASTAL ENGINEERING**

**2.1 Abrasion**

The mechanical wearing away by rock material transported by wind or water.

**2.2 Abrasion Platform**

A rock or clay platform which has been worn by the processes of abrasion.

**2.3 Accelerometer**

A device used in wave buoys for measuring acceleration.

**2.4 Accretion**

It may be either natural or artificial. Natural accretion is the buildup of land, solely by the action of the forces of nature, on a beach by deposition of water- or airborne material. Artificial accretion is a similar buildup of land because of an act of man, such as the accretion formed by a groin, breakwater, or beach fill deposited by mechanical means. It is also called aggradation.

**2.5 Active Margin**

A margin of a continental plate consisting of a continental shelf and slope, and an oceanic trench or basin.

**2.6 Adjustable Groin**

A groin whose permeability can be changed, usually with gates or removable sections.

**2.7 Advance (of a beach)**

1. A continuing seaward movement of the shoreline.
2. A net seaward movement of the shoreline over a specified time. It is also called progression.

**2.8 Aeolian**

*See* eolian.

**2.9** **Wave Age**

The ratio of wave velocity to wind velocity (in wave forecasting theory).

**2.10 Aggradation**

See accretion.

**2.11 Alignment**

The course along which the center line of a channel, canal, or drain is located.

**2.12 Alluvial Deposits**

Detrital material which is transported by a river and deposited — usually temporarily — at points along the floodplain of a river. It is commonly composed of sand and gravel.

**2.13 Alluvial Plane**

A plain bordering a river, formed by the deposition of material eroded from areas of higher elevation.

**2.14 Alluvium**

Soil (sand, mud, or similar detrital material) deposited by streams, or the deposits formed.

**2.15 Alongshore**

Parallel to and near the shoreline or longshore.

**2.16 Altimeter**

An instrument that determines its distance above a particular surface.

**2.17 Altimeter, Laser**

An instrument that determines altitude by measuring the length of time needed for a pulse of coherent light to travel from the instrument to the surface and back, and multiplies half this time by the speed of light to get the straight-line distance to the surface.

**2.18 Altimeter, Lidar**

*See* Altimeter, Laser.

**2.19 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 the wave crest at any instant of time. For a sinusoidal wave, the amplitude is one-half the wave height.

**2.20 Anchor Ice**

Spongy underwater ice formed on a submerged object or attached to the bottom of a shallow body of water which is itself not frozen (synonym bottom ice).

**2.21 Angle of Repose**

The maximum slope (measured from the horizontal) at which soils and loose materials on the banks of canals, rivers, or embankments will stay stable.

**2.22 Anisotropic**

Having properties that change with changing directions.

**2.23 Anoxic**

It refers to an environment that contains little or no dissolved oxygen and hence little or no benthic marine life. These conditions arise in some basins or fjords where physical circulation of seawater is limited.

**2.24 Antidunes**

Bed forms that occur in drains and are in phase with, and strongly interact with gravity water-surface waves.

**2.25 Antinode**

*See* loop.

**2.26 Apron**

A layer of stone, concrete, or other material to protect the toe of a structure.

**2.27 Aquifer**

A geologic porous formation that is water-bearing, and which transmits water from one point in the formation to another.

**2.28 Archipelago**

A sea that contains numerous islands; also the island group itself.

**2.29 Armor Layer**

The protective layer on a breakwater or seawall composed of armor units.

**2.30 Armor Unit**

A relatively large quarry stone or concrete shape that is selected to fit specified geometric characteristics and density. It is typically of nearly uniform size and generally large enough to require individual placement. In most cases, it serves as primary wave protection and is placed with a minimum thickness of two units.

**2.31 Artificial Beach Nourishment**

The process of replenishing a beach with material (usually sand) obtained from another location.

**2.32 Astronomical Tide**

The tidal levels and character which would result from gravitational effects of the Earth, Sun, and Moon, without any atmospheric influences.

**2.33 ATOLL**

A ring-shaped coral reef, often carrying low sand islands, enclosing a shallow lagoon. The reef is surrounded by deep water of the open sea.

**2.34 Attenuation**

1. A lessening of the amplitude of a wave with distance from the origin.
2. The decrease of water-particle motion with increasing depth. Particle motion resulting from surface oscillatory waves attenuates rapidly with depth, and practically disappears at a depth equal to a surface wavelength.

**2.35 Autochthonous**

A term applied to shelves on which older shelf sediments are primarily being reworked by modern shelf processes.

**2.36 Automatic Tide Gage**

An instrument that automatically registers the rise and fall of the tide. In some instruments, the registration is accomplished by printing the heights at regular intervals, in others by a continuous graph in which the height of the tide is represented by the ordinates of the curve and the corresponding time by the abscissae.

**2.37 Avulsion**

1. Rapid erosion of the shore land by waves during a storm.
2. A sudden cutting off of land by flood, currents, or change in the course of a body of water.

**2.38 Awash**

Situated so that the top is intermittently washed by waves or tidal action. Condition of being exposed or just bare at any stage of the tide between high water and chart datum.

**2.39 Back Barrier**

It pertains to the lagoon-marsh-tidal creek complex in the lee of a coastal barrier island, barrier spit, or baymouth barrier.

**2.40 Backbeach**

*See* backshore.

**2.41 Backrush**

The seaward return of the water following the uprush of the waves. For any given tide stage the point of farthest return seaward of the backrush is known as the Limit of backrush or limit backwash.

**2.42 Backshore**

That 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. It is also called backbeach.

# 2.43 Backwash

1. *See* backrush.
2. Water or waves thrown back by an obstruction such as a ship, breakwater, or cliff.

# 2.44 Backwash Ripples

1. roughness, by decrease in channel width or by a decrease of the bed gradient
2. Low amplitude ripple marks formed on fine sand beaches by the Backwash of the waves.

# 2.45 Backwater Curve

The longitudinal profile of the water surface in an open channel where the depth of flow has been increased by an obstruction as a weir or a dam across the channel, by increase in channel

# 2.46 Bank

1. The rising ground bordering a lake, river, or sea; or of a river or channel, for which it is designated as right or left as the observer is facing downstream.
2. An elevation of the sea floor or large area, located on a continental (or island) shelf and over which the depth is relatively shallow but sufficient for safe surface navigation (e.g., Georges Bank); a group of shoals.
3. In its secondary sense, used only with a qualifying word such as "sandbank" or "gravel bank," a shallow area consisting of shifting forms of silt, sand, mud, and gravel.

# 2.47 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. *See* baymouth bar, cuspate bar.

# 2.48 Barrier Beach

A bar essentially parallel to the shore, the crest of which is above normal high water level. Also called offshore barrier and barrier island.

# 2.49 Barrier Flat

The flat area, often marshy and populated with low vegetation, on the bay or lagoon side of a barrier island.

# 2.50 Barrier Island

A detached portion of a barrier beach between two inlets. It commonly had dunes, vegetated areas, and swampy terranes (*see* barrier flat) extending from the beach into the lagoon. Example: Outer Banks, North Carolina. Vypin Island, Kerala.

# 2.51 Barrier Lagoon

A bay roughly parallel to the coast and separated from the open ocean by barrier islands. Also, the body of water encircled by coral islands and reefs, in which case it may be called an atoll lagoon.

# 2.52 Barrier Reef

A coral reef parallel to and separated from the coast by a lagoon that is too deep for coral growth. Generally, barrier reefs follow the coasts for long distances and are cut through at irregular intervals by channels or passes. Example: Andaman & Nicobar islands of India, Great Barrier Reef of Australia.

# 2.53 Barrier Spit

Similar to a barrier island, but connected to the mainland.

# 2.54 Basin

A depressed area with no surface outlet, such as a lake basin or an enclosed sea.

# 2.55 Basin, Boat

A naturally or artificially enclosed or nearly enclosed harbor area for small craft.

# 2.56 Bastion

A massive groin, or projecting section of seawall normally constructed with its crest above water level.

# 2.57 Bathymetric Chart

A topographic map of the bed of the ocean, with depths indicated by contours (isobaths) drawn at regular intervals.

# 2.58 Bathymetry

The measurement of depths of water in oceans, seas, and lakes; also information derived from such measurements.

# 2.59 Bay

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. *See* also bight, embayment.

# 2.60 Baymouth Bar

A bar extending partly or entirely across the mouth of a bay.

# 2.61 Bayou

A minor sluggish waterway or estuarial creek, tributary to, or connecting, other streams or bodies of water, whose course is usually through lowlands or swamps. Sometimes called slough. The term is commonly used in the southern United States.

# 2.62 Beach

The zone of unconsolidated material that extends landward from the low water line 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). The seaward limit of a beach--unless other­wise specified--is the mean low water line. A beach includes fore­shore and backshore. *See* also shore, sustainable beach, and self-sustaining beach.

# 2.63 Beach Accretion

*See* accretion.

# 2.64 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.

# 2.65 Beach Crest

The point representing the limit of normal high tide wave run-up (*see* berm crest).

# 2.66 Beach Cusp

*See* cusp.

# 2.67 Beach Erosion

The carrying away of beach materials by wave action, tidal currents, littoral currents, or winds.

# 2.68 Beach Face

The section of the beach normally exposed to the action of the wave uprush. The foreshore of a beach.

 NOTE: Not synonymous with shore­face.

# 2.69 Beach Fill

Material placed on a beach to renourish eroding shores.

# 2.70 Beach Head

The cliff, dune, or sea wall looming above the landward limit of the active beach.

# 2.71 Beach Material

Granular sediments, usually sand or shingle moved by the sea.

# 2.72 Beach Plan Shape

The shape of the beach in plan; usually shown as a contour line, combination of contour lines or recognizable features such as beach crest and/or the still water line.

# 2.73 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.

# 2.74 Beach Ridge

*See* ridge, beach.

# 2.75 Beach Scarp

*See* scarp, beach.

# 2.76 Beach Width

The horizontal dimension of the beach measured normal to the shoreline and landward of the higher-high tide line (on oceanic coasts) or from the still water level (on lake coasts).

# 2.77 Bed

The bottom of a watercourse, or any body of water.

# 2.78 Bed Forms

Any deviation from a flatbed 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.

# 2.79 Bed Load

Sediment transport mode in which individual particles either roll or slide along the bed as a shallow, mobile layer a few particle diameters deep, the part of the load that is not continuously in suspension.

# 2.80 Bed Protection

A (rock) structure on the bed in order to protect the underlying bed against erosion due to current and/or wave action.

# 2.81 Bed Shear Stress

The way in which waves (or currents) transfer energy to the sea bed.

# 2.82 Bedding Plane

A surface parallel to the surface of deposition, which may or may not have a physical expression. The original attitude of a bedding plane should not be assumed to have been horizontal.

# 2.83 Bedrock

The solid rock that underlies gravel, soil, and other superficial material. Bedrock may be exposed at the surface (an outcrop) or it may be buried under a few centimeters to thousands of meters of unconsolidated material.

# 2.84 Bench

1. A level or gently sloping erosion plane inclined seaward.
2. A nearly horizontal area at about the level of maximum high water on the sea side of a dike.

# 2.85 Bench Mark, Tidal

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

# 2.86 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.

# 2.87 Benefits

The asset value of a scheme, usually measured in terms of the cost of damages avoided by the scheme, or the valuation of perceived amenity or environmental improvements.

# 2.88 Benthic

Pertaining to the sub-aquatic bottom.

# 2.89 Benthos

Those animals who live on the sediments of the sea floor, including both mobile and non-mobile forms.

# 2.90 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.

# 2.91 Berm, Beach

*See* beach berm.

# 2.92 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.

# 2.93 Berm Crest

The seaward limit of a berm. Also called berm edge.

# 2.94 Bight

A bend in a coastline forming an open bay. A bay formed by such a bend.

# 2.95 Bio-Shield

 A vegetation belt that protects the coast/bank from flow induced by wave, tidal and river flows. Bio-shields include mangroves, casuarina plantations etc.

# 2.96 Bioturbation

The disturbance of sediment bedding by the activities of burrowing organisms.

# 2.97 Birdfoot Delta

A river delta formed by many levee-bordered distributaries extending seaward and resembling in plan the outstretched claws of a bird. Example: Krishna River delta, Mississippi River delta.

# 2.98 Blanket (Foundation or Bedding)

A layer or layers of graded fine stones underlying a breakwater, groin, or rock embankment to prevent the natural bed material from being washed away.

# 2.99 Blown Sands

*See* eolian sands.

# 2.100 Blowout

A depression on the land surface caused by wind erosion.

# 2.101 Bluff

A high, steep bank or cliff.

# 2.102 Bog

A wet, spongy, poorly drained area which is usually rich in very specialized plants, contains a high percentage of organic remnants and residues and frequently is associated with a spring, seepage area, or other subsurface water source. A bog sometimes represents the final stage of the natural processes of eutrophication by which lakes and other bodies of water are very slowly transformed into land areas.

# 2.103 Boil

An upward flow of water in a sandy formation due to an unbalanced hydrostatic pressure resulting from a rise in a nearby stream, or from removing the overburden in making excavations.

# 2.104 Bold Coast

A prominent landmass that rises steeply from the sea.

# 2.105 Bore

A very rapid rise of the tide in which the advancing water presents an abrupt front of considerable height. In shallow estuaries where the range of tide is large, the high water is propagated inward faster than the low water because of the greater depth at high water. If the high water over­takes the low water, an abrupt front is presented, with the high-water crest finally falling forward as the tide continues to advance. It is also called eager.

# 2.106 Bottom (nature of)

The composition or character of the bed of an ocean or other body of water (e.g., clay, coral, gravel, mud, ooze, pebbles, rock, shell, shingle, hard, or soft).

# 2.107 Bottom Boundary Layer

The lower portion of the water flow that experiences frictional retardation based on its proximity to the bed.

# 2.108 Bottomset

One of the horizontal or gently inclined sediment layers deposited in front of the advancing forest beds of a delta.

# 2.109 Boulder

A rounded rock more than 256 mm (10 inch) in diameter; larger than a cobblestone. *See* soil classification.

# 2.110 Boundary Conditions

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

# 2.111 Box Gage

A tide gage that is operated by a float in a long vertical box to which the tide is admitted through an opening in the bottom. In the original type of box gage the float supported a graduated rod which rose and fell with the tide.

# 2.112 Braided River

A river type with multiple channels separated by shoals, bars and islands.

# 2.113 Breaching

Failure of the beach head or a dike allowing flooding by tidal action.

# 2.114 Breaker

A wave breaking on a shore, over a reef, etc. Breakers may be classified into four types: collapsing—breaking occurs over lower half of wave, with minimal air pocket and usually no splash-up. Bubbles and foam present. Plunging—crest curls over air pocket; breaking is usually with a crash. Smooth splash-up usually follows. Spilling—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. Surging—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.

# 2.115 Breaker Depth

The still-water depth at the point where a wave breaks. Also called breaking depth.

# 2.116 Breaker Index

Ratio of breaking wave height to deepwater wave height.

# 2.117 Breaker Zone

The zone within which waves approaching the coastline commence breaking, typically in water depths of between 5 and 10 meters.

# 2.118 Breaking

Reduction in wave energy and height in the surf zone due to limited water depth.

# 2.119 Breakwater

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

# 2.120 Breastwork

Vertically-faced or steeply inclined structure usually built with timber and parallel to the shoreline, at or near the beach crest, to resist erosion or mitigate against flooding.

# 2.121 Buffer Area

A parcel or strip of land that is designed and designated to permanently remain vegetated in an undisturbed and natural condition to protect an adjacent aquatic or wetland site from upland impacts, to provide habitat for wildlife and to afford limited public access.

# 2.122 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.

# 2.123 Bull Nose

Substantial lip or protuberance at the top of the seaward face of a wall, to deflect waves seaward.

# 2.124 Buoy

A float; especially a floating object moored to the bottom, to mark a channel, anchor, shoal rock, etc. Some common types include: a nun or nut buoy is conical in shape; a can buoy is squat and cylindrical above water and conical below water; a spar buoy is a vertical, slender spar anchored at one end; a bell buoy, bearing a bell, runs mechanically or by the action of waves, usually marks shoals or rocks; a whistling buoy, similarly operated, marks shoals or channel entrances; a dan buoy carries a pole with a flag or light on it.

# 2.125 Buoyancy

The resultant of upward forces, exerted by the water on a submerged or floating body, equal to the weight of the water displaced by this body.

# 2.126 Bypassing, Sand

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.

# 2.127 Caisson

Concrete box-type structure.

# 2.128 Calcareous

Containing calcium carbonate (CaCO3), chiefly as the minerals calcite and aragonite. When applied to rock, it implies that as much as 50 percent of the rock is carbonate (e.g., calcareous sand).

# 2.129 Calm

The condition of the water surface when there is no wind waves or swell.

# 2.130 Canal

An artificial watercourse cut through a land area for such uses as navigation and irrigation.

# 2.131 Canyon

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

# 2.132 Cape

A land area jutting seaward from a continent or large island which prominently marks a change in, or interrupts notably, the coastal trend; a prominent feature. Examples: **Cape Comorin, India;** Cape Cod, USA; Cape Hatteras, USA.

# 2.133 Capillary Wave

A wave whose velocity of propagation is controlled primarily by the surface tension of the liquid in which the wave is traveling. Water waves of length less than about 1 inch are considered capillary waves. Waves longer than 1 inch and shorter than 2 inches are in an intermediate zone between capillary and gravity waves.  *See* ripple.

