GLOSSARY OF HIGHWAY-RELATED DRAINAGE TERMS

(Reprinted from the 1999 edition of the American Association of State Highway and Transportation Officials Model Drainage Manual)

G.1 Introduction

This Glossary is divided into three parts:

- Introduction,
- Glossary, and
- References.

It is not intended that all the terms in this Glossary be rigorously accurate or complete. Realistically, this is impossible. Depending on the circumstance, a particular term may have several meanings; this can never change.

The primary purpose of this Glossary is to define the terms found in the *Highway Drainage Guidelines* and *Model Drainage Manual* in a manner that makes them easier to interpret and understand. A lesser purpose is to provide a compendium of terms that will be useful for both the novice as well as the more experienced hydraulics engineer. This Glossary may also help those who are unfamiliar with highway drainage design to become more understanding and appreciative of this complex science as well as facilitate communication between the highway hydraulics engineer and others.

Where readily available, the source of a definition has been referenced. For clarity or format purposes, cited definitions may have some additional verbiage contained in double brackets [ ]. Conversely, three "dots" (...) are used to indicate where some parts of a cited definition were eliminated. Also, as might be expected, different sources were found to use different hyphenation and terminology practices for the same words. Insignificant changes in this regard were made to some cited references and elsewhere to gain uniformity for the terms contained in this Glossary: as an example, "groundwater" vice "ground-water" or "ground water," and "cross section area" vice "cross-sectional area."

Cited definitions were taken primarily from two sources: W.B. Langbein and K.T. Iseri's "General Introduction and Hydrologic Definitions" *(37)* and a draft of a Glossary being developed by the Interagency Hydrology Committee. A few cited definitions were considered to be partially outdated; corrections are suggested where this occurred. Future plans of the AASHTO Task Force on Hydrology and Hydraulics are to integrate the current American Society of Civil Engineers Glossary of hydrologic terms with this Glossary.

Many terms are explained and defined in several ways—sometimes with considerable detail. This was done intentionally for several reasons:

- to facilitate understanding for those who respond better to a particular written format or detail of explanation,
- to highlight actual or apparent contradictions in current terminology,
- to avoid or minimize litigation problems from overly restrictive definitions, and
- to selectively augment certain subject matter in the AASHTO *Highway Drainage Guidelines* and *Model Drainage Manual*.

Some terms included in this Glossary will have limited application to highway drainage design. They have been included for several reasons:

- to facilitate communication with other, related sciences; and
- to preclude confusion with similar, but different hydraulics-related terms.

As often happens in any science, some practitioners have different names for the same thing. Every attempt has been made to sort out these colloquialisms and synonyms and assign all the definitions to one term. Cross-referencing of these terms was attempted, but is unlikely to ever be complete or to satisfy all practitioners. It is anticipated that errors and oversights will be resolved with revisions of this Glossary. The reader is encouraged to submit their experience with this Glossary to the AASHTO Task Force on Hydrology and Hydraulics. In particular, the following information is solicited:

- proposed terms and definitions,
- proposed revisions of present terms to include reasons where appropriate, and
- problems (particularly legal) with the present definitions.

In cross-referencing, two terms are used: “See” and “Compare with.” The term “see” usually means one of two things: (1) The definition is provided under a different term; (2) The cross-referenced term provides additional information. The term “compare with” infers that the cross-referenced term may be at variance with or an antonym of the defined term; judgmental decisions may be needed in such cases.

This Glossary also attempts to “package” like terms having two or more words. This provides the added advantage of facilitating a comparison of terms without flipping back and forth between pages. As an example, see the section of this Glossary that addresses “Streams,” “Gages,” “Probability Distribution,” or “Weir.” In some instances this might prove inconvenient and add some length to the Glossary, but it was felt the advantages outweighed the disadvantages. An exception was made where a particular term might best be left with another, smaller grouping of like terms.

The scientific, and in particular the regulatory, world is inundated with acronyms and abbreviations. This Glossary attempts to define some of the more familiar acronyms and abbreviations likely to be encountered by the highway hydraulics engineer. In a few instances, they have different meanings (See TW, for instance). A few hydraulic variables and equations are also included.

And finally, since this is a Glossary of transportation-related hydraulic terms, an attempt has been made to provide this unique focus without distorting a term's meaning.

G.2 Glossary

The following terms are provided to facilitate the application of the AASHTO *Highway Drainage Guidelines* and *Model Drainage Manual.*

AASHTO Acronym for American Association of State Highway Transportation Officials.

ABLATION The process by which ice and snow waste away from melting and evaporation or by which land wears away by the action of surface water.

ABRASION Removal of stream bank material due to entrained sediment, ice, or debris rubbing against the bank. Compare with Erosion, Scour, and Mass Wasting.

ABSORPTION The assimilation or taking up of water or other solutions by soil or other material; i.e., the entrance of water into the soil or rocks by all natural processes. It includes the infiltration of precipitation or snowmelt, gravity flow of streams into the valley alluvium (see Storage, Bank), sinks, or other large openings, and the movement of atmospheric moisture. The process by which substances in gaseous, liquid, or solid form dissolve or mix with other substances. Compare with Adsorption.

ABSTRACTION That portion of rainfall which does not become runoff. It includes interception, infiltration, and storage in depressions. It is affected by land use, land treatment and condition, and antecedent soil moisture.

ABUTMENT The superstructure support at either end of a bridge or similar type structure: usually classified as spillthrough or vertical. Considered part of the bridge substructure. See Spillthrough Abutment and Vertical Abutment.

ACCRETION Build-up of beach due to wave and wind action.

ACRE-FOOT The quantity of water required to cover 1 acre to a depth of 1 foot and equal to 43,560 cubic feet or about 326,000 gallons or 1233 m^3. Abbreviated as AF. See Hectare-meters.

ACT (ACTS) Written law, such as an Act of Congress.

ACT OF GOD In law, a direct, sudden or irresistible action of natural forces that could not reasonably have been foreseen and prevented.

ACTION (HIGHWAY) A highway action as it pertains to drainage design is any construction, reconstruction, rehabilitation, repair, or improvement in a watershed or on the transportation system that measurably changes such things as floodplain limits, established flood patterns, and runoff characteristics or that requires a design or review storm system to accommodate storm runoff.

ADSORPTION The adhesion in an extremely thin layer of molecules (such as gases, solutions, or liquids) to the surface of solid bodies or liquids with which they are in contact. Compare with Absorption.

ADVERSE SLOPE See Slope, Adverse.

AERATION ZONE See Zone of Aeration.

AEROBIC A condition in which molecular oxygen is a part of the environment.

AF Acronym for Acre-Foot. Common abbreviation is ac.-ft.

AFFLUX Backwater or height by which water levels are raised at a stated point, owing to presence of a constriction or obstruction, such as a bridge.

AGGRADATION General and progressive upbuilding of the longitudinal profile of a channel or within a drainage facility by the deposition of sediment. Compare with Sedimentation. Permanent or continuous aggradation is an indicator that a change in the stream's discharge and sediment load characteristics is taking place.

AHW Acronym for Allowable Headwater. Compare with HW.

ALERT Acronym for Automated Local Evaluation in Real Time. An automated, local flood warning system consisting of automatic self-reporting river and rainfall gages, a communications system based on line-of-sight radio transmission of data, and a base station. The base station consists of radio receiving electronic equipment and a microprocessor. Data analysis software is available to collect, quality control, and display data. A hydrologic model to provide simulation of streamflow is also available.

ALFALFA A deep-rooting plant, *Medicago Sativa*, native to Eurasia, having compound leaves with three leaflets and a cluster of small purple flowers. It is widely cultivated for forage and is used as a commercial source of chlorophyll. Its deep-rooting characteristics, commercial value, and environmental (forage and bee habitat) qualities often make it desirable as a ground cover to control erosion.

ALGAE Any of various primitive, chiefly aquatic, one-celled or multi-cellular plants that lack true stems, roots and leaves but usually contain chlorophyll.

ALLOWABLE HEADWATER See Allowable Headwater Depth.

ALLOWABLE HEADWATER DEPTH The depth or elevation of the flow impoundment for a drainage facility above which damage, some other unfavorable result, or a significant flood hazard could occur. Compare with Headwater Depth.

ALLUVIAL Referring to deposits of silts, sands, gravels, or similar detrital material which has been transported by running water.

ALLUVIAL CHANNEL Channel formed wholly in alluvium with no bedrock exposed in the channel at low flow or likely to be exposed by erosion. A channel whose processes are controlled by the flow and boundary interactions.

ALLUVIAL FAN A landform shaped like a fan in plan view and deposited where a stream issues from a narrow valley of high slope onto a plain or broad valley of low slope. Compare with Debris Cone.

ALLUVIUM Unconsolidated material such as clay, silt, sand, or gravel deposited by water in a channel, or on a floodplain, alluvial, fan, or delta.

ALPHA (α) The kinetic-energy, velocity head coefficient. See Velocity Head Coefficient.

ALTERNATE DEPTH See Depth, Alternate.

ALTERNATE BAR See Bar, Alternate.

AMC Acronym for Antecedent Moisture Condition.

AMPHIBIAN Any of the various cold-blooded, smooth-skinned vertebrates (with backbone) organisms such as toads, frogs, and salamanders characteristically hatching as an aquatic larvae that breathe by means of gills and metamorphosing to an adult form having air-breathing lungs.

ANABRANCH Individual channel of an anabranched stream. A diverging branch of a river which reenters the main stream.

ANABRANCHED STREAM See Stream, Anabranched.

ANAEROBIC A condition in which molecular oxygen is absent from the environment.

ANALYSIS, HYDRAULIC An evaluation of a drainage-related circumstance or condition based on measured or computed findings coupled with prudent judgment. Compare with Assessment, Hydraulic.

ANALYSIS, ECONOMIC See Economic Analysis. Compare with Economic Assessment.

ANASTOMOSING STREAM See Stream, Anastomosing.

ANCHOR ICE Ice in the bed of a stream or upon a submerged body or structure *(57).*

ANGLE OF FLARE Angle between direction of wingwall and the centerline of a culvert barrel.

ANGLE OF REPOSE The maximum angle, as measured from the horizontal, at which granular particles can stand.

ANGULARITY The acute angle between the plane of the highway centerline along the bridge, and a line normal to the thread of the stream; i.e., the acute angle between the thread of the stream and a line normal to the centerline along bridge. Angle of skew if abutments are parallel to the flow line.

ANNUAL FLOOD See Flood, Annual.

ANNUAL (FLOOD) SERIES A list of annual events such as annual maximum floods and minimum flows. See Flood, Annual.

A general term for a set of any kind of data in which each item is the maximum, minimum, average, or some other consistent value in a year *(34).*

A frequency series in which only the largest value for a particular series of data in each year is used, such as the annual floods*(51).*

ANNUAL RUNOFF See Runoff, Annual.

ANNUAL YIELD See Runoff, Annual.

ANTECEDENT MOISTURE See Antecedent Moisture Condition.

ANTECEDENT MOISTURE CONDITION (AMC) The degree of wetness of a watershed's surface soils at the beginning of a storm.

ANTECEDENT PRECIPITATION Rainfall that occurred prior to the particular rainstorm under consideration.

ANTECEDENT PRECIPITATION INDEX An index of moisture stored within a drainage basin before a storm *(37) (43).*

ANTIDUNE A particular type of bed form caused by water flowing over a mobile material such as sand. A sand wave indicated on the water surface by a regular undulating wave. The ridges may move upstream and the surface waves become gradually steeper on the upstream sides until they break like surf and disappear. These surface waves are usually in series and often reform after disappearing. See Bed Form. Compare with Dune.

APEX The highest point, the vertex.

APPROACH CHANNEL The reach of channel upstream from a dam, bridge constriction, culvert, or other drainage structure. See Approach Section.

APPROACH SECTION A cross section of the stream channel, normal to thread of current and for the discharge of interest, located in the approach channel. See Approach Channel.

APRON Protective material laid on a stream bed to prevent scour commonly caused by some drainage facility. More specifically, a floor lining of such things as concrete, timber, and riprap, to protect a surface from erosion, such as the pavement below chutes, spillways, at the toes of dams, or at the outlets of culverts. Material placed on the banks is commonly termed a blanket. Compare with Channel Lining and Blanket.

APRON, LAUNCHING A flexible apron designed to settle and protect the side slopes of a scour hole or eroded channel bed both during and after settlement.

AQUATIC LIFE Wildlife living or growing on, in, or adjacent to water.

AQUEDUCT See Flume.

AQUEOUS FORM Dissolved in the water.

AQUIFER A porous, water-bearing geologic formation. Generally restricted to materials capable of yielding an appreciable supply of water.

AREA The size, in square feet or in square meters, of a flow section, channel, or waterway opening. Also, the size in square miles or kilometers, acres, or hectares, of drainage area or basin, catchment area, or drainage area. See Drainage Area.

AREA CURVE When plotted against some other variable such as discharge or velocity, a graph of: 1. the cross-sectional area of a stream at a gaging station or other section; 2. the surface area of a reservoir plotted against water-surface elevations; 3. the flow area of a drainage structure.

AREA, HYDROLOGIC See Hydrologic Area.

AREA RAINFALL The average rainfall over an area, usually as derived from or discussed in contrast with point rainfall *(51)*.

AREA-CAPACITY CURVE A graph showing the relation between the surface area of the water in a reservoir and the corresponding volume.

ARID Geographic areas that are dry, lacking moisture. Compare with Desert and Semi-arid.

ARMOR Artificial surfacing of channel beds, banks, or embankment slopes to resist stream bed scour and/or lateral bank erosion. Compare with Apron, Blanket, Channel Lining, and Revetment.

ARMORING A natural process whereby an erosion-resistant layer of relatively large particles is formed on a channel bank and/or channel bed due to the removal of finer particles by streamflow; i.e., the concentration of a layer of stones on the bed of the stream which are of a size larger than the transport capability of the recently experienced flow—the winnowing out of smaller material capable of being transported while leaving the larger sizes as armor that, for discharges up to that point in time, cannot be transported. Armoring may also refer to the placement of a covering on a channel bank and/or channel bed to prevent erosion.

ARRAY A list of data in order of magnitude; in flood-frequency analysis it is customary to list the largest value first, and in a low-flow frequency analysis the smallest first *(34).*

ARROYO Term of regional geographic usage. See Channel.

ARTESIAN Pertains to groundwater that is under pressure and will rise to a higher elevation if unconstrained.

ARTICULATED CONCRETE MATTRESS Rigid concrete slabs which can move without separating as scour occurs, usually hinged together with corrosion-resistant fasteners; primarily used for a lower bank protection armor blanket.

ASPHALT, END DUMPED Mass of uncompacted, asphalt chunks of various sizes that are usually dumped from a truck for upper bank protection or from a barge for lower bank protection. The purpose is to protect the bank against erosion. Note, there may be environmental prohibitions against using asphalt for such purposes.

ASSESSMENT, HYDRAULIC Primarily a prudent, judgmental evaluation of a drainage-related circumstance or condition using observations and experience but without a large amount of measured or computed information. Compare with Analysis, Hydraulic.

ASSESSMENT, ECONOMIC See Economic Analysis or Economic Assessment.

AUGMENTATION, FLOW The addition of water to a stream, especially to meet water quality or fish and wildlife needs.

AUGMENTED FLOW The increased volume of water entering a channel, or allowed to run overland as waste waters from the diversion of surface flow or as water from another stream or watershed; or from waters withdrawn or collected upstream and released after use.

AVERAGE DISCHARGE See Discharge, Average.

AVERAGE VELOCITY See Velocity, Average.

AVULSION A sudden change in channel course that occurs when a stream suddenly breaks through its banks; usually associated with a large flood or a catastrophic flood or event.

BACKFILL The material used to refill a ditch or other excavation, material placed adjacent to or around a drainage structure, or the process of doing so.

BACKWATER The increase in water surface elevation induced upstream from such things as a bridge, culvert, dike, dam, another stream at a higher stage, or other similar structures or conditions that obstruct or constrict a channel relative to the elevation occurring under natural channel and floodplain conditions. Stated another way, water backed up or retarded in its course as compared with its normal or natural conditions of flow. Also applies to the water surface profile in a channel or conduit. See Backwater Curve.

The difference between the observed stage and that indicated by the stage-discharge relation, is reported as backwater *(37)*.

Four other similar definitions and examples are offered: 1. in a general sense, a flow retarding influence due to a dam, other constrictions such as a bridge or culvert, or another stream; 2. the increase in water-surface elevation due to a bridge constriction above the normal unconstricted elevation at an approach section located one bridge length upstream from the bridge constriction; 3. water backed up or retarded in its course as compared with its normal or natural condition of flow; 4. in stream gaging, a rise in stage produced by a temporary obstruction such as ice or weeds, or by the flooding of the stream below.

BACKWATER AREA The low-lying lands adjacent to a stream that may become flooded due to backwater effects. Compare with Floodplain.

BACKWATER CURVE A particular form (or profile) of the surface curve (water surface) of a stream of water which is concave upward. It is caused by an obstruction in the channel such as those that cause backwater. The depth is greater at all points under the curve than the critical and the normal depth, and the velocities diminish downstream. The term is sometimes used in a generic sense to denote all water surface curves or profiles. Compare with Backwater and Water Surface Profile.

BACKWATER FLOODING The backup of water into a stream from a river, lake, or ocean having a higher water elevation *(33)*.

BACKWATER RATIO The ratio (C_b) of the amount of backwater (h_l*) created by a bridge constriction to the total drop (Δh) through the constriction.

BACKWATER REACH The reach of channel influenced by the backwater curve.

BAFFLE A structure constructed on the bed of a stream or drainage facility to deflect or disturb the flow. Vanes or guides, a grid, grating, or similar device placed in a conduit to check eddy currents below them, and effect a more uniform distribution of velocities. Also a device used in a culvert or similar structure to facilitate fish passage.

BAFFLE-PIERS Obstructions set in the path of high-velocity water, such as piers on the apron of a stilling basin, to dissipate energy and prevent bank erosion and stream bed scour.

BANK The side slopes or margins of a channel between which the stream or river is normally confined. More formally, the lateral boundaries of a channel or stream, as indicated by a scarp, or on the inside of bends, by the streamward edge of permanent vegetal growth.

The margins of a channel. Banks are called right or left as viewed facing in the direction of the flow [commonly downstream] *(37).*

See Bank, Upper; Bank, Lower; Bank of Channel Left; and Bank of Channel Right.

BANK CAVING See Mass Wasting.

BANK, GUIDE See Guide Bank.

BANK, LEFT See Left Bank of a Channel.

BANK, LOWER That portion of a channel bank having an elevation less than the mean water level of the stream or river. Compare with Bank; and Bank, Upper.

BANK, MIDDLE That portion of a channel bank having an elevation approximately the same as that of the mean water level of the stream or river.

BANK, RIGHT See Right Bank of a Channel.

BANK, STREAM See Bank, Right Bank of a Channel, and Left Bank of a Channel.

BANK STORAGE See Storage, Bank.

BANK, UPPER The portion of a channel bank having an elevation greater than the average (mean annual or dominant flow) water level of the stream. Compare with Bank; and Bank, Lower.

BANKFULL DISCHARGE Discharge that, on the average, fills a channel to the point of overflowing. Commonly considered as the mean annual discharge ($Q_{2.33}$) or two- to three-year discharge (Q_2, Q_3) in a channel that has been relatively stable for a number of years without the occurrence of a large, bank-destroying flood. Sometimes used as the dominant discharge. See Discharge, Dominant.

BANKFULL STAGE Stage at which a stream first overflows its natural banks. Compare with Flood Stage. Bankfull stage is a hydraulic term, whereas flood stage implies damage *(37).*

The water elevation that reaches the top of the banks along a stream *(33).* Compare with Bankfull Discharge.

BAR An elongated deposit of alluvium, not permanently vegetated, within or along the side of a channel. See Bar, Point; Bar, Middle; and Bar, Alternate.

BAR, ALTERNATE An alluvial deposit of sand and gravel lacking permanent vegetal cover occurring in an alternating pattern from bank to bank in a relatively straight channel reach.

BAR, MIDDLE A bar lacking permanent vegetal cover that divides the flow in a channel at normal stage.