# 2.134 Cartography

The science and art of making maps.

# 2.135 Catchment Area

The area which drains naturally to a particular point on a river, thus contributing to its natural discharge.

# 2.136 Causeway

A raised road across wet or marshy ground, or across water.

# 2.137 Caustic

In refraction of waves, the name given to the curve to which adjacent orthogonal of waves refracted by a bottom whose contour lines are curved, are tangents. The occurrence of a caustic always marks a region of crossed orthogonals and high wave convergence.

# 2.138 Cay

*See* key.

# 2.139 Celerity

Wave speed.

# 2.140 Central Pressure Index (CPI)

The estimated minimum barometric pressure in the eye (approximate center) of a particular cyclone. The CPI is considered the most stable index to intensity of cyclone wind velocities in the periphery of the storm; the highest wind speeds are associated with storms having the lowest CPI.

# 2.141 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.

# 2.142 Channel Capacity

The maximum flow which a channel is capable of transmitting without its banks being overtopped.

# 2.143 Channel-Mouth Bar

A bar built where a stream enters a body of standing water, resulting from decreased flow velocity.

# 2.144 Characteristic Wave Height

*See* significant wave height.

# 2.145 Chart

A special-purpose map, especially one designed for navigation, such as a bathymetric chart.

# 2.146 Chart Datum

The plane or level to which soundings (or elevations) or tide heights are referenced (usually low water datum). The surface is called a tidal datum when referred to a certain phase of tide. To provide a safety factor for navigation, some level lower than mean sea level is generally selected for hydrographic charts, such as mean low water or mean lower low water. *See* datum plane.

# 2.147 Chemical Weathering

Disintegration of rocks and sediments by chemical alteration of the constituent minerals or of the cementing matrix. It is caused by exposure, oxidation, temperature changes, and biological processes.

# 2.148 Chenier

A long, narrow wooded beach ridge or sandy hummock forming roughly parallel to a prograding shore, usually seaward of marsh and mud-flat deposits (as along the Subarnarekha chenier delta region, West Bengal, India; south coast of Louisiana, USA).

# 2.149 Chop

The short-crested waves that may spring up quickly in a moderate breeze, and which break easily at the crest. Also called as wind chop.

# 2.150 Choppy Sea

Short, rough waves tumbling with a short and quick motion. Short-crested waves that may spring up quickly in a moderate breeze, and break easily at the crest.

# 2.151 Clapotis

The French equivalent for a type of standing wave. In American usage it is usually associated with the standing wave phenomenon caused by the reflection of a nonbreaking wave train from a structure with a face that is vertical or nearly vertical. Full clapotis is one with 100 percent reflection of the incident wave; partial clapotis is one with less than 100 percent reflection.

# 2.152 Clastic Rocks

Rocks built up of fragments which have been produced by weathering and erosion of pre-existing rocks and minerals and, typically, transported mechanically to their point of deposition.

# 2.153 Clay

A fine-grained, plastic, sediment with a typical grain size less than 0.004 mm. Possesses electromagnetic properties which bind the grains together to give a bulk strength or cohesion. *See* soil classification.

# 2.154 Cliff

A high, steep face of rock; a precipice. *See* also sea cliff.

# 2.155 Climate

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

# 2.156 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.

# 2.157 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). The surface profile is expressed in terms of the Jacobian elliptic function cn(); hence the term cnoidal.

# 2.158 Co-Tidal Lines

Lines which link all the points where the tide is at the same stage (or phase) of its cycle.

# 2.159 Coast

1. A strip of land of indefinite width (may be several kilometers) that extends from the shoreline inland to the first major change in terrain features.
2. The part of a country regarded as near the coast.

# 2.160 Coastal Area

The land and sea area bordering the shoreline.

# 2.161 Coastal Currents

1. Those currents which flow roughly parallel to the shore and constitute a relatively uniform drift in the deeper water adjacent to the surf zone. These currents may be tidal currents, transient, wind-driven currents, or currents associated with the distribution of mass in local waters.
2. For navigational purposes, the term is used to designate a current in coastwise shipping lanes where the tidal current is frequently rotary.

# 2.162 Coastal Defense

General term used to encompass both coast protection against erosion and sea defense against flooding.

# 2.163 Coastal Forcing

The natural processes which drive coastal hydro and morphodynamics. (e.g. winds, waves, tides, etc.)

# 2.164 Coastal Groundwater Discharge

# The discharge of groundwater into coastal waters, which includes both fresh and saline groundwater contributions.

# 2.165 Coastal Plain

The plain composed of horizontal or gently sloping strata of clastic materials, generally representing a strip of sea bottom that has emerged from the sea in recent geologic time.

# 2.166 Coastal Processes

Collective term covering the action of natural forces on the shoreline, and near shore seabed.

# 2.167 Coastal Strip

A zone directly adjacent to the waterline, where only coast related activities take place. Usually this is a strip of some 100 m wide. In this strip the coastal defense activities take place. In this strip often there are restrictions to land use.

# 2.168 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.

# 2.169 Coastal Zone Management

The integrated and general development of the coastal zone. Coastal Zone Management is not restricted to coastal defense works, but includes also a development in economical, ecological and social terms. Coastline Management is a part of Coastal Zone Management.

# 2.170 Coastline

1. Technically, the line that forms the boundary between the coast and the shore.

1. Commonly, the line that forms the boundary between the land and the water, especially. The water of a sea or ocean.

# 2.171 Cobble (Cobblestone)

A rock fragment between 64 and 256 mm in diameter, usually rounded. *See* soil classification.

# 2.172 Cofferdam

A temporary watertight structure enclosing all or part of the construction area so that construction can proceed in the dry.

# 2.173 Cohesive Sediment

Sediment containing significant proportion of clays, the electromagnetic properties of which cause the sediment to bind together.

# 2.174 Colloid

As a size term refers to particles smaller than 0.00024 mm, smaller than clay size.

# 2.175 Comber

1. A deepwater wave whose crest is pushed forward by a strong wind; much larger than a whitecap.
2. A long-period breaker.

# 2.176 Competence

The ability of a wind or water current to transport detritus, in terms of particle size rather than amount, measured as the diameter of the largest particles.

# 2.177 Complex Spit

A large recurved spit with secondary spits developed at its end. Example: Sandy Hook, New Jersey, coastal stretch between Kumarapuram and Koulthottam, kerala and Hukitola Bay, Odisha.

# 2.178 Confluence

The junction of two or more river reaches or branches (the opposite of a bifurcation).

# 2.179 Consolidation

The gradual, slow compression of a cohesive soil due to weight acting on it, which occurs as water is driven out of the voids in the soil. Consolidation only occurs in clays or other soils of low permeability.

# 2.180 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).

# 2.181 Continental Slope

The declivity from the offshore border of the continental shelf to oceanic depths. It is characterized by a marked increase in slope.

# 2.182 Contour

A line on a map or chart representing points of equal elevation with relation to a datum. It is called an isobath when connecting points of equal depth below a datum. Also called depth contour.

# 2.183 Controlling Depth

The least depth in the navigable parts of a waterway, governing the maximum draft of vessels that can enter.

# 2.184 Convergence

1. In refraction phenomena, the decreasing of the distance between orthogonals in the direction of wave travel. Denotes an area of increasing wave height and energy concentration.
2. In wind-setup phenomena, the increase in setup observed over that which would occur in an equivalent rectangular basin of uniform depth, caused by changes in planform or depth; also the decrease in basin width or depth causing such increase in setup.

# 2.185 Coral

1. (Biology) Marine coelenterates (Madreporaria), solitary or colonial, which form a hard external covering of calcium compounds or other materials. The corals which form large reefs are limited to warm, shallow waters, while those forming solitary, minute growths may be found in colder waters to great depths.
2. (Geology) The concretion of coral polyps, composed almost wholly of calcium carbonate, forming reefs and tree-like and globular masses. May also include calcareous algae and other organisms producing calcareous secretions, such as bryozoans and hydrozoans.

# 2.186 Coral Reef

A coral-algal mound or ridge of in-place coral colonies and skeletal fragments, carbonate sand, and organically-secreted calcium carbonate. A coral reef is built up around a wave-resistant framework, usually of older coral colonies.

# 2.187 Core

1. A cylindrical sample extracted from a beach or seabed to investigate the types and depths of sediment layers.
2. An inner, often much less permeable portion of a breakwater or barrier beach.

# 2.188 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.

# 2.189 Cove

A small, sheltered recess in a coast, often inside a larger embayment.

# 2.190 Cover Layer

The outer layer used in a rubble system as protection against external hydraulic loads.

# 2.191 Creek

1. A stream, less predominant than a river, and generally tributary to a river.
2. A small tidal channel through a coastal marsh.

# 2.192 Creep

Very slow, continuous downslope movement of soil or debris.

# 2.193 Crenulate

An indented or wavy shoreline beach form, with the regular seaward- pointing parts are rounded rather than sharp, as in the cuspate type.

# 2.194 Crest

Highest point on a beach face, breakwater, or sea wall.

# 2.195 Crest Length, Wave

The length of a wave along its crest. Sometimes called crest width.

# 2.196 Crest of Wave

1. The highest part of a wave.
2. That part of the wave above still-water level.

# 2.197 Crest of Berm

The seaward limit of a berm. Also called berm edge.

# 2.198 Crest Width, Wave

*See* crest length, wave.

# 2.199 Cross-Bedding

An arrangement of relatively thin layers of rock inclined at an angle to the more nearly horizontal bedding planes of the larger rock unit. Also referred to as cross-stratification.

# 2.200 Cross-Shore

Perpendicular to the shoreline.

# 2.201 Crown Wall

Concrete superstructure on a rubble mound.

# Current

1. The flowing of water, or other liquid or gas.
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:
4. 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;
5. Temporary - due to seasonal winds;
6. 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;
7. Nearshore - caused principally by waves breaking along a shore.

# Current, Coastal

One of the offshore currents flowing generally parallel to the shoreline in the deeper water beyond and near the surf zone; these are not related genetically to waves and resulting surf, but may be related to tides, winds, or distribution of mass.

# 2.204 Current, Drift

A broad, shallow, slow-moving ocean or lake current. Opposite of current, stream.

# 2.205 Current, Ebb

The tidal current away from shore or down a tidal stream. Usually associated with the decrease in the height of the tide.

# 2.206 Current, Eddy

*See* eddy.

# 2.207 Current, Feeder

Any of the parts of the nearshore current system that flow parallel to shore before converging and forming the neck of the rip current.

# 2.208 Current, Flood

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

# 2.209 Current, Inshore

*See* inshore current.

# 2.210 Current, Littoral

Any current in the littoral zone caused primarily by wave action; e.g., longshore current, rip current. *See* also current, near­shore.

# 2.211 Current, Longshore

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

# 2.212 Current Meter

An instrument for measuring the velocity of a current

# 2.213 Current, Nearshore

A current in the nearshore zone.

# 2.214 Current, Offshore

*See* offshore current.

# 2.215 Current, Periodic

*See* current, tidal.

# 2.216 Current, Permanent

*See* permanent current.

# 2.217 Current, Rip

*See* rip current.

# 2.218 Current, Stream

A narrow, deep, and swift ocean current, as the East India Coastal Current, Gulf Stream. *See* current, drift.

# 2.219 Current System, Nearshore

*See* nearshore current system.

# 2.220 Current, Tidal

The alternating horizontal movement of water associated with the rise and fall of the tide caused by the astronomical tide-producing forces. This is also called current, periodic. *See* also current, flood and current, ebb.

# 2.221 Current-Refraction

Process by which wave velocity, height, and direction are affected by a current

# 2.222 Cusp

One of a series of short ridges on the foreshore separated by crescent-shaped troughs spaced at more or less regular intervals. Between these cusps are hollows. The cusps are spaced at somewhat uniform distances along beaches. They represent a combination of constructive and destructive processes. Also called beach cusp.

# 2.223 Cuspate Bar

A crescent-shaped bar uniting with the shore at each end. It may be formed by a single spit growing from shore and then turning back to again meet the shore, or by two spits growing from the shore and uniting to form a bar of sharply cuspate form.

# 2.224 Cuspate Spit

The spit that forms in the lee of a shoal or offshore feature (breakwater, island, rock outcrop) by waves that are refracted and/or diffracted around the offshore feature. It may eventually grow into a tombolo linking the feature to the mainland.

# 2.225 Cycloidal Wave

A steep, symmetrical wave whose crest forms an angle of 120 degrees and whose form is that of a cycloid. A trochoidal wave of maximum steepness. *See* also trochoidal wave.

# 2.226 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 as hurricanes in the Atlantic.

# 2.227 Dam

Structure built in rivers or estuaries, basically to separate water at both sides and/or to retain water at one side.

# 2.228 Datum

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

# 2.229 Datum, Chart

*See* chart datum.

# 2.230 Datum, Plane

The horizontal plane to which soundings, ground elevations, or water surface elevations are referred. Also called reference plane. The plane is called a tidal datum when defined by a certain phase of the tide. The following datums are ordinarily used on hydrographic charts: Mean Low Water —Atlantic coast (U. S.), Argentina, Sweden, and Norway. Mean Lower Low Water —Pacific coast (U. S.). Mean Low Water Springs —United Kingdom, Germany, Italy, Brazil, and Chile. Low Water Datum — Great Lakes (U. S. and Canada). Lowest Low Water Springs — Portugal. Low Water Indian Springs — India and Japan (See Indian Tide Plane). Lowest Low Water — France, Spain, and Greece. A common datum used on United States topographic maps is Mean Sea Level. *See* also Bench Mark.

# 2.231 Davidson Current

Deep-ocean boundary current off the west coast of the U.S. which brings warmer, saltier, low oxygen, high phosphate equatorial type water from low to high latitudes.

# 2.232 Debris Line

A line near the limit of storm wave uprush marking the landward limit of debris deposits.

# 2.233 Decay Area

Area of relative calm through which waves travel after emerging from the generating area.

# 2.234 Decay Distance

The distance waves travel after leaving the generating area (fetch).

# 2.235 Decay of Waves

The change waves undergo after they leave a generating area (fetch) and pass through a calm, or region of lighter winds. In the process of decay, the significant wave height decreases and the significant wavelength increases.

# 2.236 Deep Water

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. Compare Shallow Water.

# 2.237 Deep Water Waves

A wave in water where the depth is greater than half the wave length.

# 2.238 Deflation

The removal of loose material from a beach or other land surface by wind action.

# 2.239 Degradation

The geologic process by which various parts of Earth’s surface are worn away and their general level lowered, typically by the action of wind and water.

# 2.240 Delta

1. An alluvial deposit, usually triangular or semi-circular, at the mouth of a river or stream. The delta is normally built up only where there is no tidal or current action capable of removing the sediment at the same rate as it is deposited, and hence the delta builds forward from the coastline.
2. A tidal delta is a similar deposit at the mouth of a tidal inlet, put there by tidal currents.

# 2.241 Delta Plain

The nearly-level surface composing the landward portion of a large delta.

# 2.242 Density

Mass (in kg) per unit volume of a substance; kg/m3. For pure water, the density is 1000 kg/m3, for seawater the density is usually more. Density increases with increasing salinity, and decreases with increasing temperature. More information can be found in "properties of seawater". For stone and sand, usually a density of 2600 kg/m3 is assumed. Concrete is less dense, in the order of 2400 kg/m3. Some types of basalt may reach 2800 kg/m3. For sand, including the voids, one may use 1600 kg/m3, while mud often has a density of 1100 - 1200 kg/m3.

# 2.243 Density Current

Phenomenon of relative flow within water due to difference in density.

# 2.244 Density Stratification

The lateral expansion of a sediment plume as it moves out of the distributary mouth, where salt and fresh water mix. This is most likely to occur where the speed of the river flow is moderate to low and the distributary mouth is relatively deep.

# 2.245 Density-Driven Circulation

Variations in salinity create variations in density in estuaries. These variations in density create horizontal pressure gradients, which drive estuarine circulation.

# 2.246 Depression

A general term signifying any depressed or lower area in the ocean floor.

# 2.247 Depth

The vertical distance from a specified datum to the sea floor.

# 2.248 Depth Contour

*See* contour, also isobath.

# 2.249 Depth, Controlling

*See* controlling depth.

# 2.250 Depth Factor

*See* shoaling coefficient.

# 2.251 Depth of Breaking

The still-water depth at the point where the wave breaks. Also called breaker depth.

# 2.252 Derrick Stone

*See* stone, derrick.

# 2.253 Desalination

# The process of removing salts and other minerals from seawater to produce freshwater.

# 2.254 Design Hurricane

*See* hypothetical hurricane.

# 2.255 Design Storm

A hypothetical extreme storm whose waves 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.

# 2.256 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.

# 2.257 Design Wave Condition

Usually an extreme wave condition with a specified return period used in the design of coastal works.

# 2.258 Detached Breakwater

A breakwater without any subaerial connection to the shore.

# 2.259 Detritus

Small fragments of rock which have been worn or broken away from a mass by the action of water or waves.

# 2.260 Differential Erosion / Weathering

These features develop in rocks which have varying resistance to the agencies of erosion and/or weathering so that parts of the rock are removed at greater rates than others. A typical example is the removal of soft layers between harder beds in a series of sedimentary rocks. The term may be applied to any size of feature, from small-scale etching to the regional development of hills and valleys controlled by hard and soft rocks.