BAR, POINT An alluvial deposit of sand or gravel lacking permanent vegetal cover occurring in a channel at the inside of a meander loop bendway and usually somewhat downstream from the apex of the loop. The longer, tapered portion, when present, commonly points upstream.

BARRAGE See Check Dam.

BARREL WIDTH Commonly the inside, horizontal extent of a drainage facility.

BASE The layers of specified material placed on the sub-base or subgrade to support the pavement, surface course, or a drainage facility.

BASE DISCHARGE See Base Flow.

BASE FLOOD (or STORM) See Flood, Base; and Flood (or Storm), Review.

BASE FLOODPLAIN Surface area flooded by the base flood.

BASE FLOW In the U.S. Geological Survey's annual reports on surface-water supply, the discharge above which peak discharge data are published. The base discharge at each station is selected so that an average of about three peaks a year will be presented *(37).* See Runoff, Base.

BASE FLOW RECESSION The declining rate of discharge of a stream fed only by base flow for an extended period. Typically, a base flow recession will be exponential *(20).* Compare with Depletion Curve and Recession Curve.

BASE FLOW RECESSION HYDROGRAPH A hydrograph that shows a base flow recession curve.

BASE RUNOFF See Runoff, Base.

BASE STATION The central location for receiving flood data from sensors in the ALERT [or IFLOWS] system. Gaging station providing basic hydrologic data *(33).*

BASELINE MONITORING The establishment and operation of a designed surveillance system for continuous or periodic measurements and recording of existing and changing conditions that will be compared with future observations.

BASIC HYDROLOGIC DATA Includes inventories of land and water features that vary only from place to place (topographic and geologic maps are examples) and records of processes that vary with both place and time (records of precipitation, streamflow, groundwater, and

quality-of-water analyses are examples). Basic hydrologic information is a broader term that includes surveys of the water resources of particular areas and a study of their physical and related economic processes, interrelations, and mechanisms.

BASIC-STAGE FLOOD SERIES See Partial-Duration Flood Series.

BASIN, DEBRIS A basin constructed in a channel to store debris, such as sand, gravel, silt, and driftwood. See Debris, Debris Barrier, and Debris Dam. Compare with Basin, Sedimentation; Basin, Recharge; Basin, Detention; and Basin, Retention.

BASIN DRAINAGE See Drainage Area.

BASIN, DETENTION A basin or reservoir incorporated into the watershed whereby runoff is temporarily stored, thus attenuating the peak of the runoff hydrograph. A stormwater management facility that impounds runoff and temporarily impounds runoff and discharges it through a hydraulic outlet structure to a downstream conveyance structure. Compare with Basin, Retention; Basin, Recharge; Basin, Debris; and Basin, Sedimentation.

BASIN LAG The amount of time from the centroid of the rainfall hyetograph to the hydrograph peak.

BASIN, RECHARGE A basin or pit excavated to provide a means of allowing water to soak into the ground at rates exceeding those that would occur naturally *(20).* A basin excavated in the earth to receive the discharge from streams or storm drains for the purpose of replenishing groundwater supply and/or attenuating flood discharge.

A basin or reservoir wherein water is stored for recharging the groundwater. It does not have an uncontrolled outlet. The stored water is disposed by such means as infiltration or injection (dry wells) designed for such purposes. Compare with Floodwater Retarding Structure; Retarding Reservoir; Basin, Detention; Basin, Sedimentation; Basin, Debris; and Basin Retention. See Recharge and Recharge Area.

BASIN, RETENTION A basin or reservoir wherein water is stored for regulating a flood. It does not have an uncontrolled outlet. The stored water is disposed by such means as infiltration, injection (or dry) wells, or by release to the downstream drainage system after the storm event. The release may be through a gate-controlled gravity system or by pumping. Compare with Floodwater Retarding Structure; Retarding Reservoir; Basin, Detention; Basin, Recharge; Basin, Sedimentation; and Basin, Debris.

BASIN, SEDIMENTATION A basin or tank in which floodwater or stormwater containing settleable solids is retained to remove by gravity or filtration a part of the suspended matter. Compare with Basin, Recharge; Basin, Detention; Basin, Retention; and Basin, Debris.

BASIN, STILLING See Stilling Basin.

BEARD DISTRIBUTION See Probability Distribution.

BED The bottom of a channel. The part of a channel not permanently vegetated which is bounded by banks and over which water normally flows. Compare with Substrate.

BED FORM A recognizable and commonly transient relief feature on the bed of a channel, such as a ripple, dune, or bar. A relief feature caused by water flowing over a mobile material such as sand and gravel.

BED, INDURATED A channel bed that has been made hard or has hardened. See Control.

BED LAYER A flow layer, several grain diameters thick (usually two) immediately above the bed.

BED LOAD Sediment that is transported in a stream by rolling, sliding, or skipping (saltating) along the bed or very close to it; considered to be within the bed layer. The quantity of silt, sand, gravel, or other detritus rolled along the bed of a stream, often expressed as weight or volume per time. Compare with Contact Load and Wash Load.

BED LOAD DISCHARGE The quantity of bed load passing a cross section of a stream in a unit of time. Compare with Sediment Discharge and Wash Load.

BED MATERIAL The sediment mixture of which a stream bed, lake, pond, reservoir, or estuary bottom is composed *(52).* Sediment consisting of particle sizes large enough to be found in appreciable quantities at the surface of a channel bed. Material found on the bed of a channel (may be transported as bed load discharge or sediment discharge). See Bed Load Discharge.

BED SEDIMENT DISCHARGE The part of the total sediment discharge that is composed of grain sizes found in the bed and is equal to the transport capability of the flow occurring at the time. Compare with Bed Load, Bed Load Discharge, Sediment Discharge, and Bed Load Discharge.

BED SHEAR See Tractive Force.

BED SLOPE The longitudinal inclination of a channel bottom. Compare with Superelevation.

BEDROCK The scour-resistant material underlying erodible soils and overlying the mantle rock, ranging from surface exposure to depths of several hundred miles or kilometers.

BENCH-FLUME A conduit on a topographical bench, cut into sloping ground. Compare with Flume.

BENDWAY A point of distinct curvature in a stream, river, or channel where the bankfull flow changes direction. Reach of sharpest curvature in a sinuous channel.

BENDWAY SCOUR See Scour, Bendway.

BENEFICIAL USE Relates to the beneficial use of a water and flood right. See Water Right and Flood Right. Beneficial use is such things as municipal use, agricultural use, recreation, and environmental purposes (instream flows).

BERM A narrow shelf or ledge; also a form of dike. A more detailed description might be: 1. the space left between the upper edge of a cut and the toe of an embankment; 2. a horizontal strip or shelf built into an embankment to break the continuity of an otherwise long slope.

Also may be the top surface or plane of a shoulder, ledge, or bank constructed in connection with the roadway embankment at bridge abutments, waste along fill slopes, and canal or ditch banks. Compare with Dike.

BERNOULLI'S THEOREM A proposition advanced by Daniel Bernoulli that the energy head at any section in a flowing stream is equal to the energy head at any other downstream section plus the intervening losses.

BEST MANAGEMENT PRACTICES (BMPs) Erosion and pollution control practices employed during construction to avoid or mitigate damage or potential damage from the contamination or pollution of surface waters or wetlands from a highway action.

BETA (β) The momentum velocity head coefficient. See Momentum Coefficient.

BIOMASS The amount of living matter (as in a unit area or volume of habitat) according to *Webster's New Collegiate Dictionary.*

BIOSTIMULATION To rouse any living organisms to activity.

BIOTIC Pertaining to life or specific life conditions.

BIOTIC REGION A geographic area having similar biotic conditions. See Mitigation Alternatives.

BITUMINOUS MATTRESS An impermeable rock-, mesh-, or metal-reinforced layer of asphalt or other bituminous material placed on a channel bank to prevent erosion. Note that there may be environmental prohibitions for such material.

BLANKET Material covering all or a portion of a channel bank to prevent erosion. Stream bank surface covering, usually impermeable, designed to serve as protection against erosion. Common pavements used on channel banks are concrete, compacted asphalt, and soil-cement. Compare with Apron, Apron Launching, Armor, and Channel Lining.

BLANKET, CLAY See Clay Blanket.

BLANKET, FILTER See Filter Blanket.

BLM Acronym for the Bureau of Land Management.

BLOM DISTRIBUTION See Probability Distribution.

BMP (BMPs) Acronym for Best Management Practices.

BOG A shrug peatland dominated by ericaceous shrubs, sedges and peat moss and usually having a saturated water regime or a forested peatland dominated by evergreen trees (usually spruces and firs) and/or larch. See Wetlands.

BORE, HYDRAULIC A wave of water having a nearly vertical front, such as a tidal wave, advancing upstream as a result of high tides in certain estuaries; a similar wave advancing downstream as the result of a "cloudburst," or the sudden release of a large volume of water from a reservoir, as in the Johnstown (PA) flood. The bore is analogous to the hydraulic jump in that it represents the limiting condition of the surface curve wherein it tends to become perpendicular to the bed of the stream.

BOREAL REGION The geographical area just below the arctic tundra and usually characterized by the evergreen forests.

BOTTOM CONTRACTION A channel contraction resulting from some protrusion across the bottom of a channel.

BOTTOM MATERIAL See Bed Material.

BOULDER A rounded or angular fragment of rock, the diameter of which is in the size range of 10 inches to 13 feet or 250 mm to 4000 mm according to the FHWA's *Highways in the River Environment Manual.*

BRAID A subordinate channel of a braided stream. See Stream, Braided. Compare with Anabranch.

BRAIDED STREAM See Stream, Braided.

BRAIDING OF RIVER CHANNELS See Stream, Anastomosing.

BRANCH Term of local geographic usage. See Channel.

BREAKERS The surface discontinuities of waves as they breakup. They may take different shapes (spilling, plunging, surging). Zone of break-up is called the surf zone.

BRIDGE A structure including supports erected over a depression or an obstruction, such as water, highway, or railway, and having a tract or passageway for carrying traffic or moving loads, and, for definition purposes (AASHTO), having an opening measured along the center of the roadway equal to or more than 6.1 m (20 feet) between undercopings of abutments or spring lines of arches, or extreme outside ends of openings for multiple boxes; it may also include multiple pipes, where the clear distance between openings is less than half of the smaller contiguous opening. Also a structure that, while designed hydraulically using the principles of open channel flow to operate with a free water surface, may be inundated under flood conditions. The structure generally consists of a deck or superstructure supported on two or more abutments and often includes intermediate piers. Compare with Culvert.

BRIDGE OPENING The total cross section area beneath a bridge superstructure that is available for the conveyance of water. Compare with Bridge Waterway.

BRIDGE, RELIEF An opening through an embankment located on a floodplain for the purpose of permitting passage of overbank flow.

BRIDGE WATERWAY The area of a bridge opening available for flow as measured below a specified stage and normal to the principal direction of flow. Compare with Bridge Opening.

BROAD-CRESTED WEIR See Weir, Broad-Crested.

BROKEN RECORD A systematic record [of events such as annual floods] which is divided into separate, continuous segments because of a deliberate, discontinuation of recording for significant periods of time *(33)*.

BROKEN-BACK CULVERT See Culvert, Broken-Back.

BUBBLE GAGE See Gage, Bubble.

BUFFER ZONE Areas of trees, grass or other vegetation located between the top of a channel bank and the adjacent highway; also called greenbelts.

BULKHEAD A steep or vertical wall that supports a natural or artificial embankment and may also serve as a protective measure against bank erosion.

BYPASS FLOW See Flow, Bypass.

CAISSON A chamber, usually sunk by excavating from within, for the purpose of gaining access to the subsurface geology selected to support a structure's substructure (the foundation). If the chamber is closed on top and the water excluded by air pressure, it is called a pneumatic caisson. Oftentimes in highway construction a caisson is filled with concrete or masonry to serve as the pier or abutment substructure. Compare with Cofferdam.

CALIBRATION The process of fitting a [computational] model to a set of observed data by changing unknown or uncertain model parameters systematically within their allowable ranges until a "best fit" of the model to the observed data is achieved *(1)*.

CALIFORNIA DISTRIBUTION See Probability Distribution.

CANAL A constructed open conduit or channel for the conveyance of irrigation water which is distinguished from a ditch or lateral by its larger size. It is usually excavated in natural ground, although lined canals on berms are not uncommon. Compare with Channel and Swale.

CAPACITY A measure of the ability of a channel or conduit to convey water. Compare with Conveyance.

CAPACITY CURVE A graph of the volume of such things as a reservoir, tank, or detention pond as a function of elevation. The capacity of a reservoir is defined by reference to an elevation.

CARRYOVER See Flow, Bypass.

CATASTROPHIC FLOOD (OR STORM) See Flood (or Storm), Catastrophic.

CATCH BASIN A structure, sometimes with a sump, for inletting drainage from such places as a gutter or median and discharging the water through a conduit. In common usage it is a grated inlet, curb opening, or combination inlet with or without a sump. Note that sumps in catch basins may cause environmental hazards by further polluting "first flush" runoff and subsequent runoff passing through the catch basin.

CATCHMENT See Drainage Area.

CATCHMENT AREA See Drainage Area.

CATCHMENT BASIN See Drainage Area.

CATION EXCHANGE CAPACITY (CEC) The sum total of exchangeable cations that a soil can absorb; expressed in milliequivalents per gram, or per 100 g of soil.

CAUCHY DISTRIBUTION See Probability Distribution.

CAUSEWAY Rock or earth embankment carrying a roadway across water.

CAVING BANK See Mass Wasting.

CAVITATION A phenomenon associated with the vaporization of a flowing liquid in a zone of low pressure, wherein cavities filled with liquid vapor (vapor bubbles) alternately develop and collapse. Significant cavitation is unusual in highway drainage structures but, if present, may cause structural deterioration. Put another way, a condition wherein a vacuum, to any degree, exists as a result of flowing water. Complete cavitation occurs when the pressure within the affected part is reduced to that of the vapor pressure of the water.

CEC Acronym for Cation-Exchange Capacity.

CELERITY, WAVE The velocity of a wave measured relative to the liquid, known as celerity C, is equal to the wave length divided by the period [of the wave], or C = L/t *(13).*

CELLULAR-BLOCK MATTRESS Regularly cavitated, interconnected concrete blocks placed directly on a bank (or shore) to prevent erosion. The cavities can permit bank (or shore) drainage and the growth of either volunteer or planted vegetation when synthetic filter fabric is not used between the mattress and bank (or shore). See Apron and Blanket.

CFR Acronym for Code of Federal Regulations.

CFS (cfs) Acronym for cubic feet per second *(37).* See Cubic Feet per Second.

CFS-DAY (cfs-day) Often [erroneously] called a "second-foot-day." The volume of water represented by a flow of 1 cubic foot/s/day *(50).*

CHAIN OR TAPE GAGE See Gage, Chain or Tape.

CHANNEL The term "channel" has been defined numerous ways: 1. the bed and banks that confine the flow of surface water in a natural stream or artificial channel; also see River and Stream; 2. the course where a stream of water runs or the closed course or conduit through which water runs, such as a pipe; 3. An open conduit either naturally or artificially created which periodically or continuously contains moving water or which forms a connecting link between two bodies of water. River, creek, run, branch, anabranch, [arroyo, draw, wash] and tributary are some of the terms used to describe natural channels. Natural channels may be single or braided (see Braiding of River Channels). Canal [, ditch, lateral] and floodway are some of the terms used to describe artificial channels *(37).*

Channel has also been defined as an elongated, open depression in which water may, or does, flow. An elongated depression, either naturally or artificially created and of appreciable size, which periodically or continuously contains moving water or which forms a connecting link between two bodies of water. It must have a definite bed and bank, which serve to confine the water up to some bankfull discharge amount.

Local convention may use river, stream, arroyo, or branch. With constructed canals, the term ditch or lateral may be used. See Field Ditch.

Compare with Swale, Canal, and Waterway.

CHANNEL, ALLUVIAL See Alluvial Channel.

CHANNEL, APPROACH See Approach Channel.

CHANNEL, BED See Bed.

CHANNEL COEFFICIENT A roughness factor in the Kutter, Manning, Bazin, and other formulas expressing the character of a channel as it affects the friction slope of water flowing therein. More specifically, for highway drainage design in the United States, the roughness factor, n, in Manning's equation. See Manning's Equation.

CHANNEL, COLLATERAL Channels that are side-by-side; accompanying; from the same source; or similar but of subordinate nature.

CHANNEL CONTRACTION The degree of contraction imposed by a bridge type constriction on the river channel for a given discharge. It is measured by the channel-contraction ratio (M), which is defined as the ratio of that portion of flow directed at the contracted opening divided by the total flow that must pass through the contracted opening. Sometimes the inverse of this

ratio is used to define the channel contraction, so caution is warranted. Compare with Constriction, Contracted Section, Contraction, and Coefficient of Contraction.

CHANNEL DIVERSION The taking of water from a stream or other body of water into a canal, pipe, or other conduit *(37).* The removal of all or a portion of the flow from a natural or artificial (canal, ditch, field ditch, or lateral) channel.

CHANNEL LINING The material applied to the bottom and/or sides of a natural or constructed channel. Material may be such things as concrete, sod, grass, rock, or any of several other types of commercial linings. Covering of stones on a channel bed or bank (used in the AASHTO *Model Drainage Manual* with reference to natural covering). Compare with Apron, Blanket, and Armor.

CHANNEL, LOW FLOW Lower portion of natural or artificial watercourse often of perceptible extent with a definite bed and banks which confines and conducts continuously or periodically flowing water. A low flow channel is considered as that portion of a channel commonly lying below the plane of the ordinary highwater (OHW). A low flow channel may be adjoined by a floodplain. The bankfull capacity is often associated with the dominate discharge or mean annual discharge.

CHANNEL, INCISED See Incised Channel; Incised Reach; and Stream, Incised.

CHANNEL, MEANDERING See Meandering Channel.

CHANNEL MIGRATION Change in position of a channel by lateral erosion of one bank and the simultaneous accretion of the opposite bank. Systematic channel shifting in the direction of flow.

CHANNEL, NATURAL A surface or underground watercourse created by natural agents and conditions. The principal stream channel or channels and, if the stream is braided, its natural and customary overflow channels.

CHANNEL, NON-UNIFORM A channel where the flow streamlines are not straight and parallel. The velocity vector varies significantly with distance along a flow streamline at a given instance. With non-uniform channels, resistance and gravity forces are not in balance, the water surface is not parallel to the channel bottom or friction slope, S_f. Also, the rate of loss of total head will not equal the average channel bottom slope, S_0. Compare with Channel, Uniform.

CHANNEL, OPEN A channel having a water surface exposed at all points to atmospheric pressure. Any conveyance in which water flows with a free surface. Compare with Open Channel Flow.

CHANNEL PATTERN The aspect of a stream channel in plan view, with particular reference to such things as the degree of sinuosity, braiding, or anabranching.

CHANNEL PROCESS Behavior of a channel with respect to channel migration, erosion, and sedimentation.

CHANNEL ROUTING The process whereby a peak flow and/or its associated streamflow hydrograph is mathematically transposed to another site downstream taking into account the effect of channel storage.

CHANNEL, REGIME See Regime Channel.

CHANNEL SLOPE Fall per unit length along the channel centerline.

CHANNEL, STABLE A condition that exists when a channel has a bed slope and cross section which allows it to transport the water and sediment delivered from the upstream watershed without significant aggradation, deposition or bank erosion. See Regime, Regime Channel, and Regime of a Stream.

CHANNEL STORAGE See Storage, Channel.

CHANNEL, TORTUOUS A winding channel which is not free to shift its alignment. Compare with Flow, Turbulent.

CHANNEL, UNIFORM Channel with a uniform cross section and constant roughness. A constant slope is also a requirement for uniform flow and depth. See Depth, Normal.

[For highway drainage design,] a channel where the flow streamlines are [essentially] straight and parallel. Lack of [significant] variation in the velocity vector with distance along a streamline at a given instant. If a channel is uniform and resistance and gravity forces are in near balance, the water surface will be parallel to the bottom of the channel and to the friction slope, S_f, and the rate of loss of total head will equal the slope, S_o, of the channel bottom. This is the condition of uniform flow. The depth from the water surface to the bottom grade line of the channel, which because of the parallelism of the water surface and grade line is the same at all sections, is known as normal depth, Y_o [Y_n]. The normal depth is a function of the shape and roughness of the channel, its slope, and the rate of discharge. For a given discharge, channel shape, and slope, the normal depth will vary according to the total effect of boundary resistance *(56).* Compare with Channel, Non-Uniform.

CHANNEL, WANDERING A channel exhibiting a more or less non-systematic process of channel shifting, erosion, and deposition, with no definite meanders or braided pattern.

CHANNELIZATION Straightening and/or deepening of a channel by such things as artificial cutoffs, grading, flow-control measures, river training, or diversion of flow into an artificial channel. See River Training Structures.

CHECK DAM A relatively low dam or weir across a channel for the diversion of irrigation flows from a small channel, canal, ditch, or lateral. A check dam can also be a low structure, dam or weir, across a channel for such things as the control of water stage or velocity or the control

of channel bank erosion and channel bed scour from such things as headcutting. Sometimes termed a barrage in Britain and former British Commonwealth countries.

CHECK FLOOD See Flood (or Storm), Review.

CHECK FLOOD FOR BRIDGE SCOUR See Flood (or Storm), Review.

CHEMICAL GAGING A process of measuring the flow of water by ascertaining the resulting degree of dilution of a chemical solution of known saturation introduced at a known rate into the stream.

CHEMICAL STABILIZATION Channel bank protection technique involving the application of chemical substances to increase particle cohesiveness and to shift the size distribution toward the coarser fraction. The net effect is to improve the erosion resistance of the material.

CHEGODOYEV DISTRIBUTION See Probability Distribution.

CHEMICAL-HYDROMETRY See Chemical Gaging.

CHEMOCLINE A salinity or other chemical gradient within surface waters. Chemoclines are usually thought of for lakes, but might include some ponds. See Lake and Pond.

CHEZY FORMULA An empirical formula for uniform flow expressing the relation between velocity of water, hydraulic radius, and friction slope; thus, $V = C(RS)^{1/4}$ where V = velocity; R = hydraulic radius; S_n = energy or friction slope; and C = a coefficient.

CHOKING (OF FLOW) Severe backwater effect resulting from excessive constriction.

CHUTE An open or closed channel used to convey water, usually situated on the ground surface. Compare with Cutoff. Two other definitions are: 1. a high-velocity conduit for conveying water to a lower level; 2. an inclined drop or fall. See Drop.

CHUTE CUTOFF See Cutoff.

CIPOLLETTI WEIR See Weir, Cipolletti.

CIVIL ACTION Action presenting an issue to be resolved under civil law, as distinguished from criminal law, and/or brought to establish or recover private and civil rights or redress for damage; tort action.

CIVIL LAW The system of jurisprudence established by a nation, state, or commonwealth peculiarly for itself; the division of law regulating ordinary private matters, as distinct from laws regulating criminal, political or military matters. The civil laws regarding the management of naturally occurring waters established the rights or easements, both favorable and restrictive, of the riparian owners individually and with respect to others, and are directed toward equitable use and the preservation and continuation of natural drainage conditions. Compare with Common Law.

CIVIL LAW DOCTRINE OR RULE A rule of law pertaining to the disposal of drainage waters, under which the owner of higher land has the right or easement to dispose of the surplus or excess waters from his lands to lower lands, unobstructed by the owners thereof. Compare with Common Enemy Doctrine or Rule, Natural Drainage Doctrine or Rule, and Reasonable Use Doctrine and Rule.

CLAY Material passing the No. 200 (0.074 mm) U.S. Standard Sieve that exhibits plasticity (putty-like properties) within a range of water contents and has considerable strength when air-dry (Unified Soil Classification System) *(21,* FHWA *Highways in the River Environment Manual).*

CLAY BLANKET Layer of compacted clay placed over cohesionless bank soils to protect them against erosive streamflow.

CLAY PLUGS See Meander Plugs.

CLEARANCE An unobstructed horizontal or vertical space. Compare with Freeboard.

CLIMATE The sum total of the meteorological elements that characterize the average and extreme condition of the atmosphere over a long period of time at any one place or region of the earth's surface. The collective state of the atmosphere at a given place or over a given area within a specified period of time *(37).*

CLIMATIC YEAR A continuous 12-month period during which a complete annual cycle occurs, arbitrarily selected for the presentation of data relative to hydrologic or meteorologic phenomena. The climatic year is usually designated by the calendar year during which most of the 12 months occur *(37).* See also Water Year.

A year selected for the presentation of data on water supply, precipitation, etc.; the climatic year of the USGS extends from October 1 to September 30 following.

CLOUDBURST A torrential downpour of rain, which by its spottiness and relatively high intensity suggests the bursting and discharge of a whole cloud at once *(73).*

COAST LINE The line or interface forming the boundary between the land and water. See Shore.

COASTAL ZONE The strip of land that extends inland from a coast (or shore) line to the first major change in terrain features.

COBBLE A fragment of rock the diameter of which is in the size range of 2.5 inches to 10 inches or 64 to 250 mm *(21,* FHWA *Highways in the River Environment Manual).*

CODE OF FEDERAL REGULATIONS (CFR) Codifies and publishes at least annually Federal regulations currently in force. The CFR is kept up to date by individual issues of the *Federal Register.* The two publications must be used together to determine the latest version of any given rule. See *Federal Register.*

COE Acronym for the U.S. Army Corps of Engineers.

COEFFICIENT OF CONTRACTION The ratio of the smallest cross section area of the flow after passing the constriction to the nominal cross section area of the constriction. Compare with Channel Contraction.

COEFFICIENT OF DISCHARGE Ratio of observed to theoretical discharge. Also the coefficient used for orifice or other flow processes to estimate the discharge past a point or through a reach.

COEFFICIENT OF ROUGHNESS See Channel Coefficient.

COEFFICIENT OF SKEW (SKEWNESS) See Skew Coefficient.

COFFERDAM A barrier built in the water so as to form an enclosure from which the water is pumped to permit free access to the area within. Compare with Caisson.

COLLATERAL CHANNEL See Channel, Collateral.

COMBINATION INLET See Inlet, Combination.

COMBINED SEWER See Sewer, Combined.

COMMON ENEMY DOCTRINE OR RULE A common law rule recognized by some states, pertaining to the disposal of surplus or excess surface waters, which holds that such waters are a "common enemy," and, therefore, the land owner has the right to protect his lands from such waters coming from higher lands. Under this rule, surface waters are regarded as a common enemy which each landowner may fight as he deems best and without regard to the harm that may be caused to others. Compare with Civil Law Doctrine or Rule, Natural Drainage Doctrine or Rule, and Reasonable Use Doctrine and Rule.

COMMON LAW As distinguished from "Roman" or "Civil" law, the body of unwritten law, especially of England, based on long-standing usages and customs and the court decisions and decrees recognizing, affirming and enforcing such usages and customs. Compare with Civil Law.

COMMON LAW, FEDERAL A body of decisional law developed by the Federal courts, unencumbered by state court decisions.

COMMON LAW RULES Principles or maxims established under the common law doctrine or rule.

COMMUNITY SPECIES LEVEL The living part of the ecosystem having an ecological structure which exists in dynamic equilibrium with its environment.

COMPOSITE HYDROGRAPH See Hydrograph, Composite.

CONCENTRATION TIME See Time of Concentration.

CONCORDANT FLOWS See Flow, Concordant.

CONCRETE PAVING Plain or reinforced concrete slabs poured or placed on the surface to be protected.

CONDUIT An artificial or natural channel; usually a closed structure such as a pipe or culvert. A general term for any channel intended for the conveyance of water, whether open or closed; any container for flowing water. With highways, conduits are often considered as being a pipe, culvert, flume, channel, chute, or similar drainage facility.

CONFIDENCE LIMITS Computed [statistical] values on both sides of an estimate of a parameter that show for a specified probability the range in which the true value of the parameter lies.

CONFLUENCE The junction of two or more streams.

CONJUGATE DEPTH See Depth, Conjugate.

CONSERVATION STORAGE See Storage, Conservation.

CONSTRICTION A compressed or constricted section or reach of a channel may be a natural condition or one produced by raising the bottom (as a sill or dam), or contracting the width (as a highway embankment on a floodplain), or both. A control section, such as a bridge crossing, channel reach, sill or dam, with limited flow capacity in which the discharge is related to the upstream water surface elevation; a constriction may be either natural or artificial. See Contraction, Stream Contraction, and Stream Constriction. Compare with Channel Contraction, Contracted Section, and Contraction.

CONSTRICTION GEOMETRY A measure of the size, shape, and character of such things as the embankments and abutments of a bridge type constriction, expressed as dimensionless length ratios.

CONSUMPTIVE USE A term used mainly by irrigation engineers to mean the amount of water used in crop growth plus evaporation from the soil *(51).* See Evapotranspiration.

The quantity of water absorbed by the crop and transpired or used directly in the building of plant tissue together with that evaporated from the cropped area: U.S. Bureau of Reclamation. The quantity of water transpired and evaporated from a cropped area or the normal loss of water from the soil by evaporation and plant transpiration *(8).* The quantity of water discharged to the atmosphere or incorporated in the products of the process in connection with vegetative growth, food processing, or an industrial process *(45).*

CONSUMPTIVE USE, NET The consumptive use decreased by the estimated contribution of rainfall toward the production of irrigated crops *(62).* See Effective Precipitation. Net consumptive use is sometimes called crop irrigation requirement.

CONSUMPTIVE WASTE The water that returns to the atmosphere without benefiting man *(63).*

CONTACT LOAD SEDIMENT Particles that roll or slide along in almost continuous contact with the stream bed. Compare with Bed Load.

CONTENTS The volume of water in a reservoir [or lake]. Unless otherwise indicted, reservoir content is computed on the basis of a level pool and does not include bank storage *(37) (52).*

CONTIGUOUS Touching, adjacent, adjoining, bordering on. Adjacent things may or may not be in actual contact, but they are not separated by like things. That which is adjoining something and touches it at some point or along a line. Things are contiguous when they touch along the whole or most of one side.

CONTINUITY EQUATION Discharge equals velocity times cross section area ($Q = V \times A$). For steady flow there is a continuity of discharge through succeeding sections of channel, expressed as: $Q = (A_1)(V_1) = (A_2)(V_2) = (A_nV_n)$ = a constant.

CONTINUOUS MODELS Models which simulate the rainfall-runoff process over long periods of time (months or years) including dry periods between events *(1).*

CONTINUOUS STREAM See Stream, Continuous.

CONTRACTED SECTION A cross section within a constriction; for example, at the downstream side of a bridge opening, or at a culvert entrance. Compare with Contraction, Channel Contraction, and Constriction.

CONTRACTING REACH A reach of channel wherein flow is accelerating; where the velocity head at lower cross section exceeds the velocity head at the upper cross section.

CONTRACTION The effects of a channel constriction on flow. Also, see Stream Contraction and Stream Constriction. Synonymous with Constriction.

CONTRACTION COEFFICIENT See Coefficient of Contraction.

CONTRACTION METHOD (OF FLOW MEASUREMENT) A method of indirect measurement of peak discharge following a flood by field survey of highwater marks and channel and bridge geometry at a constriction, such as at a bridge. Discharge is computed on the basis of an evaluation of energy changes between the approach section and the downstream side of the constriction by methods given in U.S. Geological Survey Circular 284. See Indirect Methods (of Flow Measurement).

CONTRACTION SCOUR See Scour, Contraction.

CONTROL A natural constriction of the channel, a long reach of the channel, a stretch of rapids, or an artificial structure downstream from a gaging station that determines the stage-discharge relation at the gage. A control may be complete or partial. A complete control exists where

the stage-discharge relation at a gaging station is entirely independent of fluctuations in stage downstream from the control. A partial control exists where downstream fluctuations have some effect upon the stage-discharge relation at a gaging station. A control, either partial or complete, may also be shifting. Most natural controls are shifting to a degree, but a shifting control exists where the stage-discharge relation experiences frequent changes owing to impermanent bed or banks *(37).*

A feature downstream from the gage that determines the stage-discharge relation at the gage. This feature may be a natural constriction of the channel, artificial structure, or a uniform cross section over a long reach of the channel *(52).*

A control may relate to a drainage design exclusive of any gage considerations. A section or a reach of a conduit where conditions exist that make the water level about it a fairly stable index of discharge; i.e., a section or reach of an open conduit or stream channel which maintains a stable relationship between stage and discharge. A control may be partial or complete. A complete control is independent of downstream conditions and is effective at all stages. An overflow dam, a ledge of rock crossing a channel, a boulder-covered reach, and an indurated bed are examples. Controls may be either natural or artificial. See Control Section; Control Structure; and Bed, Indurated.

CONTROL FLUME See Flume, Control.

CONTROL SECTION A control section, such as a bridge opening, reach of channel, or dam, with a definable flow capacity, in which the discharge is related to some measurable depth(s) such as the upstream water surface elevation, tailwater elevation, and/or contracted flow depth. See Control.

CONTROL STRUCTURE A structure [in a riverine environment] on a stream or canal that is used to regulate the flow or stage of the stream, or to prevent the intrusion of salt water *(52).* See Control.

CONTROLLED RIVER See River, Controlled.

CONTROLLED SPILLWAYS See Spillway, Controlled.

CONVENTION A short conduit for uniting two others having different hydraulic elements; a transition. Not a common term.

CONVEYANCE A measure of the ability of a stream, channel, or conduit to convey water. A comparative measure of the water-carrying capacity of a channel; that portion of the Manning discharge formula which accounts for the physical elements of the channel. Conveyance is expressed as: $(1/n)AR^{2/3}$ where n is Manning's n, A is the cross section area of flow, and R is the hydraulic radius. See Manning's Equation.

A measure of the water transporting capacity of such things as a channel, floodplain, drainage facility, storm drain, and/or other natural or artificial watercourse feature traversed by flows such as runoff or irrigation water. With the review flood or storm, conveyance may include that associated with overtopping flows and inundation of a traveled way at cross-drainages. Compare with Capacity.

CORE-WALL A wall of such things as masonry, sheet-piling, or puddled clay built inside a dam or embankment to reduce percolation.

CORPS See COE.

CORRELATION The process of establishing a relation between a variable and one or more related variables. Correlation is "simple" if there is only one independent variable and "multiple" if there are more than one independent variable. For gaging-station records, the usual variables are the short-term gaging-station record and one or more long-term gaging-station records *(59).*

CORRELATIVE ESTIMATE A discharge determined by correlation. A correlative estimate represents a likely value of the discharge for any particular period according to a specified method of analysis *(36).*

CORROSION The deterioration of pipe or structure by chemical action.

COST-EFFECTIVE A measure of a drainage design strategy's acceptability is often based on a judgment where either expected first costs or, when appropriate, the economic analysis costs are weighed against the selected design criteria.

The relationship between the benefits derived from a system and the cost of purchasing, operating, and maintaining it *(33).*

COUNTERMEASURE A measure, either incorporated into the design of a drainage facility or installed separately at or near the facility, that serves to prevent, minimize, or control hydraulic problems.

COVER The vertical extent of soil above the crown of a pipe or culvert. [Depending on the context, may also be] the vegetation, or vegetational debris, such as mulch, that exists on the soil surface. In some classification schemes, fallow or bare soil is taken as the minimum cover class *(51).*

CRADLE A footing structure shaped to fit the conduit it supports.

CREEK Term of regional geographic usage. See Channel.

CREST The maximum elevation of a flood at a specific location *(33).* Other definitions are: 1. the top of a dam, dike, spillway, or weir; 2. the overflow portion of a road or embankment; 3. the summit of a wave; and 4. the peak of a flood.

CREST-STAGE GAGE See Gage, Crest-Stage.

CRITERIA See Design Criteria.

CRIB See Retard.

CRIB DAM See Dam, Crib.

CRITERION A standard, rule, or test on which a judgment can be based. Compare with Design Criteria.

CRITERIA, DESIGN See Design Criteria.

CRITICAL DEPTH When the energy head is a minimum and the velocity head equals one-half the mean depth, the corresponding depth is Belanger's critical depth *(3)*.

The depth at which the specific energy (depth + velocity head) for a particular discharge is a minimum. It is the depth at which, for a given energy content of the water in a channel, maximum discharge occurs or the depth at which, in a given channel, a given quantity of water flows with minimum content of energy.

CRITICAL FLOW That flow in open channels at which the energy content of the fluid is at a minimum. Also, that flow which has a Froude number of unity. Flow at critical depth. See Critical Depth.

CRITICAL PUBLIC SERVICES [Services] typically consisting of police and fire assistance, emergency medical services, communications, utilities, transportation, and public works *(33)*.

CRITICAL SHEAR STRESS The minimum amount of shear stress (tractive force) exerted by passing stream currents required to initiate soil particle motion. Compare with Tractive Force.

CRITICAL SLOPE That particular slope of a given uniform conduit operating as an open channel at which normal depth equals critical depth for a given discharge (Q_c). The slope required in a conduit to sustain flow at critical depth for a given discharge; critical slope (S_c) must equal the energy slope (S_E) for the given discharge flowing at critical depth.

CRITICAL VELOCITY Mean velocity (V_c) of flow at critical depth (d_c); in open channels the velocity head equals one-half the mean depth.

CRITICAL-DEPTH METHOD (OF FLOW MEASUREMENT) A method for indirect measurement of peak discharge, following a flood, by field survey of highwater marks and channel and control-section or control structure geometry. Discharge is computed on a basis of critical flow (flow at minimum energy) theory. See Indirect Method (of Flow Measurement).

CROSS DRAINAGE The runoff from contributing drainage areas both inside and outside the highway right of way and the transmission thereof from the upstream side of the highway facility to the downstream side.

CROSS SECTION (STREAM OR VALLEY) A diagram or drawing cut across a channel normal to the expected flow direction [for a particular flood magnitude] that illustrates the banks, bed, [vegetal cover, soils,] and water surface. The shape of a channel, stream, or valley, viewed across the axis. In watershed investigations and channel analyses it is determined by a line approximately perpendicular to the main path of water flow [for a particular flood magnitude], along which measurements of distance and elevation are taken to define the cross-sectional area [, conveyance properties] and shape. In hydraulic analyses, vegetal patterns, floodplain material, and bed material [as well as any other conveyance properties] are considered part of the cross section *(51).*

CROSS-SLOPE See Roadway Cross-Slope.

CROSSING See Crossover.

CROSSOVER The relatively short and shallow reach of a stream between bends; also called a crossing. The point where flows crossover from one low flow channel bank to the other.

CUBIC FEET PER SECOND A unit measurement of water flow. Sometimes erroneously called "second feet," primarily in oral discussions. See cfs.

A unit expressing rates of discharge. Cubic feet per second is equal to the discharge of a stream of rectangular cross section, a foot wide and one foot deep, flowing water at an average velocity of one foot per sec. Abbreviated cfs or cusec *(37).*

The rate of discharge representing a volume of one cubic foot passing a given point during one second and equivalent to 7.48 gallons per second or 448.8 gallons per minute or 0.028 32 m^3/s *(52).*

CUBIC FEET PER SECOND PER SQUARE MILE The average number of cubic feet of water flowing per second from each square mile of area drained, assuming that the runoff is distributed uniformly in time and space *(52).*

CUBIC FOOT PER SECOND-DAY The volume of water represented by a flow of one cubic foot per second for 24 hours. It is equivalent to 86,400 cubic feet, approximately 1.9835 acre-feet, about 646,000 gallons, or 2445 m^3.

CUBIC METER PER SECOND A unit measurement of water flow, primarily in oral discussions.

A unit expressing rates of discharge. Cubic meter per second is equal to the discharge of a stream of rectangular cross section, a meter wide and one meter deep, flowing water at an average velocity of one meter per second. See cubic feet per second. Symbolized by m^3/s.

CULVERT A structure which is usually a closed conduit or waterway that is designed hydraulically to take advantage of submergence to increase hydraulic capacity. A structure used to convey surface runoff through such things as a highway or railroad embankment. Although there are borderline cases, a culvert is a structure, as distinguished from bridges, which is usually covered with embankment and is composed of structural material around the entire perimeter, although some are supported on spread footings with the channel bed serving as the bottom of the culvert. A culvert commonly has a regular, uniform shape, where a bridge opening may not—in other words, a culvert is a relatively large pipe or conduit. A culvert usually has a large ratio of length to width. Usually in practice, and in certain localities by AASHTO's definition, a structure of less than 6.1 m or 20 feet span as measured along the road centerline is classified as a culvert. Compare with Bridge.