# 2.261 Diffraction (of water waves)

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.

# 2.262 Diffraction Coefficient

Ratio of diffracted wave height to deep water wave height.

# 2.263 Dike

Earth structure along sea or river in order to protect low lands from flooding by high water; dikes along rivers are sometimes called levees, sometimes also written as dyke.

# 2.264 Discharge

The volume of water per unit of time flowing along a pipe or channel.

# 2.265 Ditch

A channel to convey water for irrigation or drainage.

# 2.266 Diurna

Having a period or cycle of approximately one tidal day.

# 2.267 Diurnal Current

The type of tidal current having only one flood and one ebb period in the tidal day. A Rotary Current is diurnal if it changes its direction through all points of the compass once each tidal day.

# 2.268 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.

# 2.269 Diurnal Tide

A tide with one high water and one low water in a tidal day.

# 2.270 Divergence

1. In refraction phenomena, the increasing of distance between orthogonals in the direction of wave travel. It denotes an area of decreasing wave height and energy concentration.
2. In wind-setup phenomena, the decrease in setup observed under that which would occur in an equivalent rectangular basin of uniform depth, caused by changes in planform or depth. Also, the increase in basin width or depth causing such decrease in setup.

# 2.271 Diverging Wave

Waves that move obliquely out from a vessel’s sailing line.

# 2.272 Diversion Channel

A waterway used to divert water from its natural course. The term is generally applied to a temporary arrangement e.g. to by-pass water around a dam site during construction.

# 2.273 Dock

The slip or waterway between two piers, or cut into the land, for the reception of ships.

# 2.274 Dolphin

A cluster of piles.

# 2.275 Downdrift

The direction of predominant movement of littoral materials.

# 2.276 Downstream

Along coasts with obliquely approaching waves there is a longshore (wave-driven) current. For this current, one can define an upstream and a downstream direction. For example, on a beach with an orientation West-East, the sea is to the North. Suppose the waves come from North West, then the current flows from West to East. Here, upstream is West of the observer, and East is downstream of the observer.

# 2.277 Downwelling

A downward movement (sinking) of surface water caused by onshore Ekman transport, converging currents, or when a water mass becomes denser than the surrounding water.

# 2.278 Drainage Basin

Total area drained by a stream and its tributaries.

# 2.279 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.

# 2.280 Drift

1. Sometimes used as a short form for littoral drift.
2. The speed at which a current runs.
3. Floating material deposited on a beach (driftwood
4. A deposit of a continental ice sheet; e.g., a drumlin.

# 2.281 Drift Current

A broad, shallow, slow-moving ocean or lake current.

# 2.282 Drift Sector

A particular reach of marine shore in which littoral drift may occur without significant interruption, and which contain any and all natural sources of such drift, and also any accretion shore forms accreted by such drift.

# 2.283 Dromond

A large medieval fast-sailing galley or cutter.

# 2.284 Drowned Coast

A shore with long, narrow channels, implying that subsidence of the coast has transformed the lower portions of river valleys into tidal estuaries.

# 2.285 Drumlin

A low, smoothly-rounded, elongate hill of compact glacial till built under the margin of the ice and shaped by its flow.

# 2.286 Drying Beach

That part of the beach which is uncovered by water (e.g. at low tide). Sometimes referred to as 'subaerial' beach.

# 2.287 Dunes

1. Ridges or mounds of loose, wind-blown material, usually sand.
2. Bed forms smaller than bars but larger than ripples that are out of phase with any water-surface gravity waves associated with them.

# 2.288 Durability

The ability of a material to retain its physical and mechanical properties (i.e. resist degradation) in engineering service.

# 2.289 Duration

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

# 2.290 Duration, Minimum

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

# 2.291 Duration of Ebb

The interval of time in which a tidal current is ebbing, determined from the middle of the slack waters.

# 2.292 Duration of Fall

The interval from high water to low water.

# 2.293 Duration of Flood

The interval of time in which a tidal current is flooding, determined from the middle of slack waters.

# 2.294 Duration of Rise

The interval from low water to high water.

# 2.295 Dynamic Equilibrium

Short term morphological changes that do not affect the morphology over a long period.

# 2.296 Dynamic Viscosity

In fluid dynamics, the ratio between the shear stress acting along any plane between neighboring fluid elements and the rate of deformation of the velocity gradient perpendicular to this plane.

# 2.297 Eager

*See* bore.

# 2.298 Ebb

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

# 2.299 Ebb Current

The movement of a tidal current away from shore or down a tidal stream. In the semidiurnal type of reversing current, the terms greater ebb and lesser ebb are applied respectively to the ebb currents of greater and lesser velocity of each day. The terms of maximum ebb and minimum ebb are applied to the maximum and minimum velocities of a continuously running ebb current, the velocity alternately increasing and decreasing without coming to a slack or reversing. The expression maximum ebb is also applicable to any ebb current at the time of greatest velocity.

# 2.300 Ebb Interval

The interval between the transit of the moon over the meridian of a place and the time of the following strength of ebb.

# 2.301 Ebb Shield

High, landward margin of a flood-tidal shoal that helps divert ebb-tide currents around the shoal.

# 2.302 Ebb Strength

The ebb current at the time of maximum velocity.

# 2.303 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 inlet-associated bars and estuary entrance shoals.

# 2.304 Ebb Tide

The period of tide between high water and the succeeding low water; a falling tide.

# 2.305 Echo Sounder

An electronic instrument used to determine the depth of water by measuring the time interval between the emission of a sonic or ultrasonic signal and the return of its echo from the bottom.

# 2.306 Ecosystem

The living organisms and the nonliving environment interacting in a given area, encompassing the relationships between biological, geochemical, and geophysical systems.

# 2.307 Eddy

A circular movement of water formed on the side of a main current. Eddies may be created at points where the main stream passes projecting obstructions or where two adjacent currents flow counter to each other.

# 2.308 Eddy Current

*See* eddy.

# 2.309 Edge Wave

An ocean wave parallel to a coast, with crests normal to the shoreline. An edge wave may be standing or progressive. Its height diminishes rapidly seaward and is negligible at a distance of one wavelength offshore.

# 2.310 Ekman Transport

Resultant flow at right angles to and to the right of the wind direction (in the northern hemisphere) referred to as upwelling and downwelling.

# 2.311 Elevation

The vertical distance from mean sea level or other established datum plane to a point on the earth's surface; height above sea level. Although sea floor elevation below MSL should be marked as a negative value, many charts show positive numerals for water depth.

# 2.312 El Niño

Warm equatorial water which flows southward along the coast of Peru and Ecuador during February and March of certain years. It is caused by poleward motions of air and unusual water temperature patterns in the Pacific Ocean, which cause coastal downwelling, leading to the reversal in the normal north-flowing cold coastal currents. During many El Niño years, storms, rainfall, and other meteorological phenomena in the western Hemisphere are measurably different than during non-El Niño years.

# 2.313 Elutriation

The process by which a granular material can be sorted into its constituent particle sizes by means of a moving stream of fluid (usually air or water). Elutriators are extensively used in studies of sediments for determining Particle size distribution. Under certain circumstances wind, rivers and streams may act as elutriating agents.

# 2.314 Embankment

Fill material, usually earth or rock, placed with sloping sides and with a length greater than its height. Usually an embankment is wider than a dike.

# 2.315 Embayment

An indentation in the shoreline forming an open bay.

# 2.316 Emergent Coast

A coast in which land formerly under water has recently been exposed above sea level, either due to uplift of the land or a drop in sea level.

# 2.317 Endemic

Native or confined to a specific geographic area.

# 2.318 Energy Coefficient

The ratio of the energy in a wave per unit crest length transmitted forward with the wave at a point in shallow water to the energy in a wave per unit crest length transmitted forward with the wave in deep water. On refraction diagrams, this is equal to the ratio of the distance between a pair of orthogonals at a selected shallow-water point to the distance between the same pair of orthogonals in deep water. It is also the square of the refraction coefficient.

# 2.319 Entrance

The avenue of access or opening to a navigable channel or inlet.

# 2.320 Eolian (Aeolian)

Pertaining to the wind, especially used with deposits such as loess and dune sand, and sedimentary structures like wind-formed ripple marks.

# 2.321 Eolian Sands

Sediments of sand size or smaller which have been transported by winds. They may be recognized in marine deposits off desert coasts by the greater angularity of the grains compared with water­borne particles.

# 2.322 Equatorial Currents

1. Ocean currents flowing westerly near the equator. There are two such currents in both the Atlantic and Pacific Oceans. The one to the north of the equator is called the North Equatorial Current and the one to the south is called the South Equatorial Current. Between these two currents there is an easterly flowing stream known as the Equatorial Countercurrent.
2. Tidal currents occurring semimonthly as a result of the moon being over the equator. At these times the tendency of the moon to produce Diurnal Inequality in the current is at a minimum.

# 2.323 Equatorial Tides

Tides occurring semimonthly due to the moon’s position over the equator. At these times, the tendency of the moon to produce a Diurnal Inequality in the tide is minimal.

# 2.324 Erosion

The wearing away of land by the action of natural forces. On a beach, the beach material is carried away by wave action, tidal currents, littoral currents, or by deflation.

# 2.325 Escarpment

A more or less continuous line of cliffs or steep slopes facing in one general direction which are caused by erosion or faulting. It is also called scarp.

# 2.326 Estuarine Restoration

It means restoring an area of estuary habitat to a successful, self-sustaining ecosystem by means of activities like baseline assessments, setting performance standards and defining long-term monitoring and conservation plans, restoring physical and hydrological conditions, reducing inflow of nutrients, BOD and other pollutants, chemical cleanup of toxins and revegetation of an area through native plantings or natural regrowth.

# 2.327 Estuary

1. The part of a river that is affected by tides.
2. 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.

# 2.328 Eustatic Sea Level Change

Change in the relative volume of the world’s ocean basins and the total amount of ocean water.

# 2.329 Eye

In meteorology, usually, the "eye of the storm" (hurricane) is the roughly circular area of comparatively light winds and fair weather found at the center of a severe tropical cyclone.

# 2.330 Fairway

The parts of a waterway that are open and unobstructed for navigation. The main traveled part of a waterway; a marine thoroughfare.

# 2.331 Far-Infragravity

The frequency band (nominally 0.001 - 0.02 Hz) occupied by shear instabilities of the longshore current. This band falls both below and in the lower part of the Infragravity band occupied by Infragravity waves.

# 2.332 Fathom

A unit of measurement used for soundings equal to 1.83 meters (6 feet).

# 2.333 Fathometer

The copyrighted trademark for a type of echo sounder.

# 2.334 Fault

A fracture in rock along which there has been an observable amount of displacement. Faults are rarely single planar units; normally they occur as parallel to sub-parallel sets of planes along which movement has taken place to a greater or lesser extent. Such sets are called fault or fracture-zones.

# 2.335 Fauna

The entire group of animals found in an area.

# 2.336 Feeder Beach

An artificially widened beach serving to nourish downdrift beaches by natural littoral currents or forces.

# 2.337 Feeder Current

*See* current, feeder.

# 2.338 Feeling Bottom

The initial action of a deepwater wave, in response to the bottom, upon running into shoal water.

# 2.339 Fetch

The area in which seas are generated by a wind having a fairly constant direction and speed. Sometimes used synonymously with fetch length. It is also called generating area.

# 2.340 Fetch Length

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

# 2.341 Fetch-Limited

Situation in which wave energy (or wave height) is limited by the size of the wave generation area (fetch).

# 2.342 Filter

Intermediate layer, preventing fine materials of an underlayer from being washed through the voids of an upper layer.

# 2.343 Fiord (Fjord)

A narrow, deep, steep-walled inlet of the sea, usually formed by entrance of the sea into a deep glacial trough.

# 2.344 Firth

A narrow arm of the sea; also, the opening of a river into the sea.

# 2.345 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.

# 2.346 Flood Channel

Channel located on ebb-tidal shoal that carries the flood tide over the tidal flat into the back bay or lagoon.

# 2.347 Flood Current

The movement of a tidal current toward the shore or up a tidal stream. In the semidiurnal type of reversing current, the terms greater flood and lesser flood are applied respectively to the flood currents of greater and lesser velocity each day. The terms maximum flood and minimum flood are applied to the maximum and minimum velocities of a flood current the velocity of which alternately increases and decreases without coming to slack or reversing. The expression maximum flood is also applicable to any flood current at the time of greatest velocity.

# 2.348 Flood Gate

A gravity outlet fitted with vertically-hinged doors, opening if the inner water level is higher than the outer water level, so that drainage takes place during low water.

# 2.349 Flood Interval

The interval between the transit of the moon over the meridian of a place and the time of the following flood.

# 2.350 Flood Mark

Proof of any kind on the shoreline, or on structures like bridge abutments, used to determine the highest level attained by the water surface during the flood (note: the height of the flood mark usually includes the wave run-up).

# 2.351 Flood Plain

1. A flat tract of land bordering a river, mainly in its lower reaches, and consisting of ALLUVIUM deposited by the river. It is formed by the sweeping of the meander belts downstream, thus widening the valley, the sides of which may become some kilometers apart. In time of flood, when the river overflows its banks, sediment is deposited along the valley banks and plains.
2. Synonymous with 100-year floodplain. The land area susceptible to being inundated by stream derived waters with a 1 percent chance of being equaled or exceeded in any given year.

# 2.352 Flood Ramp

Seaward-dipping sand platform dominated by flood-tidal currents, located on ebb-tidal shoal near the opening to the inlet.

# 2.353 Flood Routing

The determination of the attenuating effect of storage on a river-flood passing through a valley by reason of a feature acting as control (e.g. a reservoir with a spillway capacity less than the flood inflow, or the widening or narrowing of a valley).

# 2.354 Flood Tidal Delta

The bulge of sand formed at the landward mouth of tidal inlets as a result of flow expansion.

# 2.355 Flood Tide

The period of tide between low water and the succeeding high water; a rising tide.

# 2.356 Flood Wall, Splash Wall

Wall, retired from the seaward edge of the seawall crest, to prevent water from flowing onto the land behind.

# 2.357 Flora

The entire group of plants found in an area.

# 2.358 Fluvial

It is of or pertaining to rivers; produced by the action of a river or stream (e.g., fluvial sediment).

# 2.359 Flushing Time

The time required to replace all the water in an Estuary, Harbor, etc., by the action of current and tide.

# 2.360 Foam Line

1. The front of a wave as it advances shoreward, after it has broken.
2. Lines of foam such as those which move around the head of a rip.

# 2.361 Following Wind

Generally, the same as a tailwind; in wave forecasting, wind blowing in the direction of ocean-wave advance.

# 2.362 Foredune

The front dune immediately behind the backshore.

, knots, or miles per hour.

# 2.363 Forerunner

Low, long-period ocean swell which commonly precedes the main swell from a distant storm, especially a tropical cyclone.

# 2.364 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. *See* beach face.

# 2.365 Fore Reef

The seaward side of a reef (usually coral); in places a steep slope covered with reef talus.

# 2.366 Forward Speed (Hurricane)

Rate of movement (propagation) of the hurricane eye in meters per second.

# 2.367 Freeboard

At a given time, the vertical distance between the water level and the top of the structure. On a ship, the distance from the waterline to main deck or gunwale.

# 2.368 Fringing Reef

A coral reef attached directly to an insular or continental shore. There may be a shallow channel or lagoon between the reef and the adjacent mainland.

# 2.369 Front of the Fetch

In wave forecasting, the end of the generating area toward which the wind is blowing.

# 2.370 Froude Number

The dimensionless ratio of the inertial force to the force of gravity for a given fluid flow. It may be given as $Fr =\frac{V}{\sqrt{Lg}}$ where V is a characteristic velocity, L is a characteristic length, and g is the acceleration of gravity.

# 2.371 Fully-Developed 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.

# 2.372 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.

# 2.373 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 (*see* Beaufort scale).

# 2.374 Gauge (Gage)

Instrument for measuring the water level relative to a datum.

# 2.375 Generating Area

In wave forecasting, the continuous area of water surface over which the wind blows in nearly a constant direction. Sometimes it is synonymously used with fetch length. It is also called fetch.

# 2.376 Geographical Information System (GIS)

Database of information which is geographically referenced, usually with an associated visualization system.

# 2.377 Geometric Mean Diameter

The diameter equivalent of the arithmetic mean of the logarithmic frequency distribution. In the analysis of beach sands, it is taken as that grain diameter determined graphically by the inter­section of a straight line through selected boundary sizes, (generally points on the distribution curve where 16 and 84 percent of the sample is coarser by weight) and a vertical line through the median diameter of the sample.

# 2.378 Geometric Shadow

In wave diffraction theory, the area outlined by drawing straight lines paralleling the direction of wave approach through the extremities of a protective structure. It differs from the actual protected area to the extent that the diffraction and refraction effects modify the wave pattern.

# 2.379 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.

# 2.380 Geophysics

The study of the physical characteristics and properties of the earth, usually employing quantitative physical methods.

# 2.381 Geotextile

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

# 2.382 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.

# 2.383 Glacio-Isostacy

The state of hydrostatic equilibrium of the Earth’s crust as influenced by the weight of glacier ice.

# 2.384 Global Positioning System (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.

# 2.385 Gorge

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

# 2.386 Graded Bedding

An arrangement of particle sizes within a single bed, with coarse grains at the bottom of the bed and progressively finer grains toward the top of the bed.