CULVERT, BROKEN BACK A culvert having two or more longitudinal structure profile slopes. Such culverts are sometimes effective in reducing outflow velocities by energy dissipation from a hydraulic jump near the outlet.

CULVERT METHOD (OF FLOW MEASUREMENT) A method of indirect measurement of peak discharge, following a flood, by field survey of highwater marks and channel and culvert geometry where temporary upstream flood storage effects can be quantified or are not significant. Discharge is computed on the basis of an evaluation of energy changes between the approach section (headwater) and the control section. See Indirect Methods (of Flow Measurement) and Flow Types.

CULVERT, SAG A culvert where the inlet and outlet flowline is above the barrel flowline. A culvert that "sags" in order to pass under a low highway grade line. More commonly used to convey irrigation flows; not suitable for drainage subject to freezing. In the common but incorrect highway vernacular, a "siphon" or "inverted siphon."

A pipeline crossing a depression or under a highway, railroad, canal, etc. that makes use of pressure flow. A closed conduit, a part of which rises above the hydraulic grade line. It utilizes atmospheric pressure to affect or control the flow of water through it. The term "inverted siphon" or "siphon" is commonly and incorrectly used in highway drainage as such structures have none of the properties of a true siphon; i.e., these two terms are misnomers.

CUMULATIVE CONVEYANCE A tabulation or graphical plot of the accumulated measures of conveyance at various points across a cross section proceeding from the landward edge of one floodplain (or stream bank) to the landward edge of the other floodplain (or stream bank) so as to encompass the water surface width of a particular flood. Compare with Flow Distribution.

CURB OPENING INLET See Inlet, Curb Opening.

CURRENT Water flowing through a channel. The generally downstream moving portion or vector of flowing water.

CURRENT METER An instrument for measuring the speed of flowing water. The U.S. Geological Survey uses a rotating cup meter *(33).*

A device that is lowered into a stream in order to record the rate at which the current is moving *(20).*

An instrument used to measure the flow velocity of a current. It is usually operated by a wheel equipped with vanes or cups which is rotated by the action of the impinging current. An indicating or recording device is provided to measure the speed of rotation which is correlated with the velocity of the current. A device or instrument for determining or measuring the velocity of flowing water by ascertaining the speed at which a stream of water rotates a vane or a wheel.

CUSEC The abbreviation for cubic feet per second is common in the British Commonwealth countries, but is generally not used in the United States *(37).* See Cubic Feet Per Second.

CUT BANK The concave wall of a meandering stream. The outside, eroding bank of a bendway.

CUTOFF A natural or artificial channel that shortens the length of a stream; natural cutoffs may occur either across the neck of a meander loop (neck cutoffs) or across a point bar (chute cutoffs). Compare with Cutoff Wall.

CUTOFF, CHUTE See Cutoff.

CUTOFF, NECK See Cutoff.

CUTOFF WALL A wall, collar, or other structure intended to reduce percolation of water along otherwise smooth surfaces, or through porous strata. May also be a wall, usually constructed of such things as sheet piling or concrete, that extends from the end of a drainage structure and/or flowline downward to below the expected scour depth, or to scour-resistant material. Compare with Cutoff.

CYCLE A regularly recurring succession of events such as the cycle of the seasons. Climatic cycle sometimes is used to describe a group of wet years followed or preceded by a group of dry years *(3).* Compare with Trend and Probability Distribution.

D_{16} The particle diameter at the 16 percentile point on a size versus weight distribution curve.

D_{50} Median size of riprap or granular material. The particle diameter at the 50 percentile point on a size versus weight distribution curve such that half of the particles (by weight) are larger and half are smaller.

D_{85} The particle diameter at the 85 percentile point on a size versus weight distribution curve.

DAILY DISCHARGE Discharge averaged over one day.

DAM A barrier to confine or raise water for storage or diversion, or to create a hydraulic head.

DAM, CRIB A barrier made of timber, forming bays or cells which are filled with stone or other suitable material.

DAM, DEBRIS The barrier constructed across a channel to form a debris basin.

DAM, DIVERSION A barrier constructed for the purpose of diverting part or all the water from a channel into a different course.

DAM METHOD (OF FLOW MEASUREMENT) A method of indirectly determining the peak discharge of a flood by using the field survey of highwater marks in the headwater and tailwater pools, and the dam or highway-embankment geometry. Discharge is computed by recognized head-on-weir formulas, adjusted for degree of submergence when necessary. See Indirect Methods (of Flow Measurement).

DAM-BREAK ANALYSIS The use of a [computer] model to calculate the effects of a flood caused by the actual or hypothetical failure of a dam *(33).*

DAMAGE REACH A length of floodplain or valley selected for damage evaluation *(51).*

DATUM Plane of reference for elevations.

d_c See Critical Depth.

DEAD STORAGE See Storage, Dead.

DEBRIS Any material transported by the stream, either floating or submerged, such as logs, brush, suspended sediment, bed load, or trash that may lodge against a structure. Compare with Detritus.

DEBRIS BARRIER See Drift Barrier.

DEBRIS BASIN See Basin, Debris.

DEBRIS CONE A fan-shaped deposit of soil, sand, gravel, and boulders at the point where a steep stream meets a valley, or where its velocity is reduced sufficient to cause such deposits. Compare with Alluvial Fan.

DEBRIS DAM See Dam, Debris.

DEEP WATER (FOR WAVES) Water of such a depth that surface waves are little affected by bottom conditions; customarily, water deeper than half the wave length.

DEFLECTOR Little used alternative term for “Spur Dike” or “Spur.” See Dike, Spur.

DEGRADATION (STREAM BED) General and progressive lowering of the longitudinal profile of the channel bed due to long-term erosion. A progressive lowering of the channel bed due to

scour. Permanent or continuing degradation is an indicator that a change in the stream's discharge and sediment load characteristics is taking place.

DEMONSTRABLY Where such things as an engineering analysis or assessment, sometimes coupled with an economic analysis or assessment, along with prudent judgment is used to support a drainage related finding.

DENSITY OF WATER SEDIMENT MIXTURE Bulk density (mass per unit volume) including both water and sediment.

DENTAL A tooth-like projection on an apron, stilling basin, or other surface, to deflect or break the force of flowing water; a form of baffle. See Apron and Baffle Piers.

DENTATED SILL A notched sill at the end of an apron or stilling basin to check the force of flowing water and thus reduce erosion downstream from the apron. Compare with Dental.

DEPENDABLE YIELD, n-YEARS The minimum supply of a given water development that is available on demand, with the understanding that lower yields will occur once in n-years, on the average *(53).*

DEPENDENT VARIABLE See Variable.

DEPLETION The progressive withdrawal of water from surface or groundwater reservoirs at a rate greater than that of replenishment. Compare with Recession Curve and Stream Flow Depletion.

DEPLETION CURVE See Recession Curve

DEPOSITION The settling of material from the streamflow onto the bed.

DEPRESSION STORAGE See Storage, Depression.

DEPTH, ALTERNATE For a given rate of flow and a given specific head, two depths of flow are possible. These two depths are alternate depths. These depths, one less than and one greater than critical depth, may be present in a channel or conduit for any given value of specific energy above the minimum. Compare with Depth, Conjugate.

DEPTH, CONJUGATE The alternate depth of flow involved with the hydraulic jump; i.e., The depth d_1 and d_2 before and after a hydraulic jump. Unlike the alternate depths for a given specific head, the conjugate depths for a hydraulic jump reflect the energy loss from the hydraulic jump. Compare with Depth, Alternate.

DEPTH, CRITICAL See Critical Depth.

DEPTH, NORMAL The depth of water in an open conduit that corresponds to uniform velocity for the given flow. It is a hypothetical depth under conditions of steady nonuniform flow; the depth for which the water surface and bed are parallel. Normal depth and velocity apply only

to uniform flow with a free water surface. These conditions will be approached with a steady discharge in a length of uniform channel that is sufficient to establish uniform flow. See Channel, Uniform.

DEPTH OF SCOUR The vertical distance a stream bed is lowered by scour below a reference elevation.

DEPTH-AREA CURVE A graph showing the change in average rainfall depth as the drainage area changes.

A graph showing the changes in average rainfall depth as the size of the area receiving precipitation changes *(51).* It may also be the relationship between water depth and the land surface area inundated.

DESERT A wild, uninhabited and uncultivated tract. An arid barren tract incapable of supporting any considerable population without an artificial water supply (*Webster's New Collegiate Dictionary*). Compare with Arid and Semi-arid.

DESIGN/ANALYSES MODELS Models used for simulation of the detailed performance of particular elements within a subcatchment *(1).*

DESIGN CRITERIA Criteria, coupled with prudent judgmental factors, that are used to design a drainage facility. Compare with Policy.

DESIGN DISCHARGE The maximum rate of flow (or discharge) for which a drainage facility is designed and thus expected to accommodate without exceeding the adopted design constraints. Maximum flow a bridge, culvert, or other drainage facility is expected to accommodate without contravention of the adopted design criteria. The peak discharge, volume, stage or wave crest elevation and its associated probability of exceedance (see Exceedance Probability) selected for the design of a road culvert or bridge over a channel, floodplain or along a shoreline. By definition, the design discharge, or wave, does not overtop the road. The design discharge headwater, or wave height, may be at an elevation lower than the road's profile grade in order to meet other design criteria such as the protection of property, accommodating land use needs, lowering of velocities, reducing scour, or complying with regulatory mandates.

With irrigation facilities, the design discharge is the water right plus any flood right. Where floodwaters can enter the irrigation ditch or canal, the design discharge would include the water right, flood right, and any floodwaters capable of being conveyed to the point of interest (without first escaping elsewhere).

Selected flood discharge and corresponding recurrence interval for designing a highway encroachment. The design flood for highway bridge scour analyses shall be the base (100-year) flood, and the review flood the 500-year event. Compare with Flood, Review; Flood, Catastrophic; and Superflood.

DESIGN FISH See Fish, Design.

DESIGN FLOOD See Design Discharge.

DESIGN FLOOD FOR BRIDGE SCOUR The flood flow equal to or less than the 100-year flood that causes the deepest scour at bridge foundations. The highway or bridge may be inundated at the stage of the design flood for bridge scour. The worse case scour condition may occur for the overtopping flood due to the potential for pressure flow.

DESIGN FLOOD (OR STORM) SYSTEM Drainage facility (or storm drain system) that uses natural terrain and constructed facilities to provide for the conveyance of runoff from a frequently occurring flood (or storm), up to and including the design flood (or storm runoff), in a practicable and cost-effective manner so as to avoid a significant increase in the existing flood hazard or causing a flood hazard greater than allowed by policy and design criteria. By definition this system also precludes overtopping of the highway as well as an unacceptable flood hazard due to an encroachment on a floodplain or spread on the traveled way of guttered highways and streets. See Encroachment and Spread.

The water conveyance elements (such as gutters, inlets, laterals, trunks, pipes, channels, and ditches) of a storm drain system. Storm drains generally are that portion of the total drainage system between the most remote point of interception of runoff, such as a gutter(s), to an outfall(s). Sometimes erroneously called storm sewer when sewage is not involved. Compare with Sewer, Storm; Drain, Storm; and Sewer, Combined.

DESIGN FLOOD FREQUENCY (OR STORM FREQUENCY) The frequency (recurrence interval) for the selected design discharges (storms) that is expected to be accommodated without contravention of the adopted design criteria. See Design Discharge.

DESIGN FLOW See Design Discharge.

DESIGN HIGHWATER ELEVATION The maximum water levels that can occur through a reach and at a culvert, bridge-type opening, or other drainage facility without contravention of the adopted design criteria. May also be the usual term used to describe the estimated water surface elevation or profile in the stream (or other surface waters) at the project site for the selected design discharge.

DESIGN HIGHWATER LEVEL See Design Highwater Elevation.

DESIGN STORM Selected storm of a given frequency (recurrence interval) used for designing a design storm system. See Design Flood (or Storm) System.

Hypothetical storm derived from intensity-duration-frequency curves by reading the rainfall intensity from these curves for various durations for the frequency of interest and rearranging these rainfall intensities to fit an assumed storm pattern and storm duration *(51).*

A given rainfall amount, areal distribution, and time distribution, used to estimate runoff. The rainfall amount is either a given frequency (25-, 50-year, etc.) or a special large [or specific frequency] value *(51).*

DETENTION BASIN See Basin, Detention.

DETERMINISTIC See Hydrology, Deterministic.

DETOUR A temporary change in the roadway alignment. It may be localized at a structure or may be along an alternate route.

DETRITUS Loose fragments, particles, grains, grasses twigs or similar material comprising the smaller fraction of debris carried by flowing water. Compare with Debris and Drift.

DEVELOPMENT Refers to any constructed change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation, or drilling operations or storage of equipment or materials. Taken from the 1992 NFIP regulations.

Land use changes from those of an existing condition.

Compare with Direct and Indirect Support (of Floodplain Development), Land Treatment Measure, and Land Use.

DIKE An impermeable linear structure for the containment or control of overbank flow; such dikes trend parallel with a river bank and differ from a levee only in that such dikes extend for a much shorter distance along the bank. Relatively short dikes are also placed to contain and redirect flow such as into a culvert or down some other path. Compare with Levee.

DIKE, EMBANKMENT SPUR Relatively short dikes constructed normal to an embankment such as an approach fill to a bridge or otherwise along a highway. Their purpose is to impede flow and direct it away from such embankments. An embankment spur dike is placed at an angle to the roadway for the purpose of shifting the erosion characteristics of stream or floodplain flow away from a drainage structure or a roadway embankment. Compare with Dike, Riparian Spur.

DIKE, FINGER See Dike, Embankment Spur.

DIKE, GUIDE See Guide Bank.

DIKE, RIPARIAN SPUR River training structure used for bank protection. A permeable or impermeable, linear structure projecting into a channel from a bank. A dike of rock or other material constructed from the bank into the channel for protection or for channel improvement. A dike extending from a bank into a channel that is designed: 1. to reduce the stream velocity as the current passes through the dike, thus encouraging sediment deposition along the bank (permeable dike); or 2. to deflect erosive currents away from the stream bank

(impermeable dike). An embankment or wall constructed more or less perpendicular to a stream bank or shoreline (also termed "groin"). A structure in the form of a barrier placed oblique to the primary motion of water, designed to control movement of bed load. Riparian spur dikes (groins) are usually solid, although they may be constructed with openings to induce sedimentation and control the elevations of such sediments. An elongated, permeable or impermeable obstruction projecting into a stream to control shoaling and scour by deflection of currents and waves. A dike constructed of piles, rock, or other material extending into a stream, the sea, or at the mouths of rivers to induce scouring, bank building, or bank or protection. Compare with Dike, Embankment Spur; and Retard.

DIKE, SPUR An outdated term for a Guide Bank. See Dike; Dike, Riparian Spur; and Guide Bank.

DIKE, TOE See Dike, Training.

DIKE, TRAINING Embankments constructed to provide a transition from the natural stream channel or floodplain into, and/or away from a channel constriction such as a bridge crossing. Embankments constructed to prevent lateral flow from scouring the corner of the downstream side of an approach embankment to a bridge as well as the bridge abutment.

DIMICTIC LAKE See Lake, Dimictic.

DIRECT AND INDIRECT SUPPORT (of floodplain development) To encourage, allow, serve, or otherwise facilitate additional base (100-year) floodplain development. Direct support results from an encroachment. Indirect support results from a highway action outside the base floodplain that leads to development in the base floodplain. Compare with Development.

DIRECT PRECIPITATION Water that falls directly into a lake or stream without passing through any land phase of the hydrologic cycle *(20).*

DIRECT RUNOFF See Runoff, Direct. Compare with Rainfall, Effective.

DIRT See Soil.

DISCHARGE Volume of water passing a point during a given time. The rate a volume of flow passes a point per unit of time, usually expressed in cubic feet per second (ft^3/sec) or cubic meters per second (m^3/s). Four somewhat differently stated definitions are: 1. the quantity of water, silt, or other mobile substances passing along a conduit per unit of time; 2. rate of flow such as cubic feet per second (ft^3/sec) or cubic meters per second (m^3/s), gallons per second or liters per second, millions of gallons per day or millions of liters per day; 3. the act involved in water or other liquid passing through an opening or along a conduit or channel; 4. the water or other liquid which emerges from an opening or passes along a conduit or channel. See cubic feet per second or cubic meters per second.

In its simplest concept, discharge means outflow; therefore, the use of this term is not restricted as to course or location, and it can be applied to describe the flow of water from a

pipe or from a drainage basin. If the discharge occurs in some course or channel, it is correct to speak of the discharge of a canal [, channel,] or of a river. It is also correct to speak of the discharge of a canal [, channel,] or stream into a lake, a stream, or an ocean (see Streamflow and Runoff) *(37).* The volume of water (or more broadly, volume of fluid plus suspended sediment) that passes a given point within a given period of time *(52).*

The data in the reports of USGS on surface water represent the total discharge, and streamflow and runoff represent water with the solids dissolved in it and the sediment mixed with it. Of these terms, discharge is the most comprehensive. The discharge of drainage basins is distinguished as follows:

Yield -------- Total water runoff or crop; includes runoff plus underflow.

Runoff ------- That part of water yield that appears in streams.

Streamflow ---- The actual flow in streams, whether or not subject to regulation, or underflow. See Underflow.

Each of these terms can be reported in total volumes (such as cubic feet per second, cubic meters per second or acres-feet per year, hectare-meter per year). The differentiation between runoff as a volume and streamflow as a rate is not accepted. Compare with Runoff and Streamflow.

DISCHARGE, AVERAGE In the annual series of the USGS reports on surface-water supply (the arithmetic average of all complete water years of record whether or not they are consecutive). Average discharge is not published for less than 5 years of record. The term “average” is generally reserved for average of record, and “mean” is used for averages of shorter periods, namely, daily mean discharge.

DISCHARGE CURVE See Stage-Discharge Curve.

DISCHARGE, DESIGN See Design Discharge.

DISCHARGE, DOMINANT The channel forming (morphological sense) discharge in a specific channel for a specific channel feature. The dominant discharge for hydraulic geometry relationships is sometimes taken to be the bankfull discharge. With stable banks, the bankfull discharge has a return period of approximately 1.5 years, whereas the bankfull discharge is sometimes associated with the mean annual flood ($Q_{2.33}$) or two-year flood (Q_2).

DISCHARGE RATING CURVE See Stage-Discharge Curve.

DISCHARGE, MEAN See Discharge, Average.

DISCHARGE, PEAK See Peak Discharge.

DISCHARGE, SEDIMENT See Sediment Discharge.

DISCHARGE, UNIT Discharge per unit width (may be average over a cross section, or local at a point).

DISK, SECCHI See Secchi Disk.

DISTRIBUTED SYSTEM The opposite of a lumped system. See Lumped System.

DISTRIBUTION, FREQUENCY, AND DISTRIBUTION, GRAPH See Probability Distribution.

DISTRIBUTION, HYDROGRAPH See Hydrograph, Distribution.

DISTRIBUTION, PROBABILITY Various probability distributions that may be of interest to a hydrologist and highway hydraulics engineer are California, Cauchy, Exponential, Extremal, Extreme Value, Gumbel, Logarithmetically Transformed, Normal, Partly Bounded, Pearson, Student's t, Totally Bounded, and Weibull. See Probability Distribution.

DISTRIBUTION SYSTEM A [statistical] system in which at least some of the variations in space have been recognized and established *(1).* Also used to refer to such things as a drinking water system.

DISTRIBUTION-FREE Requiring no assumptions about the kind of probability distribution a set of data may have *(34).*

DITCH An artificial channel, usually distinguished from a canal by its smaller size. See Canal, Channel, and Field Ditch.

DITCH, FIELD See Field Ditch.

DIVERSION See Channel Diversion.

DIVERSION DAM See Dam, Diversion.

DIVIDE See Drainage Divide.