# 2.387 Gradient

1. A measure of slope (soil- or water-surface) in meters of rise or fall per meter of horizontal distance.
2. More general, a change of a value per unit of distance, e.g. the gradient in longshore transport causes erosion or accretion.
3. With reference to winds or currents, the rate of increase or decrease in speed, usually in the vertical; or the curve that represents this rate.

# 2.388 Grading

Distribution, with regard to size or weight, of individual stones within a bulk volume; heavy, light and fine grading are distinguished.

# 2.389 Gradual Closure Method

Method in which the final closure gap in a dam is closed gradually either by the vertical or horizontal closure method; this in contradiction with a sudden closure.

# 2.390 Granular Filter

Band of granular material which is incorporated in an embankment, dam, dike, or bottom protection and is graded so as to allow seepage to flow across or down the filter zone without causing the migration of the material adjacent to the filter.

# 2.391 Gravel

Unconsolidated natural accumulation of rounded rock fragments coarser than sand but finer than pebbles (2-4 mm diameter).

# 2.392 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 intermediate zone between capillary and gravity waves. *See* ripple.

# 2.393 Groin (British, Groyne)

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. *See* T-Groin, permeable groin, impermeable groin.

# 2.394 Groin Bay

The beach compartment between two groins.

# 2.395 Groin System

A series of groins acting together to protect a section of beach. They are commonly called a groin field.

# 2.396 Gulf

A relatively large portion of the ocean or sea extending far into land; the largest of various forms of inlets of the sea (e.g., Gulf of Mexico, Gulf of Aqaba).

# 2.397 Gut

A tidal stream connecting two larger waterways.

# 2.398 Halocline

A zone in which salinity changes rapidly.

# 2.399 Half-Tide Level

A plane midway between mean high water and mean low water, also called mean tide level.

# 2.400 Harbor (British, Harbour)

Any protected water area affording a place of safety for vessels. *See* also port.

# 2.401 Harbor Oscillation (Harbor Surging)

The non-tidal vertical water movement in a harbor or bay. Usually, the vertical motions are low; but when oscillations are excited by a tsunami or storm surge, they may be quite large. Variable winds, air oscillations, or surf beat may also cause oscillations. *See* seiche.

# 2.402 Hard Defenses

General term applied to impermeable coastal defense structures of concrete, timber, steel, masonry, etc., which reflect a high proportion of incident wave energy.

# 2.403 Head of Rip

The part of a rip current that has widened out seaward of the breakers. *See* also current, rip; current, feeder; and neck (rip).

# 2.404 Headland (Head)

1. A comparatively high promontory with either a cliff or steep face extending out into a body of water, such as a sea or lake. An unnamed head is usually called a headland.
2. The section of rip current which has widened out seaward of the breakers, also called head of rip.
3. Seaward end of breakwater or dam.

# 2.405 Headwater Level

The level of water in the reservoir.

# 2.406 Heave

1. The vertical rise or fall of the waves or the sea.
2. The translational movement of a craft parallel to its vertical axis.
3. The net transport of a floating body resulting from wave action.

# 2.407 High Seas

This term, in municipal and international law, denotes the continuous body of salt water in the world that is navigable in its character and that lies outside territorial waters and maritime belts of the various countries.

# 2.408 High Tide, High Water (HW)

The maximum elevation reached by each rising tide. *See* tide.

# 2.409 High Water (HW)

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. Non-technically, also called the high tide.

# 2.410 High Water Line

In strictness, the intersection of the plane of mean high water with the shore. The shoreline delineated on the nautical charts of the National Ocean Service is an approximation of the high water line. For specific occurrences, the highest elevation on the shore reached during a storm or rising tide, including meteorological effects.

# 2.411 High Water Mark

A reference mark on a structure or natural object, indicating the maximum stage of tide or flood.

# 2.412 High Water of Ordinary Spring Tides (HWOST)

A tidal datum appearing in some British publications, based on high water of ordinary spring tides.

# 2.413 Higher High Water (HHW)

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.

# 2.414 Higher Low Water (HLW)

The higher of two low waters of any tidal day.

# 2.415 Highest Astronomical Tide (HAT)

The highest level of water which can be predicted to occur under any combination of astronomical conditions. This level may not be reached every year.

# 2.416 Hindcasting

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

# 2.417 Hinterland

The region lying inland from the coast. Also, the inland area served by a port.

# 2.418 Historic Event Analysis

Extreme analysis based on hindcasting typically ten events over a period of 100 years.

# 2.419 Holocene

An epoch of the quaternary period, from the end of the Pleistocene, about 8,000 years ago, to the present time. Syn: Recent.

# 2.420 Homopycnal Flow

A condition in which the outflow jet from a river or coastal inlet and the water in the receiving basin are of the same density or are vertically mixed.

# 2.421 Hook

A spit or narrow cape of sand or gravel which turns landward at the outer end; a recurved spit.

# 2.422 Horizontal Closure Method

Construction of a dam by dumping the materials from one or both banks, thus constricting the channel progressively laterally until the dam is closed. This method is also known as end dumping and point tipping.

# 2.423 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 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.

# 2.424 Hurricane Path or Track

Line of movement (propagation) of the eye through an area.

# 2.425 Hurricane Stage Hydrograph

A continuous graph representing water level stages that would be recorded in a gage well located at a specified point of interest during the passage of a particular hurricane, assuming that effects of relatively short-period waves are eliminated from the record by damping features of the gage well. Unless specifically excluded and separately accounted for, hurricane surge hydrographs are assumed to include effects of astronomical tides, barometric pressure differences, and all other factors that influence water level stages within a properly designed gage well located at a specified point.

# 2.426 Hurricane Wind Pattern or Isovel Pattern

An actual or graphical representation of near-surface wind velocities covering the entire area of a hurricane at a particular instant. Isovels are lines connecting points of simultaneous equal wind velocities, usually referenced 9 meters (30 feet) above the surface, in meters per second, knots, or meters per hour; wind directions at various points are indicated by arrows or deflection angles on the isovel charts. Isovel charts are usually prepared at each hour during a hurricane, but for each half hour during critical periods.

# 2.427 Hydraulic Radius

Quotient of the wetted cross-sectional area and the wetted perimeter.

# 2.428 Hydraulically Equivalent Grains

Sedimentary particles that settle at the same rate under the same conditions.

# 2.429 Hydrography

1. The description and study of seas, lakes, rivers and other waters.
2. The science of locating aids and dangers to navigation.
3. The description of physical properties of the waters of a region.

# 2.430 Hydrographic Pressure

The pressure exerted by water at any given point in a body of water at rest.

# 2.431 Hypopycnal Flow

Outflow from a river or coastal inlet in which a wedge of less dense water flows over the denser sea water.

# 2.432 Hypothetical Hurricane ("Hypo hurricane")

A representation of a hurricane, with specified characteristics, that is assumed to occur in a particular study area, following a specified path and timing sequence.

* Transposed — A hypo hurricane based on the storm transposition principle, assumed to have wind patterns and other characteristics basically comparable to a specified hurricane of record, but transposed to follow a new path to serve as a basis for computing a hurricane surge hydrograph that would be expected at a selected point. Moderate adjustments in timing or rate of forward movement may also be made, if these are compatible with meteorological considerations and study objectives.
* Hypo hurricane Based on Generalized Parameters — Hypo hurricane estimates based on various logical combinations of hurricane characteristics used in estimating hurricane surge magnitudes corresponding to a range of probabilities and potentialities. The standard project hurricane is most commonly used for this purpose, but estimates corresponding to more or less severe assumptions are important in some project investigations.
* Standard Project Hurricane (SPH) — A hypothetical hurricane intended to represent the most severe combination of hurricane parameters that is reasonably characteristic of a specified region, excluding extremely rare combinations. It is further assumed that the SPH would approach a given project site from such direction, and at such rate of movement, to produce the highest hurricane surge hydrograph, considering pertinent hydraulic characteristics of the area. Based on this concept, and on extensive meteorological studies and probability analyses, a tabulation of "Standard Project Hurricane Index Characteristics" mutually agreed upon by representatives of the U. S. Weather Service and the Corps of Engineers, is available.
* Probable Maximum Hurricane — A hypo hurricane that might result from the most severe combination of hurricane parameters that is considered reasonably possible in the region involved, if the hurricane should approach the point under study along a critical path and at optimum rate of movement. This estimate is substantially more severe than the SPH criteria.
* Design Hurricane — A representation of a hurricane with specified charac­teristics that would produce hurricane surge hydrographs and coincident wave effects at various key locations along a proposed project alignment. It governs the project design after economics and other factors have been duly considered. The design hurricane may be more or less severe than the SPH, depending on economics, risk, and local considerations.

# 2.433 Ice Age

A loosely used synonym of glacial epoch, or time of extensive glacial activity; specifically refers to the latest period of widespread continental glaciers, the Pleistocene Epoch.

# 2.434 Ice Front

The floating vertical cliff forming the seaward edge of an ice shelf or other glacier that enters the sea.

# 2.435 Ice Shelf

An extensive sheet of ice which is attached to the land along one side but most of which is afloat and bounded on the seaward side by a steep cliff (ice front) rising 2 to 50 + m above the sea level. They are ommon along polar coasts (Antarctica, Greenland), and generally of great breadth, and sometimes extending tens or hundreds of km seaward from the continental coastline.

# 2.436 Impermeable Groin

A groin constructed such that sand cannot pass through the structure (but sand may still move over or around it).

# 2.437 Impulsive Wave

Waves that tend to break onto the coast and coastal structures.

# 2.438 Incident Wave

Wave moving landward.

# 2.439 Indian Spring Low Water

The approximate level of the mean of lower low waters at spring tides, used principally in the Indian Ocean and along the east coast of Asia. S*ee* also Indian Tide Plane.

# 2.440 Indian Tide Plane

The datum of Indian spring low water.

# 2.441 Infragravity Wave

Long waves with periods of 30 seconds to several minutes.

# 2.442 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. *See* also tidal inlet.

# 2.443 Inlet Gorge

Generally, the deepest region of an inlet channel.

# 2.444 Inshore (Zone)

In beach terminology, the zone of variable width extending from the low water line through the breaker zone. It is also called shoreface.

# 2.445 Inshore Current

Any current in or landward of the breaker zone.

# 2.446 Insular Shelf

The zone surrounding an island extending from the low water line to the depth (usually about 183 m; 100 fathoms) where there is a marked or rather steep descent toward the great depths.

# 2.447 Internal Waves

Waves that occur within a fluid whose density changes with depth, either abruptly at a sharp surface of discontinuity (an interface), or gradually. Their amplitude is greatest at the density discontinuity or, in the case of a gradual density change, somewhere in the interior of the fluid and not at the free upper surface where the surface waves have their maximum amplitude.

# 2.448 Intertidal

The zone between the high and low water tides.

# 2.449 Irregular Waves

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

# 2.450 Irrotational Wave

A wave with fluid particles that do not revolve around an axis through their centers, although the particles themselves may travel in circular or nearly circular orbits. Irrotational waves may be progressive, standing, oscillatory, or translatory. For example, the Airy, Stokes, cnoidal, and solitary wave theories describe irrotational waves. *See* trochoidal wave.

# 2.451 Isobath

A contour line connecting points of equal water depths on a chart.

# 2.452 Isopachyte

Line connecting points on the seabed with an equal depth of sediment.

# 2.453 Isovel Pattern

*See* hurricane wind pattern.

# 2.454 Isthmus

A narrow strip of land, bordered on both sides by water, that connects two larger bodies of land.

# 2.455 Jet

To place (a pile, slab, or pipe) in the ground by means of a jet of water acting at the lower end.

# 2.456 Jetty

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. It is also called wharf or pier. *See* training wall.

# 2.457 Joint Probability

The probability of two (or more) eventsoccurring together.

# 2.458 Joint Probability Density

Function specifying the joint distribution of two (or more) variables.

# 2.459 Joint Return Period

Average period of time between occurrences of a given joint probability event.

# 2.460 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.

# 2.461 Katabatic Wind

Wind caused by cold air flowing down slopes due to gravitational acceleration.

# 2.462 Key

A cay, especially, one of the low, insular banks of sand, coral, and limestone off the southern coast of Florida.

# 2.463 Kinematic Viscosity

The dynamic viscosity divided by the fluid density.

# 2.464 Kinetic Energy (of Waves)

In a progressive oscillatory wave, a summation of the energy of motion of the particles within the wave.

# 2.465 Knoll

A submerged elevation of rounded shape rising less than 1000 meters from the ocean floor and of limited extent across the summit. Compare Seamount.

# 2.466 Knot

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

# 2.467 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.

# 2.468 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.

# 2.469 Laminar Flow

Slow, smooth flow, with each drop of water traveling a smooth path parallel to its neighboring drops. Laminar flow is characteristic of low velocities, and particles of sediment in the flow zones are moved by rolling or saltation.

# 2.470 Land Breeze

A light wind blowing from the land to the sea, caused by unequal cooling of land and water masses.

# 2.471 Land-Sea Breeze

The combination of a land breeze and a sea breeze as a diurnal phenomenon.

# 2.472 Landlocked

Enclosed, or nearly enclosed, by land-thus protected from the sea, as a bay or a harbor.

# 2.473 Landmark

A conspicuous object, natural or artificial, located near or on land, which aids in fixing the position of an observer.

# 2.474 Lead Line

A line, wire, or cord used in sounding (to obtain water depth). It is weighted at one end with a plummet (sounding lead). It is also called sounding line.

# 2.475 Ledge

A rocky formation forming a ridge or reef, especially one underwater or near shore.

# 2.476 Lee

1. Shelter, or the part or side sheltered or turned away from the wind or waves.
2. The quarter or region toward which the wind blows.

# 2.477 Leeward

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

# 2.478 Length of Wave

The horizontal distance between similar points on two successive waves measured perpendicularly to the crest.

# 2.479 Levee

1. A ridge or embankment of sand and silt, built up by a stream on its flood plain along both banks of its channel.
2. A large dike or artificial embankment, often having an access road along the top, which is designed as part of a system to protect land from floods.

# 2.480 Light Breeze

A wind with velocity from 4 to 6 knots.

# 2.481 Limit of Backrush (Limit of Backwash)

*See* backrush, backwash.

# 2.482 Littoral

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

# 2.483 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.

# 2.484 Littoral Current

*See* current, littoral.

# 2.485 Littoral Deposits

Deposits of littoral drift.

# 2.486 Littoral Drift, Littoral Transport

The movement of beach material in the littoral zone by waves and currents. Includes movement parallel (long shore drift) and sometimes also perpendicular (cross-shore transport) to the shore.

# 2.487 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.

# 2.488 Littoral Zone

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

# 2.489 Load

The quantity of sediment transported by a current. It includes the suspended load of small particles and the bedload of large particles that move along the bottom.

# 2.490 Long Waves

Waves with periods above about 30 seconds; can be generated by wave groups breaking in the surf zone. *See* also Infragravity waves.

# 2.491 Longshore

Parallel to and near the shoreline; alongshore.

# 2.492 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.

# 2.493 Longshore Current

*See* current, longshore.

# 2.494 Longshore Drift

Movement of (beach) sediments approximately parallel to the coastline.

# 2.495 Longshore Transport Rate

*See* littoral transport rate.

# 2.496 Longshore Trough

An elongate depression or series of depressions extending along the lower beach or in the offshore zone inside the breakers.

# 2.497 Loop

That part of a standing wave where the vertical motion is greatest and the horizontal velocities are least. Loops (sometimes called antinodes) are associated with clapotis and with seiche action resulting from wave reflections. *See* node.

# 2.498 Low Tide (Low Water, LW)

The minimum elevation reached by each falling tide. *See* tide

# 2.499 Low Tide Terrace

A flat zone of the beach near the low water level.

# 2.500 Low Water (LW)

The minimum height reached by each falling tide. Nontechnically, also called low tide.

# 2.501 Low Water Datum

An approximation to the plane of mean low water that has been adopted as a standard reference plane. *See* also datum, plane and chart datum.

# 2.502 Low Water Line

The line where the established low water datum intersects the shore. The plane of reference that constitutes the low water datum differs in different regions.

# 2.503 Low Water of Ordinary Spring Tides (LWOST)

A tidal datum appearing in some British publications, based on low water of ordinary spring tides.

# 2.504 Lower High Water (LHW)

The lower of the two high waters of any tidal day.

# 2.505 Lower Low Water Datum

An approximation to the plane of mean lower low water that has been adopted as a standard reference plane for a limited area and is retained for an indefinite period regardless of the fact that it may differ slightly from a better determination of mean lower low water from a subsequent series of observations.

# 2.506 Lower Low Water (LLW)

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.

# 2.507 Lowest Astronomical Tide (LAT)

The lowest tide level, which can be predicted to occur under average meteorological conditions and any combination of astronomical conditions. This level may not be reached every year. Also called tidal day.

# 2.508 Lunar Day

The time of rotation of the Earth with respect to the moon, or the interval between two successive upper transits of the moon over the meridian of a place. The mean lunar day is approximately 24.84 solar hours in length, or 1.035 times as great as the mean solar day. Also called tidal day.

# 2.509 Lunar Tide

The portion of the tide that can be attributed directly to attraction to the moon.

# 2.510 Mach-Stem Wave

Higher-than-normal wave generated when waves strike a structure at an oblique angle.

# 2.511 Macro-Tidal

Tidal range greater than 4 m.

# 2.512 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.

# 2.513 Mangrove

A tropical tree with interlacing prop roots, confined to low-lying brackish areas.

# 2.514 Margin, Continental

A zone separating a continent from the deep-sea bottom.

# 2.515 Marginal Probability

The probability of a single variable in the context of a joint probability analysis.

# 2.516 Marginal Return Period

The return period of a single variable in the context of a joint probability analysis.

# 2.517 Marigram

A graphic record of the rise and fall of the tide. The record is in the form of a curve in which time is represented by abscissas and the height of the tide by ordinates.

# 2.518 Marker, Reference

A mark of permanent character close to a survey station, to which it is related by an accurately measured distance and azimuth (or bearing).

# 2.519 Marker, Survey

An object placed at the site of a station to identify the surveyed location of that station.

# 2.520 Marsh

A tract of soft, wet land, usually vegetated by reeds, grasses and occasionally small shrubs.

Soft, wet area periodically or continuously flooded to a shallow depth, usually characterized by a particular subclass of grasses, cattails and other low plants.

# 2.521 Marsh, Diked

A former salt marsh which has been protected by a dike.

# 2.522 Marsh, Salt

A marsh periodically flooded by salt water.

# 2.523 Mass Transport, Shoreward

The movement of water due to wave motion, which carries water through the breaker zone in the direction of wave propagation. It is part of the nearshore current system.

# 2.524 Mattress

A blanket of brushwood or bamboo, poles, geotextile and reed lashed together to protect a shoreline, embankment or river/sea bed against erosion. Sometimes placed on the sea bed during jetty construction to prevent stone from settling into soft bottom.

# 2.525 Mean Depth

The average depth of the water area between the still water level and the shoreface profile from the waterline to any chosen distance seaward.

# 2.526 Mean Diameter, Geometric

*See* geometric mean diameter.

# 2.527 Mean High Water Springs (MHWS)

The average height of the high water occurring at the time of spring tides.

# 2.528 Mean High Water (MHW)

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.

# 2.529 Mean Higher High Water (MHHW)

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.

# 2.530 Mean Low Water (MLW)

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.

# 2.531 Mean Low Water Springs

The average height of low waters occurring at the time of the spring tides. It is usually derived by taking a plane depressed below the half-tide level by an amount equal to one-half the spring range of tide, necessary corrections being applied to reduce the result to a mean value. This plane is used to a considerable extent for hydrographic work outside of the United States and is the plane of reference for the Pacific approaches to the Panama Canal. Frequently abbreviated to low water springs.

# 2.532 Mean Lower Low Water (MLLW)

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.

# 2.533 Mean Range of Tide

The difference in height between mean high water and mean low water.

# 2.534 Mean Rise of the Tide

The height of mean high water above the plane of reference or datum of chart.

# 2.535 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.

# 2.536 Mean Steepness

The ratio of the mean depth to the horizontal distance over which the mean depth was determined.

# 2.537 Mean Tide Level

A plane midway between mean high water and mean low water. not necessarily equal to mean sea level. It is also called half-tide level.

# 2.538 Mean Water Level

The mean surface level as determined by averaging the heights of the water at equal intervals of time, usually at hourly intervals.

# 2.539 Mean Wave Height

The mean of all individual waves in an observation interval of approximately half an hour. In case of a Rayleigh-distribution 63% of the significant wave height.

# 2.540 Meandering

A single channel having a pattern of successive deviations in alignment which results in a more or less sinusoidal course.

# 2.541 Median Diameter

The diameter which marks the division of a given sand sample into two equal parts by weight, one part containing all grains larger than that diameter and the other part containing all grains smaller.

# 2.542 Megaripple

See SAND WAVE.

# 2.543 Meso-Tidal

Tidal range between 2 m and 4 m.

# 2.544 Meteorological Tides

Tidal constituents having their origin in the daily or seasonal variation in weather conditions which may occur with some degree of periodicity.

# 2.545 Micro-Tidal

Tidal range less than 2 m.

# 2.546 Mid-Extreme Tide

A plane midway between the extreme high water and the extreme low water occurring in any locality.

# 2.547 Middle-Ground Shoal

A shoal formed by ebb and flood tides in the middle of the channel of the lagoon or estuary end of an inlet.

# 2.548 Mineral

A naturally occurring, inorganic, crystalline solid that has a definite chemical composition and possesses characteristic physical properties.

# 2.549 Minimum Duration

*See* duration, minimum.

# 2.550 Minimum Fetch

The least distance in which steady-state wave conditions will develop for a wind of given speed blowing a given duration of time.

# 2.551 Mist

Water vapor suspended in the air in very small drops finer than rain, larger than fog.

# 2.552 Mixed Current

Type of tidal current characterized by a conspicuous velocity difference between the two floods or two ebbs usually occurring each tidal day.

# 2.553 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.

# 2.554 Mole

In coastal terminology, a massive land-connected, solid-fill structure of earth (generally revetted), masonry, or large stone, which may serve as a breakwater or pier.

# 2.555 Monochromatic Waves

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

# 2.556 Monolithic

Like a single stone or block. In coastal structures, the type of construction in which the structure's component parts are bound together to act as one.

# 2.557 Moraine

An accumulation of earth, stones, etc., deposited by a glacier, usually in the form of a mound, ridge or other prominence on the terrain.

# 2.558 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.

# 2.559 Morphologically Averaged

Single wave condition producing the same net longshore drift as a given proportion of the annual wave climate.

# 2.560 Morphology

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

# 2.561 Mud

A fluid-to-plastic mixture of finely divided particles of solid material and water.

# 2.562 Mud Flat

A level area of fine silt and clay along a shore alternately covered or uncovered by the tide or covered by shallow water.

# 2.563 National Tidal Datum Epoch (NTDE)

A period of 19 years adopted by the National Ocean Service as the period over which observations of tides are to be taken and reduced to average values for tidal datums.

# 2.564 Natural Tracer

A component of a sediment deposit that is unique to a particular source and can be used to identify the source and transport routes to a place of deposition.

# 2.565 Nautical Mile

The length of a minute of arc, 1/21,600 of an average great circle of the Earth. Generally, one minute of latitude is considered equal to one nautical mile. The accepted United States value as of 1 July 1959 is 1,852 meters (6,076.115 feet), approximately 1.15 times as long as the U.S. statute mile of 5,280 feet. Also geographical mile.

# 2.566 Neap High Water

*See* neap tide.

# 2.567 Neap Low Water

*See* neap tide.

# 2.568 Neap Range

*See* neap tide.

# 2.569 Neap Tidal Current

A tidal current of decreased velocity occurring semimonthly as the result of the moon being in quadrature.

# 2.570 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 and is of no practical significance where the type of tide is diurnal. The average height of the high waters of the neap tide is called neap high water or high water neaps (MHWN), and the average height of the corresponding low water is called neap low water or low water neaps (MLWN).

# 2.571 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.

# 2.572 Nearshore Circulation

The ocean circulation pattern composed of the nearshore currents and the coastal currents.

# 2.573 Nearshore Current System

The current system caused primarily by wave action in and near the breaker zone, and which consists of four parts: the shoreward mass transport of water; longshore currents; seaward return flow, including rip currents; and the longshore movement of the expanding heads of rip currents. *See* also nearshore circulation.

# 2.574 Neck

1. The narrow strip of land which connects a peninsula with the mainland, or connects two ridges.
2. The narrow band (rip) of water flowing seaward through the surf. *See* also rip current.

# 2.575 Ness

Roughly triangular promontory of land jutting into the sea, often consisting of mobile material, i.e. a beach form.

# 2.576 Network

A set consisting of:

1. lines stations for which geometric relationships have been determined and which are so related that removal of one station from the set will affect the relationships (distances, directions, coordinates, etc.) between the other stations; and
2. connecting the stations to show this interdependence.

# 2.577 Nip

The cut made by waves in a shoreline of emergence.

# 2.578 Nodal Zone

An area in which the predominant direction of the longshore transport changes.

# 2.579 Node

That part of a standing wave where the vertical motion is least and the horizontal velocities are greatest. Nodes are associated with clapotis and with seiche action resulting from wave reflections. *See* loop.

# 2.580 Nourishment

The process of replenishing a beach. It may occur naturally by longshore transport, or be brought about artificially by the deposition of dredged materials or of materials trucked in from upland sites.

# 2.581 Numerical Modeling

Refers to analysis of coastal processes using computational models.

# 2.582 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.

# 2.583 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.

# 2.584 Offshore Barrier

*See* barrier beach.

# 2.585 Offshore Breakwater

A breakwater built towards the seaward limit of the littoral zone, parallel (or nearly parallel) to the shore.

# 2.586 Offshore Current

1. Any current in the offshore zone.
2. Any current flowing away from shore.

# 2.587 Offshore Wind

A wind blowing seaward from the land in the coastal area.

# 2.588 Onshore

A direction landward from the sea.

# 2.589 Onshore Wind

A wind blowing landward from the sea in the coastal area.

# 2.590 Opposing Wind

In wave forecasting, a wind blowing in a direction opposite to the ocean-wave advance; generally, a headwind.

# 2.591 Orbit

In water waves, the path of a water particle affected by the wave motion. In deepwater waves the orbit is nearly circular, and in shallow-water waves the orbit is nearly elliptical. In general, the orbits are slightly open in the direction of wave motion, giving rise to mass transport.

# 2.592 Orbital Current

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

# 2.593 Ordinary High Water Mark (OHWM)

That mark that will be found by examining the bed and banks and ascertaining where the presence and action of waters are so common and usual, and so long continued in all ordinary years, as to mark upon the soil a character distinct from that of the abutting upland, in respect to vegetation as that condition exists on June 1, 1971, as it may naturally change thereafter, or as it may change thereafter in accordance with permits issued by a local government. Also defined as mean high water line.

# 2.594 Ordinary Tide

This expression is not used in a technical sense by the U.S. Coast and Geodetic Survey, but the word "ordinary" when applied to tides, may be taken as the equivalent of the word "mean". Thus "ordinary high water line" may be assumed to be the same as "mean high water line".

# 2.595 Orthogonal

On a wave-refraction diagram, a line drawn perpendicularl to the wave crests. Also called wave ray.

# 2.596 Oscillation

1. A periodic motion backward and forward.
2. Vibration or variance above and below a mean value.

# 2.597 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. Compare wave of translation. *See* also orbit.

# 2.598 Outcrop

A surface exposure of bare rock, not covered by soil or vegetation.

# 2.599 Outfall

A structure extending into a body of water for the purpose of discharging sewage, storm runoff, or cooling water.

# 2.600 Outflanking

Erosionbehind or around the land-based end of a groin, jetty, or breakwater or the terminus of a bulkhead, revetment, or seawall, usually causing failure of the structure or its function.

# 2.601 Oversplash

The water that splashes over the top of a breakwater, seawall, etc.

# 2.602 Overtopping

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

# 2.603 Overtopping Discharge

The quantity of water flowing over the coasts, river banks and structures

# 2.604 Overwash

1. The part of the uprush that runs over the crest of a berm or structure 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.

# 2.605 Parapet

A low wall built along the edge of a structure such as a seawall or quay.

# 2.606 Particle Velocity

The velocity induced by wave motion with which a specific water particle moves within a wave.

# 2.607 Patch Reef

A mound like or flat-topped organic reef, generally less than 1 km across, frequently forming part of a larger reef complex.

# 2.608 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 (e.g., Sabine Pass).

# 2.609 Peak Period

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

# 2.610 Pebbles

Beach material usually well-rounded and between about 4 mm to 64 mm diameter. *See* soil classification.

# 2.611 Peninsula

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

# 2.612 Perched Beach

A beach or fillet of sand retained above the otherwise normal profile level by a submerged dike.

# 2.613 Percolation

The process by which water flows through the interstices of a sediment. Specifically, in wave phenomena, the process by which wave action forces water through the interstices of the bottom sediment and which tends to reduce wave heights.

# 2.614 Perigean Range

The average semidiurnal range occurring at the time of the perigean 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.

# 2.615 Perigean Tidal Currents

Tidal currents of increased velocity occurring monthly as the result of the moon being in perigee (i.e., at the point in its orbit nearest the Earth).

# 2.616 Perigean Tides

Tides of increased range occurring monthly as the result of the moon being in perigee.

# 2.617 Periodic Current

A current caused by the tide-producing forces of the moon and the sun; a part of the same general movement of the sea that is manifested in the vertical rise and fall of the tides. *See* also current, flood and current, ebb.

# 2.618 Permanent Current

A current that runs continuously, independent of the tides and temporary causes. Permanent currents include the freshwater discharge of a river and the currents that form the general circulatory systems of the oceans.

# 2.619 Permeability

The property of bulk material (sand, crushed rock, soft rock in situ) which permit movement of water through its pores.

# 2.620 Permeable Groin

A groin with openings or voids large enough to permit passage of appreciable quantities of littoral drift through the structure.

# 2.621 Petrography

The systematic description and classification of rocks.

# 2.622 Petrology

That branch of geology which treats the scientific study of rocks.

# 2.623 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.

# 2.624 Phase Inequality

Variations in the tides or tidal currents associated with changes in the phase of the Moon in relation to the Sun.

# 2.625 Phase Velocity

Propagation velocity of an individual wave as opposed to the velocity of a wave group.

# 2.626 Phi Grade Scale

A logarithmic transformation of the Wentworth grade scale for size classifications of sediment grains based on the negative logarithm to the base 2 of the particle diameter: $φ=-log\_{2}(D)$, where D is diameter of the particle in mm = -log2d. *See* soil classification.

# 2.627 Photic Zone

The zone extending downward from the ocean surface within which the light is sufficient to sustain photosynthesis. The depth of this layer varies with water clarity, time of year and cloud cover, but is about 100 m in the open ocean. It may be considered the depth to which all light is filtered out except for about one percent and may be calculated as about two and one-half times the depth of a secchi disk reading.

# 2.628 Phreatic Level

Upper surface of an unconfined aquifer (e.g. the top sand layer in a dike) at which the pressure in the groundwater is equal to atmospheric pressure.

# 2.629 Physical Geology

A large division of Geology concerned with earth materials, changes of the surface and interior of the earth, and the forces that cause those changes.

# 2.630 Physical Modeling

Refers to the investigation of coastal or riverine processes using a scaled model.

# 2.631 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 improperly applied to jetties.

# 2.632 Pierson-Moskowitz Spectrum

Wave spectrum typical of fully-developed deep water waves.

# 2.633 Piezometric Surface

The level at which the hydrostatic water pressure in an aquifer will stand if it is free to seek equilibrium with the atmosphere. For artesian wells, this is above the ground surface.

# 2.634 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.

# 2.635 Piling

A group of piles.

# 2.636 Piping

Erosion of closed flow channels (tunnels) by the passage of water through soil; flow underneath structures, carrying away particles, may endanger the stability of the structure.

# 2.637 Placer Deposits

Mineral deposits consisting of dense, resistant and often economically valuable minerals which have been weathered from terrigenous rocks, transported to the sea and concentrated in marine sediments by wave or current action.

# 2.638 Placer Mine

Surface mines in which valuable mineral grains are extracted from stream bar or beach deposits.

# 2.639 Plain, Coastal

*See* coastal plain.

# 2.640 Planform

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

# 2.641 Plateau

A land area (usually extensive) having a relatively level surface raised sharply above adjacent land on at least one side; table land. A similar undersea feature.

# 2.642 Pleistocene

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

# 2.643 Plunge Point

1. For a plunging wave, the point at which the wave curls over and falls.
2. The final breaking point of the waves just before they rush up on the beach.

# 2.644 Plunging Breaker

*See* breaker.

# 2.645 Pocket Beach

A beach, usually small, in a coastal reentrant or between two littoral barriers.

# 2.646 Point

1. The extreme end of a cape, or the outer end of any land area protruding into the water, usually less prominent than a cape.
2. A low profile shoreline promontory of more or less triangular shape, the top of which extends seaward.

# 2.647 Poorly-Sorted (Poorly-Graded)

Said of a clastic sediment or rock that consists of particles of many sizes mixed together in an unsystematic manner so that no one size class predominates.

# 2.648 Pore Pressure

The interstitial pressure of water within a mass of soil or rock.

# 2.649 Porosity

Percentage of the total volume of a soil not occupied by solid particles but by air and water.

# 2.650 Port

A place where vessels may discharge or receive cargo; it may be the entire harbor including its approaches and anchorages, or only the commercial part of a harbor where the quays, wharves, facilities for transfer of cargo, docks, and repair shops are situated.

# 2.651 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.

# 2.652 Prism

*See* tidal prism.

# 2.653 Probability

The chance that a prescribed event will occur, represented by a number (p) in the range 0 - 1. It can be estimated empirically from the relative frequency (i.e. the number of times the particular event occurs, divided by the total count of all events in the class considered).

# 2.654 Probability Density

Function specifying the distribution of a variable.

# 2.655 Probable Maximum Water Level

A hypothetical water level (exclusive of wave runup from normal wind-generated waves) that might result from the most severe combination of hydrometeorological, geoseismic, and other geo­physical factors and that is considered reasonably possible in the region involved, with each of these factors considered as affecting the locality in a maximum manner. This level represents the physical response of a body of water to maximum applied phenomena such as hurricanes, moving squall lines, other cyclonic meteorological events, tsunamis, and astronomical tide combined with maximum probable ambient hydrological conditions such as wave setup, rainfall, runoff, and river flow. It is a water level with virtually no risk of being exceeded.