DIVERSITY An environmentally related term referring to the range and number of species types in the biomass of surface waters.

DOCTRINE A rule, principle, theory, or tenet of the law. See Rule and Rule of Law.

DOMINANT DISCHARGE See Discharge, Dominant.

DOUBLE-MASS CURVE A plot on arithmetic cross-section paper of the cumulated values of one variable against the cumulated values of another or against the computed values of the same variable for a concurrent period of time *(58).* A graph in which accumulated amounts of item X are plotted versus accumulated amounts of item Y, the amounts for given times being used *(51).*

DRAIN A conduit for carrying off surplus groundwater or surface waters. Closed drains are usually buried.

DRAIN, STORM A conduit for carrying off stormwaters. Compare with Sewer. See Drain; Design Flood (or Storm) System; Sewer; Sewer, Combined; and Major Storm Drain.

DRAINAGE Four definitions are provided: 1. the process of removing surplus groundwater or surface waters by artificial means; 2. the manner in which the waters of an area are removed; 3. the area from which waters are drained; 4. a drainage basin. See Drainage Area.

DRAINAGE AREA The catchment area for rainfall [and other forms of precipitation] which is delineated as the drainage area producing runoff; i.e., contributing drainage area. Usually it is assumed that base flow in a stream also comes from the same drainage area.

The drainage area of a stream at a specified location is that area, measured in a horizontal plane, which is enclosed by a drainage divide. Over the years, use of the term to signify drainage basin or catchment area has come to predominate, although drainage basin is preferred. Used alone, the term "watershed" is ambiguous and should not be used unless the intended meaning is made clear *(37).*

According to the *National Engineering Handbook (51)*: 1. the area draining into a stream at a given point. The area may be of different sizes for surface runoff, subsurface flow, and base flow, but generally the surface runoff area is used as the drainage area; 2. the area contributing direct runoff to a stream. Usually it is assumed that base flow in the stream also comes from the same area. However, the groundwater watershed may be larger or smaller.

The drainage area of a stream at a specified location is that area, measured in a horizontal plane, enclosed by a topographic divide from which direct surface runoff from precipitation normally drains by gravity into the stream above the specified point. Figures of drainage area given in [WRD Data Reports] include all closed basins or noncontributing areas within the area unless otherwise noted *(52).*

The area of land drained by a channel. An area confined by drainage divides, often having only one outlet for discharge; the total drainage area contributing runoff to a single point. The watershed area to include all other catchment physical characteristics. The term "catchment" is often used synonymously with other terms such as "drainage area" and implies all physical characteristics, including the contributing area.

An area surrounded by a continuous ridge [or drainage divide] within which all runoff is expected to join into a single flow stream and which extends to the point of junction of this flow stream (downstream) with the ridge. Natural boundaries, constructed boundaries, or minimum size of pipe are criteria which can be used to define the catchment *(1).*

Three other definitions of interest are: 1. the area drained by a stream or stream system; 2. synonymous with drainage area, drainage basins, or catchment area; 3. for the sake of

clearness the use of watershed to mean catchment basin or drainage basin is avoided by the USGS and others. Compare with Drainage Basin.

DRAINAGE BASIN A part of the surface of the earth that is occupied by a drainage system, which consists of a surface stream or a body of impounded surface water together with all tributary surface streams and bodies of impounded surface water *(37)*. The land area from which surface runoff drains into a stream system *(20)*. A part of the surface of the earth that is occupied by a drainage system, which consists of a surface stream or a body of impounded surface water together with all tributary surface streams and bodies of impounded surface water *(52)*. Compare with Drainage Area.

DRAINAGE DENSITY Length of all channels above those of a specified stream order per unit of drainage area *(37)*.

DRAINAGE DIVIDE The rim of a drainage basin. The divide separating one drainage basin from another and in the past has been generally used to convey this meaning. Drainage divide, or just divide, is used to denote the boundary between one drainage area and another *(37)*.

DRAW Term of regional geographical usage. See Channel.

DRAWDOWN The difference in elevation between the water surface elevation at a constriction in a stream or conduit and the elevation that would exist if the constriction were absent. Drawdown also occurs at changes from mild to steep channel slopes and at weirs or vertical spillways. Compare with Drawdown, Rapid.

DRAWDOWN CURVE A particular form of the surface curve of a stream of water which is convex upward, generally a conversion from tranquil flow upstream to rapid flow downstream in which the stream flow drops through critical depth, such as flow over a weir or spillway or a sharp increase in stream bed slope, proceeding downstream. Compare with Backwater Curve.

DRAWDOWN, RAPID Lowering the water against a bank more quickly than the bank can drain which can leave the bank in an unstable condition due to excessive pore pressure. Compare with Drawdown.

DRIFT Alternative term sometimes used (perhaps incorrectly) for “debris.” Debris that drifts on or near the water surface. Sometimes used as general term for all debris, that floated or otherwise, in evidence following a flood. Compare with Detritus and Debris.

DRIFT BARRIER An open structure constructed across a stream channel to catch drift or debris. It may be of any form from a simple wire fence to a barrier of massive piers with heavy cables strung between them. Where acceptable, the material caught is burned in place at low stages of the stream.

DRIFT LINE An accumulation of deposited water-carried debris and/or detritus along a contour, at the base of vegetation, or within the vegetation and other topographic objects that provides direct evidence of prior inundation and often indicates the directional flow of floodwaters. See Highwater Mark.

DRIFT RATE The mass of total macro-invertebrates drifting with the current per unit of time, usually grams/hour. Depending on context, may be the rate (velocity), such as feet per second or meters per second, that floodborne drift or detritus is transported downstream.

DRIP GROOVE Linear depression in the bottom of structure components to cause water flowing on the surface to drop.

DROP Two definitions are offered: 1. a vertical or inclined structure for dropping the water in a conduit or channel to a lower level and dissipating its surplus energy. An inclined drop in a channel is often termed a chute; 2. a fall in water-surface elevation between the upstream and downstream (as between headwater and tailwater) sides of a flow-contacting drainage facility such as at a bridge constriction or culvert or between two sections of a slope-area reach.

DRY WEATHER FLOW The flow in sanitary or combined sewers that contains no stormwater *(1)*.

DUNE A sand wave of approximately triangular cross section (in a vertical plane in the direction of flow) formed by moving water or wind, with gentle upstream slope and steep downstream slope. Dunes travel downstream by the displacement of sediments on the upstream slope and their subsequent deposition on the downstream slope. See Bed Form. Compare with Antidune.

DURATION CURVE See Flow-Duration Curve for one type *(37)*.

A graph showing the percentage of time that the given flows of a stream will be equaled or exceeded. It is based upon a statistical study of historic streamflow records *(20)*.

DYNAMIC EQUILIBRIUM The delicate balance of many factors which must occur in a stream reach so that the channel is neither aggrading or degrading. See Stream, Poised.

EAP Acronym for Emergency Action Plan *(33)*. See Emergency Action Plan.

EARTH DAM A barrier to streamflow composed of earth, clay, sand, or sand and gravel, or a combination of earth and rock.

ECCENTRICITY An expression descriptive of the position of a bridge constriction not centrally located in the floodplain. Eccentricity, if considerable, has an effect upon the discharge coefficient. High eccentricity tends to decrease the discharge coefficient and increase the backwater.

ECCENTRICITY RATIO The eccentricity ratio (K_e) is defined as the ratio of flow contracted from the smaller lateral region on one side of a stream to the flow contracted from the larger lateral region on the other side, and is expressed as $K_e = K_a/K_b$ □ 1.0, where K_a and K_b are the conveyances of the smaller and larger lateral regions (approach cross section sub-sections).

ECONOMIC ANALYSIS A probabilisitically based analysis that compares the estimated construction costs with those expected average flood-related operational costs and risks that can be quantified for the anticipated service life of a project to identify an optimum design flood frequency. Compare with Economic Assessment.

ECONOMIC ASSESSMENT An economic assessment is a less rigorous, more judgmental economic analysis. Compare with Economic Analysis.

ECOREGION Continuous geographical areas characterized by distinctive flora, fauna, land forms, climate, vegetation, and ecological climax.

ECOSYSTEM The living organisms and the nonliving environment interacting in a given area. The complexity of a community and its environment functioning as an ecological unit in nature.

EDDY CURRENT A vortex-type motion of a fluid flowing contrary to the main current, such as the circular water movement that occurs when the main flow becomes separated from the bank or emerges from a bridge or culvert opening.

EDDY LOSS The energy lost (converted into heat) by swirls, eddies, and impact, as distinguished from friction loss.

EFFECT According to *Webster's New Collegiate Dictionary:* 1. something produced by an agent or cause: Result; 2. an outward sign: Appearance; 3. a distinct impression.

What occurs to surface waters as a direct or indirect result of a highway action. See Significance. Compare with Impact.

EFFECTIVE DURATION The time in a storm during which the water supply for direct runoff is produced. Also used to mean the duration of excess rain *(51).*

EFFECTIVE PARTICLE SIZE The diameter of particles, equivalent to a spherical shape, equal in size and arranged in a given manner, of a hypothetical sample of granular material that would have the same transmission constant, shear resistance (see Tractive Force), erosion/scouring response, and fall velocity as the actual material under consideration.

EFFECTIVE PRECIPITATION See Precipitation, Effective.

EFFECTIVE RAINFALL See Rainfall, Effective.

EFFLUENT Sewage, water, or other liquid, partially or completely treated or in its natural state as the case may be, flowing out of a reservoir, basin, or treatment plant.

EFFLUENT STREAM See Stream, Gaining.

ELECTROLYTES Substances that dissociate into ions in solution or when fused, thereby becoming electrically conducting.

EMBANKMENT END SLOPE Conical slope at end of road approach embankment; bridge spillslope. See Spillthrough Abutment and compare with Fill Slope.

EMBANKMENT SPUR DIKE See Dike, Embankment Spur.

EMERGENCY ACTION PLAN A detailed description of the actions that must be taken to reduce flood losses [and hazards] and to disseminate information about an actual or expected flood hazard *(33).*

EMERGENCY OPERATION CENTER (EOC) The center [for] decision-making, information gathering and dissemination, initiating of emergency actions, and coordinating responses to emergencies. The center may be part of a public service or safety unit in the local government or may be activated only when emergencies arise *(33).*

EMERGENCY SPILLWAY See Spillway, Emergency.

EMINENT DOMAIN In law, the right of a government to take, or to authorize the taking of private property for public use, just compensation being given to the owner.

ENCROACHMENT A highway action within the limits of a base (100-year) floodplain. With a design or review storm system, encroachment is sometimes used when referring to the width gutter flow spreads onto a traveled way as measured perpendicular from either the edge of the traveled way or from the face of the curb. See Spread.

ENCROACHMENT, LONGITUDINAL An encroachment that roughly parallels a channel or floodplain.

ENCROACHMENT, TRANSVERSE An encroachment that crosses a channel or floodplain. Compare with Spread.

END CONTRACTIONS The contraction in the area of overflowing water caused by such things as the ends of a weir notch.

END SECTION A structure, commonly made of concrete or metal, that is attached to the end of a culvert for such purposes as retaining the embankment from spilling into the waterway, improving the appearance, providing anchorage, improving the discharge coefficient and limiting some scour at the outlet. Compare with Inlet, Flared.

ENERGY The capacity to perform work: kinetic energy is that due to motion, and potential energy is that due to position. In a stream the total energy at any section is represented by the sum of its potential and kinetic energies.

ENERGY DISSIPATION The phenomenon whereby energy is dissipated or used up. In highway drainage this is the energy in flowing water.

ENERGY DISSIPATOR See Stilling Basin.

ENERGY EQUATION The work-energy relationship, reduced to the simplified form from the Bernoulli equation (Bernoulli's Theorem which states that $P/\gamma + Z + v^2/2g = \text{constant}$). The equation is:

$$v_1^2/2g + \rho_1/\gamma + Z_1 = V_2^2/2g + P_2/\gamma + Z_2 + h_L$$

where subscripts 1 and 2 denote the upstream and downstream cross section.

ENERGY GRADE LINE A line joining the elevation of energy heads of a stream; a line drawn above the hydraulic grade line a distance equivalent to the velocity head of the flowing water at each cross section along a stream or channel reach or through a conduit. An inclined line representing the total energy of a stream flowing from a higher to a lower elevation. For open channel flow the energy grade slope is located (or plotted) a distance equal to the velocity head ($V^2/2g$) plus the flow depth above the water surface: V = velocity, and g = acceleration due to gravity. Slope of the foregoing line joining the elevations of total energy through the reach of a stream or channel or through a conduit of flowing water.

ENERGY GRADE SLOPE See Energy Gradient.

ENERGY GRADIENT The slope of the energy line with reference to any plane or, more simply, the slope of the energy grade line. The slope of this line represents the rate of loss of head, and it must always slope downward in the direction of flow. Equivalent to Energy Gradient. Compare with Hydraulic Gradient and Friction Slope.

ENERGY HEAD See Head, Energy.

ENERGY, KINETIC Energy due to motion. The kinetic energy of a given discharge is generally taken as proportional to the product of its weight per unit of time and the velocity head of its mean velocity. For a constant discharge, kinetic energy may be represented by a line at a distance above a flowing water surface proportional to the velocity head of its mean velocity. The elevation of such a line above any datum represents the total energy (potential plus kinetic) of the given discharge above that datum. Strictly, the kinetic energy of a given discharge is the integral of the kinetic energies of its particles.

ENERGY LINE See Energy Grade Line.

ENERGY LINE, MINIMUM An energy line corresponding to conditions of critical flow.

ENERGY, POTENTIAL Energy due to position. The potential energy of a given volume of immobile water with reference to any datum is proportional to the product of its weight and the elevation of the center of gravity above that datum. The potential energy per unit of time

of a given discharge at any instant with reference to any datum is proportional to the product of its weight per unit of time and the elevation of its hydraulic grade line above that datum at that instant.

ENERGY SLOPE See Energy Grade Line.

ENERGY, SPECIFIC The energy contained in a stream of water expressed in terms of head, referred to the bed of a stream. It is equal to the mean depth of water plus the velocity head of the mean velocity.

The energy of a stream referred to its bed; namely, depth plus the velocity head based on the mean velocity.

ENERGY, TOTAL See Energy.

ENHANCEMENT See Surface Water Enhancement.

ENTRANCE HEAD The head required to cause flow into a conduit or other structure; it includes both entrance loss and velocity head; equivalent to headwater height; energy head at approach section to culvert or bridge.

ENTRANCE LOSS The head lost in eddies and friction at the inlet to a conduit or structure, expressed as a coefficient (K_e) times velocity head = K_e ($V^2/2g$).

ENTRENCHED STREAM See Stream, Incised.

ENVELOPE CURVE See Flood Envelope Curve.

ENVIRONMENTAL EFFECTS Pertaining to the effects of highway engineering works on their surroundings and on nature.

EOC Acronym for Emergency Operation Center.

EON A geologic time interval containing two or more eras. Compare with Era.

EPA Acronym for the U.S. Environment Protection Agency.

EPHEMERAL STREAM See Stream, Ephemeral.

EPILIMNION The upper, circulating water layer of a stratified lake. See Thermal Stratification.

EQUALIZER An opening, such as a culvert or bridge, placed where it is desirable to equalize the water level on both sides of an embankment.

EQUIVALENT CROSS-SLOPE An imaginary, straight cross-slope that provides conveyance equal to that of an actual or proposed compound cross-slope. Common usage in highway drainage is to facilitate estimating the stormwater conveyance of a street gutter having a compound cross-slope.

ERA A division of geological history of highest rank. There are five eras: Cenozoic; Mesozoic; Paleozoic; Proterozoic; Archeozoic. Compare with Eon.

EROSION Displacement of soil particles on the land surface due to such things as water or wind action. The wearing away or eroding of material on the land surface or along channel banks by flowing water or wave action on shores. Compare with Abrasion, Scour, Mass Wasting, and Sloughing.

EROSION, LATERAL Erosion in which the removal of material has a predominately lateral component (see Erosion), as contrasted with scour in which the component is predominately vertical (see Scour).

EROSION CONTROL MATTING Fibrous matting (e.g., jute, paper, etc.) placed or sprayed on a channel bank or land surface for the purpose of preventing erosion or providing temporary stabilization until vegetation is established.

ESTUARY Tidal reach at the mouth of a river. That portion of a river channel occupied at times or in part by both sea and river flow in appreciable quantities. The water usually has brackish characteristics.

ET Acronym for evapotranspiration *(51).* See Evapotranspiration.

EUTROPHIC LAKE See Lake, Eutrophic.

EVALUATION SERIES A list of floods or storms that produced floods during a representative period [of time], and used in water project evaluation to obtain estimates of flood damages *(51).*

EVAPORATION The process by which water passes from the liquid to the vapor state *(20).*

The process by which water is changed from the liquid or the solid state into the vapor state. In hydrology, evaporation is vaporization that takes place at a temperature below the boiling point.

EVAPORATION OPPORTUNITY Relative Evaportranspiration: The ratio of the rate of evaporation from a land or water surface in contact with the atmosphere to the evaporativity under existing atmospheric conditions. It is the ratio of actual to potential rate of evaporation, generally stated as a percentage *(47).*

The opportunity for a given rate of evaporation to continue is determined by the available moisture supply *(49).*

EVAPORATION, TOTAL The sum of water lost from a given land area [drainage area] during any specific time by transpiration from vegetation and building of plant tissue; by evaporation from water surfaces, moist soil, and snow; and by interception [questionable — Ed.]. It has

been variously termed “evaporation,” “evaporation from land areas,” “evapotranspiration,” “total loss [questionable — Ed.],” “water losses,” and “fly off” *(39).*

EVAPORATIVITY Potential Rate of Evaporation: The rate of evaporation under the existing atmospheric conditions from a surface of water that is chemically pure and has the temperature of the atmosphere *(47).*

EVAPOTRANSPIRATION Plant transpiration plus evaporation from the soil. Difficult to determine separately, therefore used as a unit for study (see Consumptive Use) *(51).* The combined loss of water from a given area by evaporation from the land and transpiration from plants *(22).* The sum of evaporation plus transpiration *(20).*

Water withdrawn from a land area by evaporation from water surfaces and moist soil and plant transpiration. It is a coined word; probably the first recorded use is on page 296 of the *Transactions of the American Geophysical Union,* Part 2, 1934 *(37).*

EVAPOTRANSPIRATION POTENTIAL See Potential Evapotranspiration.

EVENT As used in data collection, [event] represents a point at which a gage reaches a preset value and records the occurrence or transmits it to a receiver: *(33).* Compare with Flood Event.

EVENT MODELS [Computer] Models which simulate the rainfall-runoff process for a single rainfall event, where pre-event conditions must be specified. Event models usually incorporate short time intervals in the simulation *(1).*

EVERGREEN Plants that retain their leaves at the end of the growing season and usually remain green through the winter.

EXCEEDANCE FREQUENCY The percentage of values that exceed a specified magnitude, 100 times exceedance probability *(37).*

EXCEEDANCE INTERVAL See Flood-Frequency.

EXCEEDANCE PROBABILITY Probability that a random event will exceed a specified magnitude in a given time period, usually one year unless otherwise indicated *(34).*

EXCESS RAINFALL See Rainfall Excess.

EXCESSIVE PRECIPITATION See Rainfall, Excessive.

EXCESSIVE RAINFALL See Rainfall, Excessive.

EXFILTRATION The process by which stormwater leaks or flows to the surrounding soil through such things as openings in a conduit, channel banks, or lake shores.

EXPANDING REACH A reach of channel wherein flow is decelerating; where velocity head at the lower cross section is less than the velocity head at upper cross section.

EXPONENTIAL DISTRIBUTION See Probability Distribution.

EXTREMAL DISTRIBUTION See Probability Distribution.

EXTREME VALUES The largest and the smallest value [from a sample of data] are commonly referred to as extreme or [external] values, and are often associated with floods, droughts, surplus or deficit, and similar economic and safety connotations *(74).* See Probability Distributions.

EXTREME VALUE DISTRIBUTIONS See Probability Distributions.

FABRIC FILTER See Synthetic Filter.

FABRIFORM Grout-filled fabric mattress used for stream bank protection.

FALL VELOCITY See Velocity, Fall.