# 2.656 Prodelta

The part of a delta that is below the effective depth of wave erosion, lying beyond the delta front and sloping down into the basin into which the delta is advancing.

# 2.657 Profile, Beach

The intersection of the ground surface with a vertical plane; may extend from the behind the dune line or the top of a bluff to well seaward of the breaker zone.

# 2.658 Progression (of a beach)

*See* advance.

# 2.659 Progressive Wave

A wave that moves relative to a fixed coordinate system in a fluid. The direction in which it moves is termed the direction of wave propagation.

# 2.660 Promontory

A high point of land projecting into a body of water; a headland.

# 2.661 Propagation of Waves

The transmission of waves through water.

# 2.662 Prototype

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

# 2.663 Quarry Run

Waste of generally small material, in a quarry, left after selection of larger grading.

# 2.664 Quarrystone

Any stone processed from a quarry.

# 2.665 Quaternary

1. The youngest geologic period; includes the present time.
2. The latest period of time in the stratigraphic column, 0 B 2 million years, represented by local accumulations of glacial (Pleistocene) and post-glacial (Holocene) deposits which continue, without change of fauna, from the top of the Pliocene (Tertiary). The quaternary appears to be an artificial division of time to separate pre-human from post-human sedimentation. As thus defined, the quaternary is increasing in duration as man’s ancestry becomes better understood.

# 2.666 Quay (pronounced Key)

A stretch of paved bank, or a solid artificial landing place parallel to the navigable waterway, for use in loading and unloading vessels.

# 2.667 Quicksand

Loose, yielding, wet sand which offers no support to heavy objects. The upward flow of the water has a velocity that eliminates contact pressures between the sand grains and causes the sand-water mass to behave like a fluid that yields easily to pressure and tends to suck down heavy objects.

# 2.668 Radar

An instrument for determining the distance and direction to an object by measuring the time needed for radio signals to travel from the instrument to the object and back, and by measuring the angle through which the instrument’s antenna has traveled.

# 2.669 Radioactive Dating (Radiometric Dating)

Calculating an age in years for geologic materials by measuring the presence of a short-life radioactive element (e.g., carbon-14) or a long-life element (e.g., potassium-40/argon-40). The term applies to all methods of age determination based on nuclear decay of naturally-occurring radioactive isotopes. Carbon-14 methods are often used to determine the age of peat or wood found in Barrier Islands.

# 2.670 Radius of Maximum Winds

Distance from the eye of a hurricane, where surface and wind velocities are zero, to the place where surface windspeeds are maximum.

# 2.671 Raised Beach

A wave-cut platform, with or without a covering of beach materials, which is now raised above the present sea-level.

# 2.672 Random Waves

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

# 2.673 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 (MHHW) and mean lower low water (MLLW). Where the type of tide is diurnal, the mean range is the same as the diurnal range.

# 2.674 Ray, Wave

*See* Orthogonal.

# 2.675 Rayleigh Distribution

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

# 2.676 Reach

1. An arm of the ocean extending into the land, e.g., an estuary.
2. A straight section of restricted waterway that is uniform with respect to discharge, slope, and cross-section.

# 2.677 Recent

(Geological) A synonym of Holocene. *See* also quaternary.

# 2.678 Recession

1. A continuing landward movement of the shoreline.
2. A net landward movement of the shoreline over a specified time.

# 2.679 Recharge

The addition of new water to an aquifer or to the zone of saturation.

# 2.680 Recurved Spit (Hooked Spit)

A spit whose outer end is turned landward by current deflection, by the opposing action of two or more currents, or by wave refraction; a hook.

# 2.681 Red Tide

Discoloration of surface waters, most frequently in coastal zones, caused by large concentrations of microorganisms.

# 2.682 Reef

An offshore consolidated rock hazard to navigation, with a least depth of about 20 meters or less. It is often refers to coral fringing reefs in tropical waters.

# 2.683 Reef, Atoll

*See* atoll.

# 2.684 Reef, Barrier

*See* barrier reef.

# 2.685 Reef Breakwater

Rubble mound of single-sized stones with a crest at or below sea level which is allowed to be (re)shaped by the waves.

# 2.686 Reef, Fringing

*See* fringing reef.

# 2.687 Reference Plane

The plane to which sounding and tidal data are referred. *See* datum plane.

# 2.688 Reference Point

1. A specified location (in plan elevation) to which measurements are referred.
2. In beach material studies, a specified point within the reference zone.

# 2.689 Reference Station

A place for which tidal constants have previously been determined and which is used as a standard for the comparison of simultaneous observations at a second station. Also, a station for which independent daily predictions are given in the tide or current tables from which corresponding predictions are obtained for other stations by means of differences or factors.

# 2.690 Reference Zone

In regard to beach measuring procedure, the part of the foreshore subject to wave action (between the limit of uprush and the limit of backwash) at mid-tide stage. In areas of great tidal range a more complex definition is needed.

# 2.691 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.

# 2.692 Reflection

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

# 2.693 Refraction (of water waves)

1. 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 alinement with the underwater contours.
2. The bending of wave crests by currents.

# 2.694 Refraction Coefficient

The square root of the ratio of the distance between adjacent orthogonals in deep water to their distance apart in shallow water at a selected point. When multiplied by the shoaling factor and a factor for friction and percolation, this becomes the wave height coefficient or the ratio of the refracted wave height at any point to the deepwater wave height. Also, the square root of the energy coefficient.

# 2.695 Refraction Diagram

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

# 2.696 Regular Waves

Waves with a single height, period, and direction.

# 2.697 Reservoir

An artificial lake, basin or tank in which a large quantity of water can be stored.

# 2.698 Residual (Water Level)

The components of water level not attributable to astronomical effects.

# 2.699 Resonance

The phenomenon of amplification of a free wave or oscillation of a system by a forced wave or oscillation of exactly equal period. The forced wave may arise from an impressed force upon the system or from a boundary condition.

# 2.700 Retardation

The amount of time by which corresponding tidal phases grow later day by day (about 50 minutes).

# 2.701 Retrogression (of a beach)

*See* recession.

# 2.702 Return Period

Average period of time between occurrences of a given event.

# 2.703 Crown/Return Wall

A wall located at the crest of a seawall, which is designed to minimise overtopping.

# 2.704 Reversing Tidal Current

A tidal current that flows alternately in approximately opposite directions with a slack water at each reversal of direction. Currents of this type usually occur in rivers and straits where the direction of flow is more or less restricted to certain channels. When the movement is towards the shore, the current is said to be flooding, and when in the opposite direction it is said to be ebbing.

# 2.705 Revetment

1. A facing of stone, concrete, etc., to protect an embankment, or shore structure, against erosion by wave action or currents.
2. A retaining wall.
3. Facing of stone, concrete, etc., built to protect a scarp, embankment or shore structure against erosion by waves of currents.

# 2.706 Reynolds Number

The dimensionless ratio of the inertial force to the viscous force in fluid motion, $Re = \frac{LV}{γ}$ where $L $is a characteristic length, $γ$ the kinematic viscosity, and $V$ a characteristic velocity. The Reynolds number is of importance in the theory of hydrodynamic stability and the origin of turbulence.

# 2.707 Ria

A long, narrow inlet, with depth gradually diminishing inward. Shorter and shallower than a fjord.

# 2.708 Ridge and Runnel

Beach topography consisting of sand bars that have welded to the shore during the recovery stage after a storm. At low tide, water ponds in the runnels and flows seaward through gaps in the ridge.

# 2.709 Ridge, Beach

A nearly continuous mound of beach material that has been shaped by wave or other action. Ridges may occur singly or as a series of approximately parallel deposits.

# 2.710 Rill Marks

Tiny drainage channels in a beach caused by the flow seaward of water left in the sands of the upper part of the beach after the retreat of the tide or after the dying down of storm waves.

# 2.711 Rip

A body of water made rough by waves meeting an opposing current, particularly a tidal current; often found where tidal currents are converging and sinking.

# 2.712 Rip Channel

A channel cut by seaward flow of rip current, usually crosses a longshore bar.

# 2.713 Rip Current

A strong surface current flowing seaward from the shore. It usually appears as a visible band of agitated water and is the return movement of water piled up on the shore by incoming waves and wind. With the seaward movement concentrated in a limited band its velocity is somewhat accentuated. A rip consists of three parts: the feeder currents flowing parallel to the shore inside the breakers; the neck, where the feeder currents converge and flow through the breakers in a narrow band or rip; and the head of rip, where the current widens and slackens outside the breaker line. A rip current is often miscalled a rip tide. It is also called rip surf.

# 2.714 Rip Surf

*See* rip current.

# 2.715 Rip Tide

Incorrect term for rip current.

# 2.716 Riparian

1. Pertaining to the banks of a body of water.
2. Of, on or pertaining to the banks of a river.

# 2.717 Ripple

1. The ruffling of the surface of water; hence, a little curling wave or undulation.
2. A wave less than 0.05 meter (2 inches) long controlled to a significant degree by both surface tension and gravity. *See* capillary wave and gravity wave.

# 2.718 Ripple Marks

Undulations produced by fluid movement over sediments. Oscillatory currents produce symmetric ripples whereas a well-defined current direction produces asymmetrical ripples. The crest line of ripples may be straight or sinuous. The characteristic features of ripples depend upon current velocity, particle size, persistence of current direction and whether the fluid is air or water. Sand dunes may be regarded as a special kind of super ripple.

# 2.719 Ripples (bed forms)

Small bed forms with wavelengths less than 0.3 m and heights less than 0.03 m.

# 2.720 Riprap

A protective layer or facing of quarrystone, usually well graded within wide size limit, randomly placed to prevent erosion, scour, or sloughing of an embankment or bluff; also the stone so used. The quarrystone is placed in a layer at least twice the thickness of the 50 percent size, or 1.25 times the thickness of the largest size stone in the gradation.

# 2.721 Risk Analysis

Assessment of the total risk due to all possible environmental inputs and all possible mechanisms.

# 2.722 River Distributory

A stream that branches off from the main river and flows away from it, typically found in river deltas.

# 2.723 River Mouth

The part of a river where it flows into another body of water, such as an ocean, sea, or lake.

# 2.724 Rock Weathering

Physical and mineralogical decay processes in rock brought about by exposure to climatic conditions either at the present time or in the geological past.

# 2.725 Rock

1. An aggregate of one or more minerals; or a body of undifferentiated mineral matter (e.g., obsidian). The three classes of rocks are:
2. Igneous B crystalline rocks formed from molten material. Examples are granite and basalt.
3. Sedimentary B resulting from the consolidation of loose sediment that has accumulated in layers. Examples are sandstone, shale and limestone.
4. Metamorphic B formed from preexisting rock as a result of burial, heat, and pressure.
5. A rocky mass lying at or near the surface of the water or along a jagged coastline, especially where dangerous to shipping.

# 2.726 Roller

An indefinite term, sometimes considered to denote one of a series of long-crested, large waves which roll in on a shore, as after a storm.

# 2.727 Rotary Current, Tidal

A tidal current that flows continually with the direction of flow changing through all points of the compass during the tidal period. Rotary currents are usually found offshore where the direction of flow is not restricted by any barriers. The tendency for the rotation in direction has its origin in the deflecting force of the Earth’s rotation and, unless modified by local conditions, the change is clockwise in the northern Hemisphere and counterclockwise in the southern Hemisphere. The velocity of the current usually varies throughout the tidal cycle, passing through two maxima in approximately opposite directions and two minima with the direction of the current at approximately ninety degrees from the direction at the time of maximum velocity.

# 2.728 Rubble

1. Loose angular waterworn stones along a beach.
2. Rough, irregular fragments of broken rock.

# 2.729 Rubble-Mound Structure

A mound of random-shaped and random-placed stones protected with a cover layer of selected stones or specially shaped concrete armor units. (Armor units in a primary cover layer may be placed in an orderly manner or dumped at random.)

# 2.730 Run-Up, Run-Down

The upper and lower levels reached by a wave on a beach or coastal structure, relative to still-water level.

# 2.731 Runnel

A corrugation or trough formed in the foreshore or in the bottom just offshore by waves or tidal currents.

# 2.732 S-Slope Breakwater

Rubble mound with gentle slope around still-water level and steeper slopes above and below.

# 2.733 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 - see also Ness and Cusp.

# 2.734 Saline-Freshwater Interface

# The transition zone between freshwater and saline water in coastal aquifers, where mixing occurs.

# 2.735 Salinity

Number of grams of salt per thousand grams of sea water, usually expressed in parts per

thousand (symbol: ‰).

# 2.736 Salinity Gradient

Change in salinity when expressed in parts per thousand per meter.

# 2.737 Salt Marsh

A marsh periodically flooded by salt water (also tidal marsh; sea marsh).

# 2.738 Salt-Wedge Estuary

In this circulation type, the density-driven component dominates and two well-mixed layers are separated by a sharp halocline. The seawater entering the channel appears as a tongue or wedge.

# 2.739 Saltation

That method of sand movement in a fluid in which individual particles leave the bed by bouncing nearly vertically and, because the motion of the fluid is not strong or turbulent enough to retain them in suspension, return to the bed at some distance downstream. The travel path of the particles is a series of hops and bounds.

# 2.740 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.

# 2.741 Sand Bar

1. *See* bar.
2. In a river, a ridge of sand built to or near the surface by river currents.

# 2.742 Sand Bypassing

*See* bypassing, sand.

# 2.743 Sand Dune

A dune formed of sand.

# 2.744 Sand Reef

*See* bar.

# 2.745 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.

# 2.746 Sand Waves

1. Longshore sand waves are large-scale features that maintain form while migrating along the shore with speeds on the order of kilometers per year.
2. Large-scale asymmetrical bedforms in sandy river beds having high length to height ratios and continuous crestlines.

# 2.747 Scarp, Beach

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. *See* also escarpment.

# 2.748 Scatter Diagram

A two-dimensional histogram showing the joint probability density of two variables within a data sample.

# 2.749 Scour

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

# 2.750 Scour Protection

Protection against erosion of the seabed in front of the toe.

# 2.751 Sea

1. A large body of salt water, second in rank to an ocean, more or less landlocked and generally part of, or connected with, an ocean or a larger sea. Examples: Arabian Sea, Bay of Bengal
2. Waves caused by wind at the place and time of observation.
3. State of the ocean or lake surface, in regard to waves.

# 2.752 Sea Breeze

A light wind blowing from the sea toward the land caused by unequal heating of land and water masses.

# 2.753 Sea Change

1. A change wrought by the sea.
2. A marked transformation.

# 2.754 Sea Cliff

A cliff situated at the seaward edge of the coast.

# 2.755 Sea Grass

Members of marine seed plants that grow chiefly on sand or sand-mud bottom. They are most abundant in water less than 9 m deep. The common types are: Eel grass (Zostera), Turtle grass (Thallasia), and Manatee grass (Syringodium).

# 2.756 Sea Level

*See* mean sea level.

# 2.757 Sea Level Rise

The long-term trend in mean sea level.

# 2.758 Sea Puss

A dangerous longshore current; a rip current caused by return flow; loosely, the submerged channel or inlet through a bar caused by those currents.

# 2.759 Sea State

Description of the sea surface with regard to wave action. Also called state of sea.

# 2.760 Sea Water Intrusion (Sea Water Ingress)

Sea water intrusion is the movement of saline water into fresh water aquifers. Most often it is caused by ground-water pumping from coastal wells or from construction of navigation channels or oil field canals.

# 2.761 Sea coast

The coast adjacent to the sea or ocean.

# 2.762 Seamount

An elevation rising more than 1000 meters above the ocean floor, and of limited extent across the summit. Also *see* knoll.

# 2.763 Seas

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

# 2.764 Seashore

1. All ground between the ordinary high-water and low-water mark.
2. The shore of the sea or ocean, often used in a general sense (e.g., to visit the seashore).

# 2.765 Seawall

1. 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.
2. A structure separating land and water areas to alleviate the risk of flooding by the sea. Generally, shore-parallel, although some reclamation seawalls may include lengths that are normal or oblique to the (original) shoreline. A seawall is typically more massive and capable of resisting greater wave forces than a bulkhead.

# 2.766 Sechhi Disk

Visibility disk (white and black, 30 cm diameter) used to measure the transparency of the water.

# 2.767 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.

# 2.768 Sediment Cell

In the context of a strategic approach to coastal management, a length of coastline in which interruptions to the movement of sand or shingle along the beaches or near shore sea bed do not significantly affect beaches in the adjacent lengths of coastline.

# 2.769 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.

# 2.770 Sediment Source

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

# 2.771 Sediment Transport

The main agencies by which sedimentary materials are moved are: gravity (gravity transport); running water (rivers and streams); ice (glaciers); wind; and the sea (currents and longshore drift). Running water and wind are the most widespread transporting agents. In both cases, three mechanisms operate, although the particle size of the transported material involved is very different, owing to the differences in density and viscosity of air and water. The three processes are: rolling or traction, in which the particle moves along the bed but is too heavy to be lifted from it; saltation; and suspension, in which particles remain permanently above the bed, sustained there by the turbulent flow of the air or water.

# 2.772 Sediment Transport Paths

The routes along which net sediment movement occurs.