FALLING LIMB The declining portion of a hydrograph following a crest *(33).*

FALLOW Cropland kept free of vegetation during the growing season. May be a normal part of the cropping system for weed control, water conservation, soil conditioning, etc. *(51).*

FASCINE See Retard.

FAUNA The animals of a particular region or time.

FEDERAL COMMON LAW See Common Law, Federal.

FEDERAL REGISTER A daily publication of the Federal Government making federal regulations, legal notices, Presidential Proclamations, Executive Orders, etc., known to the public as they are proposed and subsequently issued. See also Code of Federal Regulations.

FEMA Acronym for Federal Emergency Management Agency.

FERN ALLIES A group of nonflowering, vascular plants comprised of clubmosses, small clubmosses, and quillworts.

FETCH The effective distance the wind blows over water in generating waves. The area in which waves are generated by wind having a rather constant direction and speed; sometimes and incorrectly used synonymously with "fetch length." The horizontal distance (in the direction of the wind) over which wind generates waves and wind setup.

FETCH LENGTH Redundant terminology, as the term "fetch" implies a length. See Fetch.

FHWA Acronym for Federal Highway Administration.

FIELD CAPACITY See Field-Moisture Capacity.

FIELD DATA All stormwater data collected in the field regardless of whether or not it was analyzed in the field *(1).*

FIELD DITCH An irrigation channel for: 1. delivering water to the rows in a field; or 2. flooding a field. A field ditch commonly does not have a recorded water and flood right at its point of diversion. These ditches deliver the water to the field from an irrigation canal having a recorded water or flood right at its point of diversion. The water right for a field ditch can sometimes be estimated based on the area being irrigated by the ditch at a point in time. That portion of the water right delivered by a field ditch can change when landowners modify their field ditch system.

FIELD, JACK See Jack Field.

FIELD-MOISTURE CAPACITY The quantity of water which can be permanently retained in the soil in opposition to the downward pull of gravity *(25).*

FIELD-MOISTURE DEFICIENCY The quantity of water, which would be required to restore the soil moisture to field moisture capacity *(26).*

FILL SLOPE Side or end slope of an earth-fill embankment. Where a fill slope forms the streamward face of a spillthrough abutment, it is regarded as part of the abutment. Compare with Embankment End Slope and Spillthrough Abutments.

FILTER Layer of synthetic fabric, sand, gravel, and/or graded rock placed (or developed naturally where suitable in-place materials exist) between the bank revetment and soil for one or more of three purposes: 1. to prevent the soil from moving through the revetment by piping, extrusion, or erosion (exfiltrating); 2. to prevent the revetment from sinking into the soil; 3. to permit natural seepage from the stream bank, thus preventing buildup of excessive hydrostatic pressure. Also may be a device or structure for removing solid or colloidal material from stormwater and floodwater or preventing the migration of fine-grained soil particles as water passes through soil; i.e., the water is passed through a filtering medium—usually a granular material or finely woven or non-woven geotextile. Depending on context, may be used to remove material other than soils from a substance.

FILTER BLANKET One or more layers of graded, intermediate-size gravel or a geotextile material laid between fine-grained material and riprap to prevent the migration of the finer material (exfiltration). Compare with Synthetic Filter.

FILTER CLOTH See Synthetic Filter.

FILTRATION The process of passing water through a filtering medium consisting of either granular material or filter geotextiles for the removal of suspended or colloidal matter.

FINE SEDIMENT LOAD See Wash Load.

FINGER DIKE See Dike, Finger.

FIRST FLUSH RUNOFF See Runoff, First Flush.

FISH An aquatic animal (pl. fish or fishes) according to *Webster's New Collegiate Dictionary.*

FISH, DESIGN A hypothetical fish embodying predetermined size, swimming, and migration characteristics that are used in the design of drainage facilities to minimize adverse effects to the fishery. See Total Fish Length.

FISH LADDER A structure with pools and drops to facilitate the migration and movement of fish around culverts, chutes, dams, or other obstructions in channels. Compare with Fishway.

FISH LENGTH, TOTAL See Total Fish Length.

FISH SCREEN A device intended to prevent the entrance of fish into a conduit or area where they are not wanted.

FISHWAY A waterway, designed or natural, that facilitates the movement of fish. Compare with Fish Ladder.

FIVE-HUNDRED YEAR FLOOD See Flood, Five-hundred Year.

FIXED BED AND BANKS (MODEL) A channel whose bed and banks are considered to be unable to move under the forces of moving water. Fixed bed and bank analyses and computer models ignore any mobility (scour or erosion) of the channel bed or banks. Compare with Mobile Bed and Banks (Model).

FLANKING Erosion resulting from streamflow between the bank and the landward end of a river training or a grade-control (drop) structure.

FLANKING INLET See Inlet, Flanking.

FLARE ANGLE See Angle of Flare.

FLARED INLET, OUTLET, AND WINGWALLS See Inlet, Flared.

FLASH FLOOD See Flood, Flash.

FLASH FLOOD WARNING The public notification issued by the National Weather Service (NWS) on a county basis when flash flooding is imminent or has been reported *(33).* See Flood, Flash.

FLASH FLOOD WATCH The public notification issued by the National Weather Service (NWS) when climatic, ground, and topographic conditions indicate that flash floods are likely to occur in a given area *(33).* See Flood, Flash.

FLASHY STREAM See Stream, Flashy.

FLOAT GAGE See Gage, Float.

FLOCCULATION The process to cause soil or other substances to form a lump or mass to facilitate their removal.

FLOOD In common usage, an event that overflows the normal flow banks or runoff that has escaped from a channel or other surface waters. See Normal Flow and Bank. In frequency analysis it can also mean an annual flood that may not overflow the normal flow banks. In technical usage, it refers to a given discharge based, typically, on a statistical analysis of an annual series of events.

An overflow or inundation that comes from a river or other body of water and causes or threatens damage. Any relatively high streamflow overtopping the natural or artificial banks in any reach of a channel. A relatively high flow as measured by either gage height or discharge quantity.

An overflow or other body of water that causes or threatens damage *(6).* Any relatively high streamflow overtopping the natural or artificial banks in any reach of a stream *(40).* A relatively high flow as measured by either gage height or discharge quantity *(35).* See Floodwaters; and Flood, Annual.

FLOOD, ANNUAL The maximum momentary peak discharge in each year of record. May be maximum daily discharge or instantaneous discharge. The highest peak discharge in a water year. The maximum flow in one year *(34).*

FLOOD, BASE A flood (or storm) or reservoir pool elevation having a 1 percent chance of being exceeded in a one year period; commonly termed a 100-year event. See One-Hundred (100-) Year Flood.

FLOOD (OR STORM), CATASTROPHIC Any flood (or storm) well in excess of the base flood (or storm) and review flood (or storm) but not exceeding the probable maximum flood (or storm). A flood (or storm) capable of causing a large amount of unavoidable damage and destruction. Compare with Superflood; Flood (or Storm), Review; and Design Discharge.

FLOOD (OR STORM), CHECK See Flood (or Storm), Review.

FLOOD CREST See Peak Discharge.

FLOOD ENVELOPE CURVE A plot showing the upper and lower boundary limits of the maximum annual floods for the range of drainage areas in a hydrologic region.

FLOOD, DESIGN See Design Discharge.

FLOOD EVENT A flow of water in a stream constituting a distinct progressive rise, culminating in a crest, together with the recession that follows the crest. Compare with Event and Peak Discharge.

FLOOD EXCEEDANCE PROBABILITY Probability that a random flood event will exceed a specified magnitude in a given time period, usually one year unless otherwise indicated.

FLOOD FREQUENCY The average time interval between occurrences of a hydrological event of a given or greater magnitude, usually expressed in years. May also be called recurrence interval. *(52)*.

The average time interval, in years, in which a given storm or amount of water in a stream will be exceeded. Also, referred to as exceedance interval, recurrence interval, or return period. May be stated as: 1. the average time interval between actual occurrences of a hydrological event of a given or greater magnitude; 2. the percent chance of occurrence in any one year period, e.g., a 2 percent chance of flood. The chances that a specific flood magnitude (discharge) will be exceeded each year expressed as a percent; i.e., a 100-year flood has a flood probability of 1 percent of being exceeded each year. In the analysis of hydrologic data the flood frequency is simply called frequency and has years as a unit of measure. Note that flood frequency is not hyphenated when referring to a specific flood's frequency, but is when referring to such things as a "flood-frequency" curve.

An expression or measure of how often a hydrologic event of given size or magnitude should, on an average, be ...exceeded. For example a 50-year frequency flood should be ...exceeded in size, on the average, only once in 50 years. In drought or deficiency studies it usually defines how many years will, on the average, be ...less than a given size or magnitude *(37)*. Note, this reference incorrectly stated "equaled or exceeded," and "equal to or less than" where the three periods (...) appear (Ed.).

FLOOD-FREQUENCY CURVE "General Introduction and Hydrologic Definitions" *(37)* offers two definitions: 1. a graph showing the number of times per year on the average, plotted as abscissa, that floods of magnitude, indicated by the ordinate, are ... exceeded; 2. a similar graph but with recurrence intervals [frequency] of floods plotted as the abscissa. A graph indicating the probability that the annual flood discharge will exceed a given magnitude, or the recurrence interval corresponding to a given magnitude. Compare with Frequency Curve and Flood Frequency.

According to Dalrymple *(18)*: 1. a graph showing the number of times per year on the average, plotted as abscissa, that floods of magnitude, indicated by the ordinate, ...or exceeded; 2. a similar graph but with recurrence intervals of floods plotted as abscissa.

Note that Flood-Frequency is hyphenated when referring to a flood-frequency (flood versus frequency) curve or relationship, and not hyphenated when referring to a specific flood's frequency.

FLOOD, FLASH A flood that occurs in a short time (minutes to hours) after the causative event *(33)*.

FLOOD, FIVE-HUNDRED YEAR The flood due to a storm and/or tide having a 0.2 percent chance of being exceeded in any given year. Compare with Superflood.

FLOOD, GREATEST OPENING The greatest flood expected to flow through a drainage structure where roadway overtopping cannot occur from the probable maximum flood.

FLOOD HAZARD Potential consequences, hazards, and inconveniences encountered by the traveling public, imposed on adjacent property owners, and incurred by the environment from a flood or a highway action in areas subject to flooding; included are such things as potential property loss or damage, loss of life, temporary or long-term loss of a transportation facility, permanent or long-lasting environmental damage, circuitous or interrupted highway travel, hydroplaning and other roadway overtopping related hazards. Compare with Flow Hazard.

FLOOD HYDROGRAPH See Hydrograph.

FLOOD INDEX The amount of rainfall that will produce a flood stage in 6 hours; it is calculated by measuring soil moisture *(33).*

FLOOD LOSS POTENTIAL The potential loss of life and property from flooding *(32).*

FLOOD, MAXIMUM POSSIBLE Not an accepted term. See Greatest Opening Flood.

FLOOD, MEAN ANNUAL Maximum annual flood peak having a 2.33 year frequency interval (recurrence interval). Flood where, if the total population of floods were known, half would be larger and the remaining half would be smaller. Compare with Flow, Mean Annual; Mean Daily Discharge; and Mean Monthly Flow.

FLOOD MEASUREMENT See Indirect Method (of Flow Measurement).

FLOOD OF RECORD The maximum estimated or measured discharge that has occurred at a site.

FLOOD, ONE-HUNDRED YEAR Magnitude of the flood that has a 0.01 probability of being ...exceeded [see following note — Ed.] in any given year and has about a 63 percent chance of being exceeded during a 100 year [year period]. It is now in vogue to call the 100-year flood the one-percent probability (chance) flood *(16).* In highway drainage design the 100-year flood is sometimes termed the base flood. See Flood, Base. Note: it is more proper to say "...probability of being exceeded in any...," rather than "...exceeded." Compare with Flood, One-Thousand Year. See X-Percent Chance Flood and Flood Frequency.

FLOOD, ONE-THOUSAND YEAR Magnitude of the flood that has a 0.001 probability of being ...exceeded in any given year. Over an infinitely long period of time it would occur on an average once every thousand years. It should be noted that over a 1000 years [year period] there is about a 63 percent chance of at least one occurrence and there is a significant chance of two, three, or more floods of this magnitude occurring during the thousand years *(16).* Again, "...probability of being exceeded in any..." is more proper. See Flood, One-Hundred Year; and X-Percent Chance Flood.

FLOOD, OVERTOPPING Incipient discharge escaping via such things as over a highway, at a watershed divide, or through emergency relief facilities. Stated another way, the flood which, if exceeded, results in flow over a highway, bridge or culvert, over a watershed divide or dike, or through structures provided for emergency relief. The worse case scour condition may occur with the overtopping flood. The total flood magnitude cannot exceed the probable maximum flood and its frequency accuracy is limited by the state of the art capability to estimate a recurrence interval.

FLOOD PEAK See Peak Discharge.

FLOOD PLANE The position occupied by the water surface of a stream during a particular flood. Also, loosely, the elevation of the water surface at various points along the stream during a particular flood *(37).* Compare with Floodplain.

FLOOD POOL Floodwater storage in a reservoir. In a floodwater retarding reservoir, the temporary storage between the crests of the principal and emergency spillways *(51).*

FLOOD PROBABILITY See Flood-Frequency.

FLOOD, PROBABLE MAXIMUM (PMF) The currently accepted term for the most severe flood that is considered reasonably possible at a site as a result of hydrologic and meteorologic conditions. This flood would result from the greatest depth of precipitation that is physically possible ["physically possible" is not a good term — Ed.] at a particular site. In practice many assumptions/calculations have to be made about the most severe combinations of meteorologic conditions, such as barometric pressure, wind speed, temperature, etc. and such variables as antecedent moisture, average basin infiltration rates, etc. It should be noted that floods greater than the computed PMF have occurred *(16).*

A PMF is developed from the PMP in much the same way as a SPF is developed. However, assumptions concerning rainfall losses, snowmelt runoff, channel efficiency, etc., are adjusted to produce the largest flood reasonably possible. The PMF is used to design high hazard structures (top of dam and spillway capacity) where failure cannot be tolerated *(30).*

The largest flood for which there is any reasonable expectancy in this climatic era *(40).* The probable maximum flood is the greatest flood that may reasonably be expected, taking into collective account the most adverse flood related conditions based on geographic location, meteorology, and terrain. A very rare flood discharge value computed by hydrometeorological methods, usually in connection with major hydraulic structures.

A catastrophic flood which, in highway design, may be defined by the upper limits of the flood envelope curve for maximum floods that have occurred in a hydrologic area and physiographic region. With highway design the PMF is sometimes arbitrarily considered to be a 10 000-year event for computational purposes.

FLOOD PROFILE A graph of elevation of the water surface of a river in flood, plotted as ordinate, against distance, measured in the downstream direction, plotted as abscissa. A flood profile may be drawn to show elevation at a given time, crests during a particular flood, or to show stages of concordant flows *(37).* See Flow, Concordant.

FLOOD, PROJECT A flood discharge value adopted for the design of projects such as dams and flood control works. The term "Design Flood" is more common to highway drainage design. See Design Discharge. Compare with Flood, Project Design.

FLOOD, PROJECT DESIGN A term common to the design of major dams and flood control works, but not routine highway drainage design.

When used in connection with levees and floodwalls, the Project Design Flood (PDF) is the flood (discharge and elevation) that, when freeboard is added, establishes the top of levee or floodwall grade. (Other, larger floods are used to design for overtopping of these kinds of structures, and to establish overtopping impacts.) For rapid flow channels the PDF is generally defined in much the same way. For reservoirs, the PDF is the flood that, with controlled releases, would fill the designated flood control storage. Tranquil flow channels do not have a single PDF; instead, they have differing design objectives over a range of flood magnitudes. They are generally formulated and designed to continue to provide stage reductions in floods exceeding channel capacity *(30).*

Compare with Level of Protection as it is not necessarily synonymous with this term. Compare with Design Discharge. See Flood, Project.

FLOOD, REGULATORY See Regulatory Flood.

FLOOD (OR STORM), REVIEW A flood (or storm) used to review (check) a drainage facility designed to accommodate a lesser design flood (or storm) so as to judge whether a significant flood hazard due to a flood larger than the proposed design discharge has been overlooked. The review flood (or storm) for all but bridge scour analyses is the greater of either the base flood, or the greatest flood when overtopping does not occur from the probable maximum flood. Bridge scour analyses shall use the greatest flood or the 500-year flood, whichever is smaller as the review (check) flood.

A flood (or storm), larger or smaller than the selected design flood, which is used to assess the performance of a drainage facility under other than design conditions.

Review (check) flood for scour is the flood resulting from a storm and/or tide having a flow rate in excess of the design flood for scour. It is used in the design of a bridge foundation to determine whether the foundations can withstand the flow and its associated scour without failing. Generally a 500-year flood. Compare with Superflood; and Flood, Catastrophic.

FLOOD RIGHT Where a state has jurisdiction over its waters, the flood right is an adjudication by that state of any excess runoff waters to a specified user for beneficial use. Runoff waters in

excess of those required to satisfy all water rights on a stream or river may be adjudicated as a flood right. Compare with Water Right. See Beneficial Use.

FLOOD ROUTING The process of determining progressively the timing and shape of a flood wave at successive points along a river *(12).*

Determining the changes in a flood wave as it moves downstream through a valley or through a reservoir (then sometimes called reservoir routing). Graphic or numerical methods are used *(51).*

FLOOD STAGE The gage elevation of the lowest bank of the reach in which the gage is situated. The term "lowest bank" is, however, not to be taken to mean an unusually low place or break in the natural bank through which the water inundates unimportant and small areas *(43).* The [elevation or] stage at which overflow of the natural banks of a stream begins to cause damage in the reach in which the elevation is measured: U.S. Weather Bureau. Compare with Bankfull Stage.

FLOOD WAVE A distinct rise in stage culminating in a crest and followed by recession to lower stages *(37).* The rise and fall in streamflow during and after a storm *(51).*

FLOOD ZONE The land bordering a stream which is subject to floods of about equal frequency; for example, a strip of the floodplain subject to flooding more often than once but not as frequently as twice in a century *(37).* Compare with Backwater Area and Floodplain.

FLOOD-CONTROL STORAGE Storage of water in reservoirs to abate flood damage: "General Introduction and Hydrologic Definitions" *(37).* See also Retarding Reservoir and Retention Basin.

FLOODPLAIN Any plain which borders a stream and is covered by its waters in time of flood. Topographic area adjoining a channel that is covered by flood flows as well as those areas where the path of the next flood flow is unpredictable, such as a debris cone, alluvial fan or braided channel. A nearly flat, alluvial lowland bordering a stream and commonly formed by stream processes, that is subject to inundation by floods.

Kirk Bryan, in "Erosion and Sedimentation in the Papago Country, Arizona" *(11),* provides this definition of a floodplain: A strip of relatively smooth land bordering a stream, built of sediment carried by the stream and dropped in the slack water beyond the influence of the swiftest current. It is called a living floodplain if it is overflowed in times of highwater, but a fossil floodplain if it is beyond the reach of the highest flood.

The lowland that borders a river, usually dry, but subject to flooding *(28).* That land outside of a stream channel described by the perimeter of the Maximum Probable Flood *(71).* Compare with Flood Plane, Flood Zone, and Backwater Area.

FLOODPLAIN DEVELOPMENT A floodplain containing, zoned to contain or reasonably foreseen to contain development that may incur a significant flood hazard or cause significant conveyance changes in a stream or river reach. See Development and Floodplain. Compare with Floodplain, Developed; and Floodplain, Undeveloped.

FLOODPLAIN, DEVELOPED A floodplain that contains a significant amount of development. See Development and Floodplain Development.

FLOODPLAIN, UNDEVELOPED A floodplain expected to either remain in a native or rural condition or incur no development during the service life of the highway that will not result in a significant flood hazard from a highway action. See Development and Direct and Indirect Support (of Floodplain Development).

FLOODPROOF Limiting or preventing the intrusion of floodwaters into a proposed or existing facility to protect their contents and structural integrity against flooding.

FLOODS ABOVE A BASE See Partial-Duration Flood Series.

FLOODWATER RETARDING STRUCTURE A dam, usually with an earth fill, having a flood pool where incoming floodwater is temporarily stored and slowly released downstream through a principal spillway. The reservoir contains a sediment pool and sometimes storage for irrigation or other purposes *(51).* Compare with Retarding Reservoir, Retention Basin, and Detention Basin.

FLOODWATERS Waters which escape from a natural watercourse in great volume and flow over adjoining lands in no regular channel. The fact that such errant waters make for themselves a temporary channel or follow some natural channel, gully, or depression, does not affect their character as "floodwaters" or give to the course which they follow the character of a natural "watercourse." Compare with Flood and Riparian Waters.

FLOODWAY "General Introduction and Hydrologic Definitions" *(37)* offers two definitions: 1. a part of the floodplain, otherwise leveed, reserved for emergency diversion of water during floods; 2.a part of the floodplain which, to facilitate the passage of floodwater, is kept clear of encumbrances.

The channel of a river or stream and those parts of the floodplain adjoining the channel, which are reasonably required to carry and discharge the floodwater or floodflow of any river or stream *(19).* Compare with Regulatory Floodway.

FLOODWAY, REGULATORY See Regulatory Floodway.

FLORA The aggregate of plants growing in and usually peculiar to a particular biotic or physiographic region or period.

FLOW A stream of water; movement of such things as water, silt and/or sand; discharge; total quantity carried by a stream. Characterized by the haphazard movement of small elements of

a fluid undergoing translation. In terms of the Reynold's number, turbulent flow corresponds to high values of that number.

FLOW, BYPASS Flow which bypasses an inlet on grade and is carried in the street or channel to the next inlet downstream. Sometimes termed carryover.

FLOW, CHOKING See Choking.

FLOW CONCENTRATION A preponderance of the streamflow. Compare with Flow Distribution.

FLOW, CONCORDANT Flows at different points in a river system that have the same recurrence interval or the same frequency of occurrence. It is most often applied to flood flows *(37).*

FLOW, CRITICAL See Critical Flow.

FLOW DISTRIBUTION The estimated or measured spatial distribution of the total streamflow from the landward edge of one floodplain or stream bank to the landward edge of the other floodplain or stream bank. Usually shown as a percent of accumulated flow from one edge (0%) to the other edge (100%). Same as the cumulative conveyance only in terms of discharge rather than conveyance. Compare with Cumulative Conveyance.

FLOW, FRONTAL The portion of flow which passes over the upstream side of a grate and is subsequently captured. Compare with Splash-Over.

FLOW HAZARD Flow characteristics (discharge, stage, velocity, or duration) that are associated with a hydraulic problem or that can reasonably be considered of sufficient magnitude to cause a hydraulic problem or to test the effectiveness of a countermeasure. Compare with Flood Hazard.

FLOW, GRADUALLY VARIED Flow in which changes in depth and velocity take place slowly over large distances, resistance to flow dominates, and acceleration forces are neglected.

FLOW, LAMINAR That type of flow in which each particle moves in a direction parallel to every other particle and in which the head loss is approximately proportional to the first power of the velocity. It is sometimes designated "streamline flow" or "viscous flow." Laminar flow is characterized by the steady, translatory motion of adjacent small elements of the fluid. Tendencies toward turbulence or instability in truly laminar flow are damped out by viscous shear forces. In terms of the Reynold's number, laminar flow corresponds to low values of that number.

Flow in which the head loss is proportional to the first power of the velocity *(22).*

That type of flow in which the fluid particles follow paths that are smooth, straight and parallel to the channel walls. In laminar flow the viscosity of the fluid damps out turbulent motion *(20).*

Laminar flow changes to turbulent flow in a pipe between the critical value of 2000 and about 50 000 (there is no definite upper limit). Compare with Flow, Turbulent.

FLOW LINE Four definitions are offered: 1. the hydraulic grade line; 2. a conduit, as a pipe, laid on the hydraulic gradient; 3. bottom invert of a conduit; 4. flowage line.

FLOW, MEAN ANNUAL The annual mean flow, Q_a, for the year based on the 12 monthly means. Compare with Flood, Mean Annual; Mean Daily Discharge; and Mean Monthly Flow.

FLOW MEASUREMENT See Indirect Method (of Flow Measurement).

FLOW, NONUNIFORM A flow, the velocity of which is undergoing a positive or negative acceleration. If the flow is constant, it is referred to as "steady non-uniform flow." A flow in which the velocities vary from point to point along the stream or conduit, due to variations in cross section, slope, etc. Compare with Flow, Uniform. See Flow, Steady.

FLOW, NORMAL See Normal Flow; and Depth, Normal.

FLOW, ONE-DIMENSIONAL See One-Dimensional Water Surface Profile and Two-Dimensional Water Surface Profile.

FLOW, ORIFICE Flow similar to that through an orifice. For highway drainage design, in culvert flow it corresponds to flow-type V; i.e., a culvert flowing part-full under high head.

FLOW, OVERBANK Water movement over the top of a bank either due to a rising stream stage or to inland surface water runoff. Compare with Flood; and Flow, Overland.

FLOW, OVERLAND The flow of rainwater [, melting hail,] or snowmelt over the land surface toward stream channels. After it enters a stream, it becomes runoff *(37)*.

The flow of water over a land surface due to direct precipitation. Overland flow generally occurs when the precipitation rate exceeds the infiltration capacity of the soil and depression storage is full. Also called Horton's Overland Flow *(20)*.

Runoff which makes its way over the land surface prior to concentrating in gullies and streams; sometimes termed Sheet Flow. Compare with Flow, Overbank.

FLOW, PRESSURE Where flows passing through a bridge type opening are contracted vertically by the superstructure to the extent that the flow has a pressure head and flow streamlines analogous to that occurring at a sluice gate.

FLOW, RAPID See Flow, Supercritical.

FLOW, RAPIDLY VARIED Flow in which changes in depth and velocity take place over short distances, acceleration forces dominate and energy loss due to friction is minor.

FLOW REGIME The system or order characteristic of streamflow with respect to velocity, depth, and specific energy. See Flow, Critical; Flow, Subcritical; and Flow, Supercritical.

FLOW, RETURN That part of irrigation water that is not consumed by evapotranspiration and that returns to its source or another body of water. The term is also applied to the water that is discharged from industrial plants. Also called return water *(37).*

FLOW, SHEET See Flow, Overland.

FLOW, SINUOUS See Flow, Turbulent.

FLOW SLIDE Saturation of a bank to the point where the soil material behaves more like a liquid than a solid; the soil/water mixture may then move downslope resulting in a bank failure. See Sloughing.

FLOW, SLUICE Flow through a culvert under high head whereby the entrance contracts the flow and causes a part-time flow condition through the barrel; also referred to as orifice-type flow and similar to flow from under a sluice gate.

FLOW, STEADY A flow in which the flow rate or quantity of fluid passing a given point per unit of time remains constant. A constant discharge with respect to time.

FLOW, STEADY NONUNIFORM See Flow, Nonuniform; and Flow, Steady.

FLOW STREAM Flow from a catchment in an open or closed conduit *(1).*

FLOW, STREAMING See Flow, Subcritical.

FLOW, SUBCRITICAL In this state, gravity forces are dominant so that the flow has a relatively low velocity and is often described as tranquil or streaming. Also, that flow which has a Froude number less than unity. Flow at velocities less than critical velocity; flow at depths greater than critical depth. Flow at velocities less than one of the recognized critical values; specifically, turbulent flow with a mean velocity less than Belanger's critical velocity; streaming flow. Compare with Flow, Supercritical.

FLOW, SUPERCRITICAL In this state, inertia forces are dominant so that flow has a high velocity and is usually described as rapid or shooting. Also, that flow which has a Froude number greater than unity. Flow at velocities greater than critical velocity; flow at depths less than critical depth. Flow at velocities greater than one of the recognized critical values; specifically turbulent flow with a mean velocity equal to or greater than Belanger's critical velocity; shooting flow; rapid flow. Compare with Flow, Subcritical.

FLOW, TRANQUIL See Flow, Subcritical.

FLOW, TURBULENT The flow condition in which inertial forces predominate over viscous forces and in which head loss is not linearly related to velocity *(22).* That type of flow in

which the fluid particles move along very irregular paths. Momentum can be exchanged between one portion of the fluid and another. That type of flow in which any particle may move in any direction with respect to any other particle and in which the head loss is approximately proportional to the second power of the velocity. See Turbulence. Compare with Flow, Laminar.

FLOW, TWO-DIMENSIONAL See Two-Dimensional Water Surface Profile.

FLOW TYPE, BRIDGE As applied to flow through bridges there are four principal flow types, enumerated as follows: 1. Type I—Subcritical approach flow with subcritical flow in the most contracted section of the bridge opening (backwater due primarily to opening geometry); 2. Type IIA—Subcritical approach flow with flow passing through the normal flood depth (but not critical depth) in the most contracted section of the bridge opening. This is a transition range where the opening geometry is still influential, but the backwater starts to become influenced primarily by the amount of contraction; 3. Type IIB—Subcritical approach flow with flow theoretically passing through the bridge opening at critical depth in the most contracted section of the bridge opening. Backwater is due primarily to the amount of contraction; 4. Type III—Supercritical approach flow with supercritical flow through the bridge opening at a greater depth than the approach or tailwater flow (no backwater possible).

FLOW TYPE, CULVERT As applied to flow through culverts, there are six principal flow types, enumerated as follows: 1. Type I flow—Part-full flow (low upstream head) with control at inlet; 2. Type II flow—Part-full flow (low upstream head) with control at outlet; 3. Type III flow—Part-full flow (low upstream head) under backwater conditions (tailwater control); 4. Type IV flow—Full-flow with both inlet and outlet of culvert submerged; 5. Type V flow—Part full, sluice-type flow under high upstream head; 6. Type VI flow—Full-flow under high upstream head.

FLOW, UNIFORM Flow of constant cross section and average velocity through a reach of channel during an interval of time. A constant flow of discharge, the mean velocity of which is also constant. Uniform flow is also referred to as “steady uniform flow.” It is an ideal condition that can, in reality, only be approximated. If the velocity of the constant discharge varies, the flow is defined as “steady non-uniform.” When the average velocities at successive points or sections in the direction of steady flow are the same, the flow is described as uniform. Truly uniform flow, although frequently assumed for computational convenience, seldom occurs in natural open channels. Constant depth flow through a straight reach of a uniform artificial canal is an example of reasonably uniform flow. Compare with Flow, Nonuniform. See Flow, Steady.

FLOW, UNSTEADY Flow of variable cross section and average velocity through a reach of channel during an interval of time. A changing discharge with respect to time; opposite of Steady Flow; frequently labeled “varied flow.” Compare with Flow, Steady.

FLOW-CONTROL STRUCTURE A structure within and/or outside a channel that controls the direction, depth, or velocity of flowing water. May act as a countermeasure.

FLOW-DURATION CHART A graph indicating the percentage of time during which a given discharge is exceeded.

FLOW-DURATION CURVE A cumulative frequency curve that shows the percentage of time that specified discharges are equaled or exceeded *(58).*

FLUME An open or closed channel used to convey water. An open conduit of such things as wood, concrete, or metal on a prepared grade, trestle, or bridge. A flume holds water as a complete structure. A concrete lined canal would still be a canal without the lining, but the lining supported independently would be a flume. A large flume is also termed an aqueduct. Compare with Bench-Flume.

FLUME, CONTROL An open conduit or artificial channel arranged for measuring the flow of water which generally includes a constricted section wherein critical depth exists. See: Flume, Parshall Measuring; and Flume, Venturi.

FLUME, PARSHALL MEASURING (Formerly termed the "Improved Venturi Flume") A calibrated device developed by engineers of the U.S. Department of Agriculture, of whom Ralph I. Parshall, Assoc. M. Am. Soc. C. E., has been the principal experimenter. Its purpose is to measure the flow of water in open conduits. It consists essentially of a contracting length, a throat (flume control), an expanding length. At the throat is a sill over which the water is intended to flow at critical depth. The upper head is measured a definite distance upstream and the lower head a definite distance downstream from the sill. The lower head need not be observed except where the sill is submerged more than about 67 percent. A special form of control flume. Compare with Flume, Venturi.

FLUME, VENTURI A type of open flume with a contracted throat that causes a drop in the hydraulic grade line; used for measuring flow. Compare with Flume, Parshall Measuring.

FLUSH ENTRANCE See Inlet, Flush.

FLUVIAL GEOMORPHOLOGY A study of the structure and formation of the earth's features which result from the forces of water. Sometimes river engineers abbreviate fluvial geomorphology in discussions to a simpler, but incorrect, term "morphology." Compare with Geomorphology. See Morphology and Morphology Problems.

FLUVIAL SEDIMENT See Sediment, Fluvial.

FORD A location where a highway crosses a channel by allowing high annual or larger flows to pass over the highway and lower flows to pass through a culvert(s). Often used with cutoff walls, roadway lane markers and paved roadway embankments and traveled way (and shoulders). Warning signs may be included, also.

FOREST INFLUENCES Effects resulting from the presence of forest or brush upon climate, soil, water, runoff, streamflow, floods, erosion and soil productivity *(37).*

FORK LENGTH Fork length of a fish is a standard measure of length advocated by some fishery experts; it is commonly measured from anterior most extremity (nose tip) to the notch in the tail fin of fork-tailed fishes (or to the center of the fin when the tail is not forked).

FRAZIL ICE A French-Canadian term for fine spicular ice, derived from the French for cinders which this variety of ice most resembles. When formed in salt water, it is known as lolly ice. It is composed of fine particles which, when first formed, are colloidal and not seen in the water in which they are floating *(5) (57).*

FREE FLOW A condition of flow through or over a structure not affected by submergence.

FREE OUTLET Those outlets whose tailwater is equal to, or lower than, critical depth at the outlet. For culvert type structures having free outlets, lowering of the tailwater has no effect on the discharge or the backwater profile upstream of the tailwater.

FREE WATER SURFACE The water surface of flow in an open channel or in a closed conduit not flowing full.

FREE WEIR A weir that is not submerged; i.e., tailwater is below the crest, or the flow is not affected by the elevation of the tailwater.

FREEBOARD Vertical clearance between the lowest structural member of the bridge superstructure, the top culvert invert, or the point of escape in a canal or channel to the water surface elevation of a flood. Freeboard may also be the vertical distance above a design stage that is allowed for waves, surges, drift and other contingencies. The vertical distance between the level of the water surface, usually corresponding to the design discharge (or wave runup) selected for freeboard considerations and a point of interest such as a low chord of a bridge beam, specific location on the roadway grade, or top of a channel bank. The distance between such things as the normal operating level and the top of the sides of an open conduit or channel, or the crest of a dam that is left to allow for wave action, floating debris, or any other condition or emergency, without overtopping the structure. For irrigation flows intercepting runoff, freeboard is based on the expected water surface elevation determined for the sum of the water right, flood right and design discharge.

The marginal height provided above [the] design [discharge] lines, [stage] on levees and in certain channels, to insure, as fully as practicable, against overtopping due to uncertainties in [such things as] the state of project maintenance or flood flow characteristics. In appropriate circumstances, special increments of levee freeboard may be provided to achieve design objectives (e.g., to control, in such an extremity, the location where initial overtopping of a levee would take place; to reduce wave overtopping; to extend the interval between major maintenance efforts for removal of tree growth, sediment deposition, etc. from the channel the levee bounds). Added height to earth levees is sometimes provided to allow [freeboard] for

settlement. In project evaluation, one-half of the inundation reduction benefits creditable to the levee freeboard zone may be included *(30).*

FREEBOARD ALLOWANCE See Freeboard.

FREQUENCY See Flood-Frequency.

FREQUENCY ANALYSIS [The interpretation and analysis of] a past record of hydrologic events in terms of future probabilities of occurrence. [The estimate] of frequencies [of occurrence] of floods, droughts, storages, rainfalls, water qualities, waves, etc; the procedure involved is known as frequency analysis *(14).*

FREQUENCY CURVE A graphical representation of the frequency of occurrence of specific events. In flood studies, frequency is expressed as the recurrence interval (RI) which is the average number of years within which a given peak discharge or rainfall intensity will be exceeded. Compare with Flood-Frequency Curve. See Frequency Analysis.

FREQUENCY CURVE, LOW FLOW See Low-Flow Frequency Curve.

FREQUENCY DISTRIBUTION See Probability Distribution.

FREQUENCY LINE The line on probability paper that represents a series of events and their frequencies.

FREQUENCY SERIES A sequence or array of actual events (floods, etc.) suitable for use in frequency analysis, or a sequence or array of hypothetical events obtained from a frequency analysis *(37).* See Frequency Analysis and Probability Distribution.

FRICTION LOSS (OR HEAD) The head or energy loss as the result of disturbances set up by the contact between a moving stream of water and its containing conduit. For convenience, friction losses are best distinguished from losses due to such things as bends, expansions, obstruction and impacts, but there is no recognized line of demarcation between them, and all such losses are often included in the term "friction loss."

FRICTION SLOPE The friction loss (or head) per unit length of conduit. For most conditions of flow, the friction slope coincides with the energy grade line, but where a distinction is made between energy losses due to such things as bends, expansions and impacts, a distinction must also be made between the friction slope and the energy grade line. Friction slope is equal to the bed or surface slope only for relatively uniform flow in nearly uniform channels. Compare with Energy Grade Line and Hydraulic Grade Line.

FRONTAL FLOW See Flow, Frontal.

FROUDE NUMBER A dimensionless number (expressed as $F = V/(gy)^{1/2}$) that represents the ratio of inertial to gravitational forces; i.e., at a Froude number of unity the flow velocity and wave celerity are equal (see Celerity, Wave). High Froude numbers can be indicative of a high

velocity associated with supercritical flow and thus the potential for scour and high momentum forces. Stated another way, a number which varies in magnitude inversely with the relative influence of gravity on the flow pattern: F > 1.0 indicates rapid (supercritical) flow; F < 1.0 indicates tranquil (subcritical) flow.

FULL HEIGHT (OR RETAINING) ABUTMENT See Vertical Abutment.

FUNCTIONS OF SURFACE WATERS The functional environmental characteristics of surface waters include such things as riparian and floodplain habitat for terrestrial and aquatic wildlife, flood control, groundwater recharge, aesthetics, shore and bank line geometry, scenic and wild rivers, endangered species habitat and water pollution abatement ability. May also be termed natural and beneficial values. See Surface Waters. Compare with Values of Surface Waters.

FUNCTIONAL HIGHWAY CLASSIFICATION A grouping of highways into classes or systems according to the quality of service they are expected to provide.

FUNGI (FUNGUS) Any of numerous plants of the division of subkingdom Thallophyta, lacking chlorophyll, ranging in form from a single cell to a body mass of branched filamentous hyphae that often produce specialized fruiting bodies and including the yeasts, molds, smuts and mushrooms.

FWS Acronym for U.S. Fish and Wildlife Service.

G (or g) The acceleration of gravity, ft/s^2.

GABION A rectangular basket made of steel wire fabric or mesh which is filled with rock or similar material of suitable size and gradation. Used to construct such things as flow-control structures, bank protection, groins, jetties, permeable dikes and riparian spur dikes. When filled with cobbles, masonry remnants, or other rock or suitable size and gradation, the gabion becomes a flexible and permeable block with which the foregoing structures and devices can be built. Compare with Riprap, Wire-Enclosed.

GALTON DISTRIBUTION Sometimes called the "law of Galton." See Probability Distribution.

GAGE (GAUGE) Two definitions are provided: 1. a staff graduated to indicate the elevation of a water surface; 2. a device for registering water levels, flow, velocity and pressure. Compare with Gaging Station, Recorder, Register, and Indicator.

GAGE, BUBBLE An automated device that measures water pressure near the bottom of the stream; this pressure equates with water depth above the gage *(33)*.

GAGE, CHAIN OR TAPE A device consisting of a tagged or indexed chain tape or other line attached to a weight which is lowered to touch the water surface, whereupon the gage height is read on a graduated staff or opposite an index. Especially suited to bridges with the graduated staff generally placed horizontally with the line running over a pulley. Bridges and

similar structures with significant contractions incur rapidly varied flow conditions which may preclude any meaningful discharge measurements when such devices are placed within the contraction.