# 2.773 Seepage

The movement of water through small cracks, pores, and interstices, out of a body of surface of subsurface water. The loss of water by infiltration from a canal, reservoir or other body of water or from a field. It is generally expressed as flow volume per unit of time.

# 2.774 Seiche

1. A standing wave oscillation of an enclosed waterbody that continues, pendulum fashion, after the cessation of the originating force, which may have been either seismic or atmospheric.
2. An oscillation of a fluid body in response to a disturbing force having the same frequency as the natural frequency of the fluid system. Tides are now considered to be seiches induced primarily by the periodic forces caused by the Sun and Moon.
3. In the Great Lakes area, any sudden rise in the water of a harbor or a lake whether or not it is oscillatory (although inaccurate in a strict sense, this usage is well established in the Great Lakes area).

# 2.775 Seismic Reflection

The return of part of the energy of seismic waves to the earth's surface after the waves bounce off an acoustic boundary (typically rock or material of different density).

# 2.776 Seismic Refraction

The bending of seismic waves as they pass from one material to another.

# 2.777 Seismic Sea Wave

*See* tsunami.

# 2.778 Selective Sorting

A process occurring during sediment transport that tends to separate particles according to their size, density, and shape. A well-sorted distribution contains a limited range of grain sizes and usually indicates that the depositional environment contains a narrow range of sediment sizes or a narrow band of depositional energy. A poorly-sorted distribution contains a wide range of grain sizes indicating multiple sources of sediment or a wide range of deposition energies.

# 2.779 Self-Sustaining Beach

A beach that has either natural or engineered sand retention and that can be stable through the continued supply of natural sediment sources, without any mechanical nourishment over a long period. Subsets include:

1. Natural or Geomorphically Self-sustaining Beaches: self-sustaining naturally without the construction of retaining structures and with no continued mechanical sand nourishment.
2. Anthropogenically Self-sustaining Beaches: self-sustaining by the construction of retaining structure(s) with or without initial beach fill but with no continued mechanical sand nourishment.

# 2.780 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.

# 2.781 Setback

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

# 2.782 Setup, Wave

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

# 2.783 Setup, Wind

See Wind Setup.

# 2.784 Shallow Water

1. Commonly, water of such a depth that surface waves are noticeably affected by bottom topography. It is customary to consider water of depths less than one-half the surface wavelength as shallow water. *See* transitional zone and deep water.
2. More strictly, in hydrodynamics with regard to progressive gravity waves, water in which the depth is less than 1/20 the wavelength.

# 2.785 Shallow Water Wave

A progressive wave which is in water less than 1/20 the wave length in depth.

# 2.786 Shear Instabilities

Instabilities of the surf zone longshore current commonly found on beaches with barred depth profiles. These instabilities are vertical motions with little surface elevation expression. Conservation of vorticity is the restoring mechanism.

# 2.787 Shear Waves

*See* shear instabilities.

# 2.788 Sheet Erosion

The removal of a thin layer of surface material, usually topsoil, by a flowing sheet of water.

# 2.789 Sheet Flow

Sediment grains under high sheer stress moving as a layer that extends from the bed surface to some distance below (on the order of a few cm). Grains are transported in the direction of fluid flow.

# 2.790 Sheet Pile

*See* pile, sheet.

# 2.791 Sheet, Smooth

A sheet on which field control and hydrographic data such as soundings, depth curves, and regions surveyed with a wire drag are finally plotted before being used in making a final chart.

# 2.792 Shelf, Continental

*See* continental shelf.

# 2.793 Shelf, Insular

*See* insular shelf.

# 2.794 Shingle

1. Loosely and commonly, any beach material coarser than ordinary gravel, especially any having flat or flattish pebbles.
2. Strictly and accurately, beach material of smooth, well-rounded pebbles that are roughly the same size. The spaces between pebbles are not filled with finer materials.

# 2.795 Shoal

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.

# 2.796 Shoaling

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

# 2.797 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. Sometimes shoaling factor or depth factor. *See* also the energy coefficient and refraction coefficient.

# 2.798 Shoaling Factor

*See* shoaling coefficient.

# 2.799 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.

# 2.800 Shore Normal

A line at right-angles to the contours in the surf zone.

# 2.801 Shore Terrace

A terrace made along a coast by the action of waves and shore currents; it may become dry land by the uplifting of the shore or the lowering of the water. Also known as shore platform or wave-cut platform.

# 2.802 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. *See* inshore (zone).

# 2.803 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.

# 2.804 Shoreline Management

The development of strategic,long-term, and sustainable Coastal defense and land-use policy within a sediment cell.

# 2.805 Short-Crested Wave

A wave, the crest length of which is of the same order of magnitude as the wavelength. A system of short-crested waves has the appearance of hills being separated by troughs.

# 2.806 Significant Wave

A statistical term relating to the one-third highest waves of a given wave group and defined by the average of their heights and periods. The composition of the higher waves depends upon the extent to which the lower waves are considered. Experience indicates that a careful observer who attempts to establish the character of the higher waves will record values which approximately fit the definition of the significant wave.

# 2.807 Significant Wave Height

The average height of the highest one-third of waves in a given wave group. Note that the composition of the highest waves depends upon the extent to which the lower waves are considered. In wave record analysis, the average height of the highest one-third of a selected number of waves, this number being determined by dividing the time of record by the significant period. Also characteristic wave height.

# 2.808 Significant Wave Period

An average period of the one-third highest waves within a given group. Note that the composition of the highest waves depends upon the extent to which the lower waves are considered. In wave record analysis, this is determined as the average period of the most frequently recurring of the larger well-defined waves in the record under study.

# 2.809 Sill

1. A submerged structure across a river to control the water level upstream.
2. The crest of a spillway.

# 2.810 Silt

Sediment particles with a grain size between 0.004 mm and 0.062 mm, i.e. coarser than clay particles but finer than sand. *See* soil classification.

# 2.811 Sinusoidal Wave

An oscillatory wave having the form of a sinusoid.

# 2.812 Slack Tide (Slack Water)

The state of a tidal current when its velocity is near zero, especially the moment when a reversing current changes direction and its velocity is zero. Sometimes considered the intermediate period between ebb and flood currents during which the velocity of the currents is less than 0.05 meter per second. *See* stand of tide.

# 2.813 Slide

In mass wasting, movement of a descending mass along a plane approximately parallel to the slope of the surface.

# 2.814 Slip

A berthing space between two piers.

# 2.815 Slip Face

The steep, downwind slope of a dune; formed from loose, cascading sand that generally keeps the slope at the angle of repose (about 34 deg.).

# 2.816 Slope

The degree of inclination to the horizontal. Usually expressed as a ratio, such as 1:25, indicating one unit rise in 25 units of horizontal distance; or in a decimal fraction (0.04). Also called gradient.

# 2.817 Slough

A small muddy marshland or tidal waterway which usually connects other tidal areas. *See* bayou.

# 2.818 Sluice

A structure containing a gate to control the flow of water from one area to another.

# 2.819 Slump

In mass wasting, movement along a curved surface in which the upper part moves vertically downward while the lower part moves outward.

# 2.820 Soft Defenses

Usually refers to beaches (natural or designed) but may also relate to energy-absorbing beach-control structures, including those constructed of rock, where these are used to control or redirect coastal processes rather than opposing or preventing them.

# 2.821 Soil

A layer of weathered, unconsolidated material on top of bed rock; in geologic usage, usually defined as containing organic matter and being capable of supporting plant growth.

# 2.822 Soil Classification

An arbitrary division of a continuous scale of grain sizes such that each scale unit or grade may serve as a convenient class interval for conducting the analysis or for expressing the results of an analysis.

# 2.823 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.

# 2.824 Sorting

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

# 2.825 Sorting Coefficient

A coefficient used in describing the distribution of grain sizes in a sample of unconsolidated material. It is defined as $ = \frac{Q1}{Q3}$ , where $Q1 $ is the diameter (in millimeters) which has 75 percent of the cumulative size-frequency (by weight) distribution smaller than itself and 25 percent larger than itself, and $Q3$ is that diameter having 25 percent smaller and 75 percent larger than itself.

# 2.826 Sound

A relatively long arm of the sea or ocean forming a channel between an island and a mainland or connecting two larger bodies, such as a sea and the ocean, or two parts of the same body; usually wider and more extensive than a strait.

# 2.827 Sounding

A measured depth of water. On hydrographic charts the soundings are adjusted to a specific plane of reference (sounding datum).

# 2.828 Sounding Datum

The plane to which soundings are referred. *See* also chart datum.

# 2.829 Sounding Line

A line, wire, or cord used in sounding, which is weighted at one end with a plummet (sounding lead). It is also called lead line.

# 2.830 Spilling Breaker

*See* breaker.

# 2.831 Spillover Lobe

Linguoid, bar-like feature formed by ebb tidal current flow over a low area of an ebb shield.

# 2.832 Spillway

A structure over or through a dam for discharging flood flows.

# 2.833 Spit

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

# 2.834 Spoil

Overburden or other waste material removed in mining, dredging, and quarrying.

# 2.835 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.

# 2.836 Spring Tidal Currents

Tidal currents of increased velocity occurring semimonthly as the result of the moon being new or full.

# 2.837 Spring Tide

A tide that occurs at or near the time of new or full moon and which rises highest and falls lowest from the mean sea level.

# 2.838 Spur-Dike

*See* groin.

# 2.839 Stack

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

# 2.840 Stand of Tide

An interval at high or low water when there is no sensible change in the height of the tide. The water level is stationary at high and low water for only an instant, but the change in level near these times is so slow that it is not usually perceptible. *See* slack tide.

# 2.841 Standard Project Hurricane

*See* hypothetical hurricane.

# 2.842 Standing Wave

A type of wave in which the surface of the water oscillates vertically between fixed points, called nodes, without progression. The points of maximum vertical rise and fall are called antinodes or loops. At the nodes, the underlying water particles exhibit no vertical motion, but maximum horizontal motion. At the antinodes, the underlying water particles have no horizontal motion, but maximum vertical motion. They may be the result of two equal progressive wave trains traveling through each other in opposite directions. Sometimes called clapotis or stationary wave.

# 2.843 Station, Control

A point on the ground whose horizontal or vertical location is used as a basis for obtaining locations of other points.

# 2.844 Stationary Wave

A wave of essentially stable form which does not move with respect to a selected reference point; a fixed swelling. Sometimes called standing wave.

# 2.845 Step

The nearly horizontal section which more or less divides the beach from the shoreface.

# 2.846 Still Water Level (SWL)

The surface of the water if all wave and wind action were to cease. In deep water this level approximates the midpoint of the wave height. In shallow water it is nearer to the trough than the crest. Also called the undisturbed water level.

# 2.847 Stochastic

Having random variation in statistics.

# 2.848 Stockpile

Sand piled on a beach foreshore to nourish downdrift beaches by natural littoral currents or forces. *See* feeder beach.

# 2.849 Stone

Quarried or artificially-broken rock for use in construction, either as aggregate or cut into shaped blocks as dimension stone.

# 2.850 Stone, Derrick

Stone heavy enough to require handling individual pieces by mechanical means, generally weighing 1 tonne or more.

# 2.851 Storm Surge

A rise above normal water level on the open coast due to the action of wind stress on the water surface. Storm surge resulting from a hurricane also includes that rise in level due to atmospheric pressure reduction as well as that due to wind stress. *See* wind setup.

# 2.852 Storm Tide

See Storm Surge..

# 2.853 Strait

A relatively narrow waterway between two larger bodies of water. *See* also sound.

# 2.854 Strand

1. The shore or beach of the ocean or a large lake. The land bordering any large body of water, especially a sea or an arm of the ocean.
2. Wharf, quay, or roadway along a water body, especially in a city.

# 2.855 Strand Plain

A pro-graded shore built seawards by waves and currents.

# 2.856 Strandflat

A wave-cut platform; an elevated wave-cut terrace.

# 2.857 Stranding

The running aground of a ship upon a strand, rock, or bottom so that it is fast for a duration.

# 2.858 Strandline

An accumulation of debris (e.g. seaweed, driftwood and litter) cast up onto a beach, and lying along the limit of wave up rush. A shoreline above the present water level.

# 2.859 Stream

1. A course of water flowing along a bed in the Earth.
2. A current in the sea formed by wind action, water density differences, etc. *See* current, stream.

# 2.860 Stream Current

A narrow, deep, and swift ocean current, such as the Gulf Stream. Opposite of drift current.

# 2.861 Structural Geology

The branch of geology concerned with the internal structure of bed rock and the shapes, arrangement, and interrelationships of rock units.

# 2.862 Subaerial

Situated or occurring on or adjacent to the surface of the earth, usually meaning above the water surface.

# 2.863 Subaerial Beach

That part of the beach which is uncovered by water (e.g. at low tide sometimes referred to as drying beach).

# 2.864 Subaqueous

Existing, formed, or taking place under water; submerged

# 2.865 Sub-Tidal Beach

The part or the beach (where it exists) which extends from low water out to the approximate limit of storm erosion. The latter is typically located at a maximum water depth of 8 to 10 meters and is often identifiable on surveys by a break in the slope of the bed.

# 2.866 Subcritical Flow

Flow for which the Froude number is less than unity; surface disturbances can travel upstream.

# 2.867 Subduction Zone

Elongate region in which the sea floor slides beneath a continent or island arc.

# 2.868 Submarine Canyon

V-shaped valleys that run across the continental shelf and down the continental slope.

# 2.869 Submarine Groundwater Discharge

1. The flow of groundwater from the seabed into the coastal ocean, often bringing dissolved substances from land to sea. It can be either of fresh groundwater, re-circulated seawater, or a composite thereof.
2. Direct groundwater outflow across the ocean–land interface into the ocean.

# 2.870 Submergent Coast

A coast in which formerly dry land has been recently drowned, either by land subsidence or a rise in seal level.

# 2.871 Subordinate Station

A tide or current station at which a short series of observations has been obtained, which is to be reduced by comparison with simultaneous observations at another station having well-determined tidal or current constants.

# 2.872 Subsidence

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

# 2.873 Subtidal

Below the low-water datum; thus permanently submerged.

# 2.874 Super-Critical Flow

Flow for which the Froude number is greater than unity; surface disturbances will not travel upstream.

# 2.875 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.

# 2.876 Surf Beat

Irregular oscillations of the nearshore water level with periods on the order of several minutes.

# 2.877 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.

# 2.878 Surface Gravity Wave (Progressive)

1. This is the term which applies to the wind waves and swell of lakes and oceans, also called surface water wave, surface wave or deep water wave,
2. A progressive gravity wave in which the disturbance is confined to the upper limits of a body of water. Strictly speaking this term applies to those progressive gravity waves whose celerity depends only upon the wave length.

# 2.879 Surface Water Wave

*See* surface gravity wave (Progressive).

# 2.880 Surge

1. The name applied to wave motion with a period intermediate between that of the ordinary wind wave and that of the tide, say from 2 to 60 min. It is low height, usually less than 0.9 m. See also Seiche.
2. In fluid flow, long interval variations in velocity and pressure, not necessarily periodic, perhaps even transient in nature.
3. *See* storm surge.

# 2.881 Surging Breaker

*See* breaker.

# 2.882 Survey, Control

A survey that provides coordinates (horizontal or vertical) of points to which supplementary surveys are adjusted.

# 2.883 Survey, Hydrographic

A survey that has as its principal purpose the determination of geometric and dynamic characteristics of bodies of water.

# 2.884 Survey, Photogrammetric

A survey in which monuments are placed at points that have been determined photogrammetrically.

# 2.885 Survey, Topographic

A survey which has, for its major purpose, the determination of the configuration (relief) of the surface of the land and the location of natural and artificial objects thereon.

# 2.886 Suspended Load

1. The material moving in suspension in a fluid, kept up by the upward components of the turbulent currents or by colloidal suspension.
2. The material collected in or computed from samples collected with a suspended load sampler. Where it is necessary to distinguish between the two meanings given above, the first one may be called the "true suspended load."

# 2.887 Suspended Load Sampler

A sampler which is used to secure a sample of the water with its sediment load without separating the sediment from the water.

# 2.888 Sustainable Beach

A beach area that is now and will continue to receive sufficient sediment input over a long period (years or decades) to remain stable. Such sediment input can be through either natural supplies of sediment or various forms of mechanical beach nourishment (placement by hydraulic dredge, land haul of material, nearshore deposition, etc.)

# 2.889 Swale

The depression between two beach ridges.

# 2.890 Swash

The rush of water up onto the beach face following the breaking of a wave. It is also called uprush, runup.

# 2.891 Swash Bars

Low broad sandy bars formed by sediment in the surf and swash zones, separated by linear depressions, or runnels, running parallel to the shore. Sand bodies that form and migrate across ebb-tidal shoals because of currents generated by breaking waves.

# 2.892 Swash Channel

1. On the open shore, a channel cut by flowing water in its return to the present body (e.g., a rip channel).
2. A secondary channel passing through or shoreward of an inlet or river bar.

# 2.893 Swash Mark

The thin wavy line of fine sand, mica scales, bits of seaweed, etc., left by the uprush when it recedes from its upward limit of movement on the beach face.

# 2.894 Swash Platform

Sand sheet located between the main ebb channel of a coastal inlet and an adjacent barrier island.

# 2.895 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 run-up.

# 2.896 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.

# 2.897 Synoptic Chart

A chart showing the distribution of meteorological conditions over a given area at a given time. Popularly called a weather map.

# 2.898 Syzygy

The two points in the Moon's orbit when the Moon is in conjunction or opposition to the Sun relative to the Earth; the times of new or full Moon in the cycle of phases.

# 2.899 T-Groin

A groin built in the shape of a letter ‘T’ with the trunk section connected to land.

# 2.900 Tectonic Forces

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

# 2.901 Tectonics

The study of the major structural features of the Earth's crust or the broad structure of a region.

# 2.902 Terminal Groin

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

# 2.903 Terrace

A horizontal or nearly horizontal natural or artificial topographic feature interrupting a steeper slope, sometimes occurring in a series.

# 2.904 Terrigenous Sediments

1. Literally land-formed sediment that has found its way to the sea floor. The term is applied
2. To sediments formed and deposited on land (e.g., soils, sand DUNES), and
3. To material derived from the land when mixed with purely marine material (e.g., sand or clay in a shelly limestone).

# 2.905 Thalweg

In hydraulics, the line joining the deepest points of an inlet or stream channel.

# 2.906 The Ghyben-Herzberg Principle

It is proposed by Badon-Ghyben (1889) and Herzberg (1901), is a method to estimate the position of the interface between freshwater and saltwater in coastal aquifers. This principle is based on the equilibrium condition where the pressure exerted by a column of freshwater is equal to the pressure exerted by a column of saltwater at the interface. The principle states that the depth of the interface below sea level ($ζ\_{s}​$) is proportional to the freshwater head ($Φ\_{f}$)above sea level.

$$ζ\_{s}​=δΦ\_{f}​$$

where $δ$ is a constant derived from the density difference between freshwater ($γ\_{f}$​) and saltwater ($γ\_{s}$​), and is given by:

$$δ=γ\_{f}/(γ\_{s}​-γ\_{f}) ​​$$

For typical densities of freshwater (1.0 g/cm³) and saltwater (1.025 g/cm³), the value of $δ$ is approximately 40. This means that for every meter of freshwater above sea level, there is approximately 40 meters of freshwater below sea level.

# 2.907 Threshold of Motion

The point at which the forces imposed on a sediment particle overcome its inertia and it starts to move.

# 2.908 Threshold Velocity

The maximum orbital velocity at which the sediment on the bed begins to move as waves approach shallow water.

# 2.909 Tidal Basin

1. A basin affected by tides, particularly one in which water can be kept at a desired level by means of a gate.
2. A basin without a caisson or gate in which the level of water rises and falls with the tides.

# 2.910 Tidal Creek

A creek draining back-barrier areas with a current generated by the rise and fall of the tide.

# 2.911 Tidal Current

*See* current, tidal.

# 2.912 Tidal Datum

*See* chart datum and datum plane.

# 2.913 Tidal Day

The time of the rotation of the Earth with respect to the Moon, or the interval between two successive upper transits of the Moon over the meridian of a place, approximately 24.84 solar hours (24 hours and 50 minutes) or 1.035 times the mean solar day. Also called lunar day.

# 2.914 Tidal Delta

*See* Delta.

# 2.915 Tidal Energy

Tidal energy is a form of power produced by the natural rise and fall of tides. The desirable locations for harvesting tidal energy are higher tidal range and stronger tidal currents.

# 2.916 Tidal Excursion

Total distance travelled by a water particle from low-water slack to high-water slack and vice-versa. Since freshwater inflows impose a net seaward movement on water particles over a tide cycle, ebb tide excursion is greater than the flood tide excursion.

# 2.917 Tidal Pumping

If there is a higher celerity of flood tide compared to ebb tide, there is a greater tendency for greater upstream movement of water on flood tide, leading to a dynamic tapping of water in the upper reaches of the estuary. This tidal distortion results in tidal pumping.

# 2.918 Tidal Flats

Marshy or muddy areas covered and uncovered by the rise and fall of the tide. A tidal marsh.

Marshy or muddy areas of the seabed which are covered and uncovered by the rise and fall of tidal water.

# 2.919 Tidal Inlet

1. A natural inlet maintained by tidal flow.
2. Loosely, any inlet in which the tide ebbs and flows. Also tidal outlet.

# 2.920 Tidal Marsh

Same as tidal flats.

# 2.921 Tidal Period

The interval of time between two consecutive, like phases of the tide.

# 2.922 Tidal Pool

A pool of water remaining on a beach or reef after recession of the tide.

# 2.923 Tidal Prism

1. The total amount of water that flows in/out of a harbor with movement of the tide, excluding any freshwater flow.
2. The volume of water present between mean low and mean high tide.

# 2.924 Tidal Range

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

# 2.925 Tidal Rise

The height of tide as referred to the datum of a chart.

# 2.926 Tidal River

That part of a river where the water level is influenced by the tide.

# 2.927 Tidal Shoals

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

# 2.928 Tidal Stand

An interval at high or low water when there is no observable change in the height of the tide. The water level is stationary at high and Low water for only an instant, but the change in level near these times is so slow that it is not usually perceptible.

# 2.929 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 tsunami.

# 2.930 Tidally Driven Circulation

The movement of fresh water and seawater that are mixed by the sloshing back and forth of the estuary in response to ocean tides.

# 2.931 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.

# 2.932 Tide Turbine

Turbines placed in tidal streams to capture energy from the current, and underwater cables transmit it to the grid.

# 2.933 Daily Retardation of Tide

The amount of time by which corresponding tides grow later day by day (about 50 minutes). Also lagging.

# 2.934 Diurnal Tide

A tide with one high water and one low water in a day.

# 2.935 Tide Staff

A tide gage consisting of a vertical graduated staff from which the height of the tide can be read directly. It is called a fixed staff when it is secured in place so that it cannot be easily removed. A portable staff is designed for removal from the water when not in use.

# 2.936 Tide Station

A place at which tide observations are being taken. It is called a primary tide station when continuous observations are to be taken over a number of years to obtain basic tidal data for the locality. A secondary tide station is one operated over a short period of time to obtain data for a specific purpose.

# 2.937 Storm Tide

*See* storm surge.

# 2.938 Tide Tables

Tables which give daily predictions of the times and heights of the tide. These predictions are usually supplemented by tidal differences and constants by means of which additional predictions can be obtained for numerous other places.

# 2.939 Toe

Lowest part of sea- and portside breakwater slope, generally forming the transition to the seabed.

# 2.940 Tombolo

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

# 2.941 Tongue

A long, narrow strip of land projecting into a body of water.

# 2.942 Topographic Map

A map on which elevations are shown by means of contour lines.

# 2.943 Topography

The configuration of a surface, including its relief and the positions of its streams, roads, building, etc.

# 2.944 Training Wall

A wall or jetty to direct current flow.

# 2.945 Marine Transgression

The invasion of a large area of land by the sea in a relatively short space of time (geologically speaking). Although the observable result of a marine transgression may suggest an almost instantaneous process, it is probable that the time taken is in reality is thousands or millions of years. The plane of marine transgression is a plane of unconformity.

# 2.946 Transitional Zone (Transitional Water)

In regard to progressive gravity waves, water whose depth is less than 2 but more than 1/25 the wavelength. Often called shallow water.

# 2.947 Translatory Wave

*See* wave of translation.

# 2.948 Transposed Hurricane

*See* hypothetical hurricane.

# 2.949 Transverse Bar

A bar which extends approximately right angles to shorelines.

# 2.950 Transverse Wave

Waves that propagate along a sailing line of a vessel.

# 2.951 Trench

A long narrow submarine depression with relatively steep sides.

# 2.952 Trochoidal Wave

A theoretical, progressive oscillatory wave was first proposed by Gerstner in 1802 to describe the surface profile and particle orbits of finite amplitude, non sinusoidal waves. The waveform is that of a prolate cycloid or trochoid, and the fluid particle motion is rotational as opposed to the usual irrotational particle motion for waves generated by normal forces. Also *see* irrotational wave.

# 2.953 Tropical Cyclone

*See* hurricane.

# 2.954 Tropical Storm

A tropical cyclone with maximum winds of less than 34 m/sec. *See* hurricane or typhoon (winds greater than 34 m/sec).

# 2.955 Trough

A long and broad submarine depression with gently sloping sides.

# 2.956 Trough of Wave

The lowest part of a waveform between successive crests. Also, that part of a wave below still-water level.

# 2.957 Tsunami

A long-period wave caused by an underwater disturbance such as a volcanic eruption or earthquake. Also called as seismic sea wave. Commonly it is miscalled as a tidal wave.

# 2.958 Turbidity

1. A condition of a liquid due to fine visible material in suspension, which may not be of sufficient size to be seen as individual particles by the naked eye but which prevents the passage of light through the liquid.
2. A measure of fine suspended matter in liquids.

# 2.959 Turbidity Current

A flowing mass of sediment-laden water that is heavier than clear water and therefore flows downslope along the bottom of the sea or a lake.

# 2.960 Turbulent Flow

Any flow which is not laminar, i.e., the stream lines of the fluid, instead of remaining parallel, becomes confused and intermingled.

# 2.961 Typhoon

*See* Hurricane. The term typhoon is applied to tropical cyclones in the western Pacific Ocean.

# 2.962 Unconformity

A surface that represents a break in the geologic record, with the rock unit immediately above it being considerably younger than the rock beneath. There are three major aspects to consider:

1. Time: An unconformity develops during a period of time in which no sediment is deposited. This concept equates deposition and time, and an unconformity represents unrecorded time.
2. Deposition: Any interruption of deposition, whether large or small in extent, is an unconformity. This aspect of unconformity pre-supposes a standard scale of deposition which is complete. Major breaks in sedimentation can usually be demonstrated easily, but minor breaks may go unrecorded until highly detailed investigations are made.
3. Structure: Structurally, unconformity may be regarded as planar structures separating older rocks below from younger rocks above, representing the break as defined in (1) and (2) above. A plane of unconformity may be a surface of weathering, Erosion or denudation, or a surface of non-deposition, or possibly some combination of these factors. It may be parallel to the upper strata, make an angle with the upper strata, or be irregular. Subsequent Earth movements may have folded or faulted it.

# 2.963 Unconsolidated

In referring to sediment grains, loose, separate, or unattached to one another.

# 2.964 Undercutting

Erosion of material at the foot of a Cliff or bank, e.g., a sea cliff, or river bank on the outside of a meander. Ultimately, the overhang collapses, and the process is repeated.

# 2.965 Undertow

A current below the water surface flowing seaward; the receding water below the surface from waves breaking on a shelving beach.

# 2.966 Underwater Gradient

The slope of the sea bottom. *See* slope.

# 2.967 Undisturbed Water Level

Same as the still water level.

# 2.968 Undulation

A continuously propagated motion to and fro, in any fluid or elastic medium, with no permanent translation of the particles themselves.

# 2.969 Upcoast

It generally means the coastal direction trending toward the north.

# 2.970 Updrift

The direction is opposite that of the predominant movement of littoral materials.

# 2.971 Upland

Dry land area above and landward of the ordinary high water mark (OHWM). Often used as a general term to mean high land far from the coast and in the interior of the country.

# 2.972 Uplift

The upward water pressure on the base of a structure or pavement.

# 2.973 Uprush

The rush of water up the foreshore following the breaking of a wave, also called swash or run-up.

# 2.974 Upstream

Along coasts with obliquely approaching waves there is a longshore (wave-driven) current. For this current one can define an upstream and a downstream direction. For example, on a beach with an orientation West-East with the sea to the North, the waves come from NW. Then the current flows from West to East. Here, upstream is West of the observer, and East is downstream of the observer.

# 2.975 Upwelling

The process by which water rises from a deeper to a shallower depth, usually as a result of offshore surface water flow. It is most prominent where persistent wind blows parallel to a coastline so that the resultant Ekman transport moves surface water away from the coast.

# 2.976 Valley

An elongated depression, usually with an outlet, between bluffs or between ranges of hills or mountains.

# 2.977 Submarine Valley

A prolongation of a land valley into or across a continental or insular shelf, which generally gives evidence of having been formed by stream erosion.

# 2.978 Velocity of Waves

The speed at which an individual wave advances. *See* wave celerity.

# 2.979 Velocity Profile

The velocity gradient within the bottom boundary layer, displayed as a graph of height above the bed against the velocity of the flow.

# 2.980 Viscosity (or Internal Fiction)

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.

# 2.981 Wash Load

Part of the suspended load with particle sizes smaller than found in the bed; it is in near-permanent suspension and transported without deposition; the amount of wash load transported through a reach does not depend on the transport capacity of the flow; the load is expressed in mass or volume per unit of time.

# 2.982 Washover

Sediment deposited inland of a beach by overwash processes.

# 2.983 Water Depth

Distance between the seabed and the still water level.

# 2.984 Water Level

Elevation of still water level relative to some datum.

# 2.985 Waterline

A juncture of land and sea. This line migrates, changing with the tide or other fluctuation in the water level. Where waves are present on the beach, this line is also known as the limit of backrush (approximately, the intersection of the land with the still-water level.)

# 2.986 Wave

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

# 2.987 Wave Age

The ratio of wave speed to wind speed.

# 2.988 Wave Celerity

The speed of wave propagation.

# 2.989 Wave Climate

The seasonal and annual distribution of wave height, period and direction.

# 2.990 Wave Climate Atlas

Series of maps showing the variability of wave conditions over a long coastline.

# 2.991 Wave Crest

*See* crest of wave.

# 2.992 Wave Crest Length

*See* crest length, wave.

# 2.993 Wave Decay

*See* decay of waves.

# 2.994 Wave Direction

The direction from which a wave approaches.

# 2.995 Wave Directional Spectrum

Distribution of wave energy as a function of wave frequency and direction.

# 2.996 Wave Forecasting

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

# 2.997 Wave Frequency

The inverse of wave period.

# 2.998 Wave Frequency Spectrum

Distribution of wave energy as a function of frequency.

# 2.999 Wave Group

A series of waves in which the wave direction, wavelength, and wave height vary only slightly. *See* also group velocity.

# 2.1000 Wave Height

The vertical distance between a crest and the preceding trough. *See* also significant wave height.

# 2.1001 Wave Height Coefficient

The ratio of the wave height at a selected point to the deepwater wave height. The refraction coefficient multiplied by the shoaling factor.

# 2.1002 Wave of Translation

A wave in which the water particles are permanently displaced to a significant degree in the direction of wave travel. Distinguished from an oscillatory wave.

# 2.1003 Wave Peak Frequency

The inverse of wave peak period.

# 2.1004 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. *See* also significant wave period.

# 2.1005 Wave Propagation

The transmission of waves through water.

# 2.1006 Wave Ray

*See* orthogonal.

# 2.1007 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.

# 2.1008 Wave Refraction

*See* refraction (of water waves).

# 2.1009 Wave Rose

Diagram showing the long-term distribution of wave height and direction.

# 2.1010 Wave Setdown

Drop in water level outside of the breaker zone to conserve momentum as wave particle velocities and pressures change prior to wave breaking.

# 2.1011 Wave Setup

*See* setup, wave.

# 2.1012 Sinusoidal Wave

An oscillatory wave having the form of a sinusoid.

# 2.1013 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. Several forms of graphical display are widely used.

# 2.1014 Wave Steepness

The ratio or wave height to wavelength also known as sea steepness.

# 2.1015 Wave Train

A series of waves from the same direction.

# 2.1016 Wave Transformation

Change in wave energy due to the action of physical processes.

# 2.1017 Wave Trough

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

# 2.1018 Wave Velocity

The speed at which an individual wave advances.

# 2.1019 Wavelength

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

# 2.1020 Weibull Distribution

A model probability distribution, commonly used in wave analysis.

# 2.1021 Weir

A low dam or wall across a stream to raise the upstream water level. Termed fixed crest weir when uncontrolled.

# 2.1022 Weir Jetty

A jetty with a low section or weir over which littoral drift moves into a predredged deposition basin which is then dredged periodically.

# 2.1023 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).

# 2.1024 Wetland Ecosystem

Wetlands are productive ecosystems which play an integral role in the ecology of the watershed and promote immense varieties of flora and fauna. They also reduce erosion as their roots hold the soil particles of streambanks, shorelines or coastlines.

# 2.1025 Well-Sorted

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

# 2.1026 Wharf

A structure built on the shore of a harbor, river, or canal, so that vessels may lie alongside to receive and discharge cargo and passengers.

# 2.1027 Whitecap

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

# 2.1028 Wicker Faggot

Bundles of twigs or sticks, often willow, used in building earthworks or levees.

# 2.1029 Wind Chop

*See* chop.

# 2.1030 Offshore Wind

A wind blowing seaward from the land in a coastal area.

# 2.1031 Onshore Wind

A wind blowing landward from the sea in a coastal area.

# 2.1032 Wind Rose

Diagram showing the long-term distribution of wind speed and direction.

# 2.1033 Wind Sea

Wave co ditions directly attributable to recent winds, as opposed to swelln.

# 2.1034 Wind Setdown

Drop in water level below the still water level on the windward ends of enclosed bodies of water and semi-enclosed bays.

# 2.1035 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. Storm surge is usually reserved for use on the ocean and large bodies of water.

# 2.1036 Wind Stress

The way in which wind transfers energy to the sea surface.

# 2.1037 Wind Tide

*See* wind setup, storm surge.

# 2.1038 Wind Waves

1. Waves being formed and built up by the wind.
2. Loosely, any wave generated by wind.

# 2.1039 Windward

The direction from which the wind is blowing.