GAGE, CREST-STAGE A simple and economical device used to record crest stages of floods or flows. It is usually constructed of a 2 inch (50-mm) pipe, with suitable intake holes, contains a wooden gage stick and has finely ground cork placed in the bottom of the pipe to float up and temporarily mark the stage on this gage stick. The cork adheres to the gage stick up to the crest elevation of a flood. Given this elevation, the discharge is estimated based on a rating curve developed for the reach using the Slope-Area Method. See Slope-Area Method. Compare with Gage, Staff; and Water-Level Recorder.

GAGE DATUM The elevation level that corresponds to stage 0.0 at a stream gage; it is often set at the stream bottom or the elevation of a very low flow *(33).*

GAGE, FLOAT A chain or tape gage in which a float is substituted for the weight. Measurement of the discharge of water by floats to determine velocities.

GAGE HEIGHT Height of the water surface above the zero reference mark on a gage. The water surface elevation [is] referred to some arbitrary gage datum. Gage height is often used interchangeably with the more general term stage although gage height is more appropriate when used with a reading on a gage *(37) (52).*

GAGE, HOOK A pointed hook attached to a graduated staff or vernier scale for accurately measuring the elevation of the surface of still water. The hook is submerged and then raised until the point makes a pimple on the water surface.

GAGE, INCLINED A staff gage placed on a slope (incline) and graduated to read (or indicate) vertical heights above the datum.

GAGE, POINT A sharp, pointed rod attached to a graduated staff or vernier scale for measuring the elevation of the surface of flowing water. The point is lowered until the tip barely touches the water, forming a streak.

GAGE, PRESSURE See Manometer.

GAGE, RECORDING See Water-Level (Stage) Recorder.

GAGE, SELF-REPORTING Instruments that automatically transmit rainfall or stream stage data from a remote gage to the base station *(33).*

GAGE, SLOPE See Gage, Inclined.

GAGE, STAFF A vertical board or structure with a graduated scale for measuring the depth of a river in feet *(33).* A graduated scale on such things as a staff, plank, metal-plate pier, or wall, by which the elevation of the water surface may be read. Compare with Gage, Crest-Stage.

GAGE, STANDARD RAIN Also "standard gage." The USWB [now the NWS] nonrecording rain gage, having an opening gage size 8 inches or 200 mm in diameter and holding capacity of 24 inches or 600 mm of rainfall. The gage is usually examined once daily at a regular time and the rainfall catch (if any) measured by depth in inches or millimeters.

GAGE, STREAM Instruments that measure the depth of the water in a stream *(33).*

GAGE, TIPPING BUCKET An electrical-mechanical device that accumulates a small, precise precipitation gage amount of rainfall before tipping to spill the water. The spill triggers an electrical signal that is counted and/or transmitted to a base station. Each count represents a preset rainfall accumulation amount (1 mm) and is tagged with the time of occurrence *(33).*

GAGING The act of measuring the flow of streams.

GAGING/SAMPLING Refers to the measurement of precipitation, flow and/or water quality parameters *(1).*

GAGING STATION A particular site on a stream, canal, lake, or reservoir where systematic observations of gage height or discharge are obtained *(52).* Used synonymously with Gage *(37).* See Stream-Gaging Station.

A location on a stream where measurements of stage or discharge are customarily made. The location includes a reach of channel through which the flow is nearly uniform, a control downstream from this reach and usually a small building to house the recording instruments. A plane on a stream, including suitable gaging appurtenances, where systematic records of stream-flow are collected.

GAGING, CHEMICAL See Chemical Gaging.

GAINING STREAM See Stream, Gaining *(37).*

GAUSS-LAPLACE DISTRIBUTION Normal Distribution *(34).* See Probability Distribution.

GAUSSIAN DISTRIBUTION Normal Distribution *(34).* See Probability Distribution.

GENERAL SCOUR See Scour, General.

GENERALIZED SKEW COEFFICIENT A skew coefficient derived by a procedure which integrates values obtained at many locations *(34).*

GEOMORPHOLOGY A study of the structure and formation of the earth's features. That branch of both physiography and geology that deals with the form of the earth, the general configuration of its surface and the changes that take place due to erosion of the primary elements and in the buildup of erosional debris. Compare with Fluvial Geomorphology. See Morphology, Geomorphology, and Morphology Problems.

GEOTEXTILE FILTER See Synthetic Filter.

GLACIER Bodies of land ice that consist of recrystallized snow accumulated on the surface of the ground and move slowly downslope *(46).*

GRADE Three definitions are suggested: 1. the longitudinal slope of a road, channel, or natural ground; 2. the finished surface of a canal bed, road bed, top of embankment, or bottom of excavation; 3. any surface prepared for the support of such things as conduit paving, ties, or rails.

GRADE CONTROL STRUCTURE Structure placed bank to bank across a stream channel (usually with its central axis perpendicular to flow) for the purpose of controlling bed slope and preventing scour or headcutting. Compare with Drop and Sill.

GRADED FILTER An aggregate filter which is proportioned by particle size to allow water to pass through at a specified rate while preventing the migration of fine-grained soil particles without clogging.

GRADED STREAM See Stream, Poised.

GRADIENT Change of elevation, velocity, pressure, or other characteristics per unit length; slope. Compare with Energy Grade Line.

GRADUALLY VARIED FLOW See Flow, Gradually Varied.

GRATE INLET See Inlet, Grate.

GRAVEL Particles, usually of rock, whose diameter is between .07 inch and 2.5 inches or 2 mm and 64 mm. The term gravel is also applied to a mixture of sizes (gravel with sand or gravel with cobbles) in which the dominant or modal fraction is the gravel size range: FHWA *Highways in the River Environment Manual.*

GRAVITY DAM A dam depending solely on its weight to resist water pressure and any momentum forces.

GREATEST OPENING FLOOD See Flood, Greatest Opening.

GREENBELT See Buffer Zone.

GRINGORTEN DISTRIBUTION See Probability Distribution.

GROIN See Dike, Riparian Spur.

GROOVE, DRIP See Drip Groove.

GROUNDWATER Subsurface water occupying the saturation zone, from which wells and springs are fed. A source of base flow in streams. In a strict sense the term applies only to water below the water table. Water at and below, the water table; basal or bottom water; phraetic water. Used also in a broad sense to mean all water below the ground surface.

Water in the ground that is in the zone of saturation, from which wells, springs and groundwater runoff are supplied *(47).* The Groundwater Subcommittee offers numerous definitions: 1. that part of the subsurface water that is in the saturated zone; 2. loosely, all subsurface water as distinct from surface water; 3. all water which occurs below the land surface [and] it includes both water within the unsaturated and saturated zones; 4. means water below the land surface in a zone of saturation; 5. groundwater is the water contained within an aquifer; 6. all water which occurs below the land surface; 7. all subsurface water as distinct from surface water; 8. subsurface water that fills available openings in rock or soil materials to the extent that they are considered water-saturated; 9. water below the land surface in a zone of saturation; 10. water in a saturated zone or stratum beneath the surface of land or water.

The water contained in interconnected pores located below the water in an unconfined aquifer or located in a confined aquifer *(20).*

The water in the saturated zone beneath the water table. A source of base flow in streams *(51).*

GROUNDWATER DISCHARGE That part of the discharge from a drainage basin that occurs through the groundwater. The term "underflow" is often used to describe the groundwater outflow that takes place in valley alluvium (instead of the surface channel) and thus is not measured at a gaging station *(37).* See Underflow.

GROUNDWATER OUTFLOW See Groundwater Discharge.

GROUNDWATER, PERCHED The Groundwater Subcommittee offers this definition *(22).* [Unconfined] Groundwater separated from an underlying body of groundwater by an unsaturated zone. Its water table is a perched water table. Perched groundwater is held up by a perching bed whose permeability is so low that water percolating downward through it is not able to bring water in the underlying unsaturated zone above atmospheric pressure.

GROUNDWATER RUNOFF That part of the runoff which has passed into the ground, has become groundwater and has been discharged into a stream channel as spring or seepage water. See also Base Runoff and Direct Runoff *(37).*

GROUT A fluid mixture of cement and water or of cement, sand and water used to fill joints and voids.

GUIDE A book that explains, outlines, or gives practical instruction in some subject according to the *Reader's Digest Great Encyclopedic Dictionary.* Something that provides a person with guiding information according to *Webster's New Collegiate Dictionary.* A manual containing guidelines on some subject. Compare with Guideline.

GUIDE BANK Formerly termed spur dike. Relatively short embankments generally in the shape of a quarter of an ellipse and constructed at the upstream side (and sometimes the downstream

side) of either or both bridge ends as an extension of the abutment spillslope. The purpose is to align the flow with the bridge opening so as to decrease scour at the bridge abutment by spreading the flow and any resultant scour throughout the bridge opening. May also be a training dike (usually when constructed downstream). See Dike, Training. Sometimes referred to using the outdated term "Spur Dike." See Dike, Spur.

GUIDELINE Any suggestion, rule, etc that guides, directs, or sets a standard: [such as] government guidelines designed to regulate wage or price increases according to *Reader's Digest Great Encyclopedic Dictionary.* Compare with Guide.

GUMBEL DISTRIBUTION See Probability Distribution.

GUTTER That portion of the roadway section adjacent to the curb which is utilized to convey stormwater runoff.

HABITAT The area or type of environment in which an organism or biological population normally lives or occurs.

HARD POINT A channel bank protection technique whereby "soft" or erodible materials are removed from a bank and replaced by stone or compacted clay. Some hard points protrude a short distance into the channel to direct erosive currents away from the bank. See Dike, Riparian Spur. Hard points also occur naturally along channel banks as passing currents remove erodible materials leaving nonerodible materials exposed. Natural hard points also result from clay plugs deposited near the cutoff points when a meander is cutoff, as well as from such things as rock outcrops.

HAZEN DISTRIBUTION See Probability Distribution.

H_E Entrance head loss, m.

HEAD The height of water above any point, plane, or datum of reference. Used also in various computations, such as energy head, entrance head, friction head, static head, pressure head, lost head, etc. The height of the free surface of a body of water above a given point.

HEAD, ELEVATION The elevation of a given point in a column of liquid above a datum *(22).*

HEAD, ENERGY The elevation of the hydraulic grade line at any section plus the velocity head of the mean velocity of the flow in that section. The energy head may be referred to any datum or to an inclined plane, such as the bed of a conduit. Also the total head above a datum at any cross section. Compare with Energy Grade Line.

HEAD, FRICTION See Friction Loss.

HEAD, HIGH A general term applied to culvert flow denoting that culvert entrance is submerged with "free getaway" (no adverse tailwater conditions) downstream from culvert. Compare with Head, Low.

HEAD, LOST The energy of a given flow that is lost (converted into heat and, therefore useless) as a result of friction, eddies and impact expressed as a head; that is, as the height through which that flow would have to fall to produce an equivalent amount of energy.

HEAD, LOW A general term applied to culvert flow, denoting that the culvert entrance is not submerged. Compare with Head, High.

HEAD, PIEZOMETRIC Elevation plus pressure head, total head at any cross section minus the velocity head at that cross section; equivalent to water surface elevation in open channel flow; equivalent to elevation of hydraulic grade line at any point.

HEAD, PRESSURE Hydrostatic pressure expressed as the height of a column of water that pressure can support at the point of measurement *(22)*. Compare with Head, Static; and Head, Total. The head at any point in a conduit represented by the height of the hydraulic grade line above that point.

HEAD, STATIC The height above a standard datum of the surface of a column of water (or other liquid) that can be supported by the static pressure at a given point. The static head is the sum of the elevation head and the pressure head *(22)*. Compare with Head, Total; and Head, Pressure.

The total head without deduction for velocity head or losses; for example, the difference in elevation of headwater and tailwater of a power plant. Compare with Head, Piezometric.

HEAD, TOTAL The total head of a liquid at a given point is the sum of three components: 1. the elevation head, which is equal to the elevation of the point above a datum; 2. the pressure head, which is the height of a column of static water that can be supported by the static pressure at the point; and 3. the velocity head, which is the height at which the kinetic energy of the liquid is capable of lifting the liquid *(22)*.

HEAD, VELOCITY The distance a body must fall freely under the force of gravity to acquire the velocity it possesses; the kinetic energy, in feet of head or meters of head, possessed by a given velocity. In flowing water, the velocity squared divided by twice gravity ($V^2/2g$).

HEADCUT The relatively fast drop (as compared to the average channel bed profile slope through a channel reach) in a channel bed profile that is, or has been, headcutting. See Headcutting.

HEADCUTTING Channel degradation associated with abrupt changes in the bed elevation (headcut) that migrates in an upstream direction. Channel bed erosion moving upstream through a basin indicating that a readjustment of the basin's profile slope, channel discharge and sediment load characteristics is taking place. Headcutting may be evidenced by the presence of waterfalls or rapidly moving water through an otherwise placid stream or river, provided there is flow present. In dry channels the presence of a relatively steep drop in the channel bed in an erodible channel is evidence of a headcut. Headcuts may range from 0.3 m or less to 3 m or more. Headcutting often leaves channel banks in an unstable condition as it

progresses through a reach as evidenced by large amounts of mass wasting. Compare with Nick Point. See Mass Wasting.

HEADLOSS A loss of energy in a hydraulics system.

HEADWALL The structural appurtenance usually applied to the end of a culvert inlet and outlet or storm drain outlet to retain an adjacent highway embankment and protect the culvert ends or storm drain outlet and highway embankment or storm drain outfall from bank erosion and channel bed scour.

HEADWATER See Headwater Depth.

HEADWATER DEPTH Depth of water above the inlet flow line at the entrance of a culvert or similar structure. Depth of water upstream of a contraction such as occurs at a bridge or similar structure. Natural flow depth plus backwater caused by a drainage structure.

That depth of water impounded upstream of a culvert, bridge, or similar contracting structure due to the influence of the structures constriction, friction and configuration. The water depth upstream from a structure. Compare with Allowable Headwater Depth.

HEADWATER ELEVATION Water surface elevation of the headwater.

HEADWATER HEIGHT See Headwater Depth.

HEADWATERS The uppermost reaches for the source of water flowing in a stream. The geographic regions near the divide of a watershed.

HECTARE-METER The quantity of water required to cover an area of 1 ha to a depth of 1 m and is equal to 9996 m^3 or about 10 x 10^6 L. Common abbreviation is ha·m. See Acre-feet.

HELICAL FLOW Three-dimensional movement of water particles along a spiral path in the general direction of flow. These secondary currents are of most significance as flow passes through a bend; their net effect is to remove soil particles from the cut bank in a bendway and deposit this material on a point bar, alternate bar or middle bar.

HERBACEOUS VEGETATION Vegetation that has a fleshy stem as distinguished from the woody tissue of shrubs and trees and that generally dies back at the end of each growing season.

HERBICIDE A substance used to destroy plants, especially weeds.

HETEROGENEITY A characteristic of a medium in which material properties vary from point to point *(22).* Pertaining to a substance having different characteristics in different locations (A synonym is nonuniform) *(20).*

$\mathbf{H_f}$ The friction headloss, m.

HIGH HEAD See Head, High.

HIGHWATER MARK A mark left as evidence of the height to which a flood reached; usually in the form of such things as deposited sediment, debris and detritus. See Drift Line.

HIGHWATER ELEVATION The water surface elevation that results from the passage of flow. It may be an "observed highwater mark elevation" as a result of someone actually viewing and recording a runoff event or a "calculated highwater elevation" as part of a design process. See Indirect Method (of Flow Measurement).

HIGHWAY See Road and Street.

HIGHWAY ACTION See Action (Highway).

HISTORIC WETLAND LOSSES See Wetlands, Historic Losses.

HISTORICAL FLOOD A past flood event of known or estimated magnitude. A known flood event predating systematic flow measurements at a given site.

HISTORICAL SERIES A list of all actual storms (or floods) that caused flood damage in a watershed, in a given period of years, with the data of each storm of flood being known *(51).*

H_L Total energy head loss, m. See Head, Energy; and Energy Grade Line.

h_o The height of the hydraulic grade line above the outlet invert of a drainage structure, m.

HOMOGENEOUS See Homogeneity.

HOMOGENEITY Records from the same populations *(34).* A characteristic of a medium in which material properties are identical everywhere *(22).* Pertaining to a substance having identical characteristics everywhere (a synonym is Uniform) *(20).*

HOOK GAGE See Gage, Hook.

HYDRAULIC Moved, operated, or effected by means of water; relating to hydraulics as in engineer [note that *Webster's* uses the plural form when referring to an engineer]; relating to water or other liquid in motion as in erosion; operated by the resistance offered or the pressure transmitted when a quantity of water, oil, or other liquid is forced through a comparatively small orifice or through a tube. These definitions have been taken from *Webster's New Collegiate Dictionary.* Compare with Hydraulics.

HYDRAULIC BORE See Bore, Hydraulic.

HYDRAULIC ELEMENTS The depth, area, perimeter, mean depth, hydraulic radius, velocity, energy and other flow related quantities pertaining to a particular stage of flowing water.

HYDRAULIC FRICTION A force-resisting flow which is exerted on contact surface between a stream and its containing channel. It usually includes the normal eddies and cross-currents attendant upon turbulent flow occasioned by the roughness characteristic of the boundary surface, moderate curvature and normal channel variations. Wherever possible, the effects of excessive curvature, eddies and impact, obstructions and pronounced channel changes are segregated from the effects of hydraulic friction.

HYDRAULIC GRADELINE In a closed conduit, a line joining the elevation to which water could stand in risers. In an open conduit, the hydraulic gradeline is the water surface; piezometric head line. Compare with Energy Gradeline. See Head, Piezometric.

A profile of the piezometric level to which the water would rise in piezometer tubes along a pipe run. In open channel flow, it is the water surface.

HYDRAULIC GRADIENT The slope of the hydraulic grade line; the slope of the water surface in uniform, open channel flow.

The change in total head with a change in distance in a given direction. The direction is that which yields a maximum rate of decrease in head *(20).* The slope of the hydraulic gradeline through a channel reach or drainage structure. Compare with Energy Gradeline and Friction Slope.

HYDRAULIC HEAD See Head.

HYDRAULIC JUMP The sudden and usually turbulent passage of water from a stage below critical depth (supercritical flow) to a stage above critical depth (subcritical flow) during which the velocity passes from supercritical to subcritical. It represents the limiting conditions of the water surface curve (or profile) wherein it tends to become perpendicular to the stream bed.

A hydraulic phenomenon, in open channel flow, whereby supercritical flow is converted to subcritical flow. This can result in a relatively abrupt and turbulent rise in the water surface. See Depth, Conjugate; Depth, Alternate; and Critical Depth.

HYDRAULIC MODEL A small-scale physical representation of a flow situation.

HYDRAULIC PERFORMANCE CURVE Computed estimates of how a drainage facility will perform over a wide range of discharges. Commonly these may include discharge and recurrence interval versus headwater, velocity, scour and/or stage (depth of flow).

HYDRAULIC PROBLEM The effect from such things as channel flow, tidal flow, or wave action on a crossing such that traffic is immediately or potentially disrupted or some other detrimental effect is expected or caused.

HYDRAULIC RADIUS In simplest terms, the cross section area of a stream divided by its wetted perimeter. The cross section area of a stream of water (normal to flow) divided by the length

of that part of its periphery in contact with its containing conduit; the ratio of area to wetted perimeter. A measure of the boundary resistance to flow, computed as the quotient of cross section area of flow divided by the wetted perimeter. For wide shallow flow, the hydraulic radius can be approximated by the average flow depth. Compare with Wetted Perimeter.

HYDRAULIC ROUGHNESS A composite of the physical characteristics which influence the flow (or conveyance) of water across the earth's surface, whether natural, channelized, or in a conduit. It affects both the time response of a watershed and drainage channel, or conduit as well as the channel or conduit storage characteristics. Compare with Manning's n.

HYDRAULIC STRUCTURE A facility used for such things as to impound, accommodate, convey, or control the flow of water, such as a dam, weir, intake, culvert, channel, or bridge.

HYDRAULIC-FILL DAM A dam composed of such materials as earth, sand and gravel, sluiced into place; generally the fines are washed toward the center for greater imperviousness.

HYDRAULICS The applied science concerned with the behavior and flow of liquids, especially in pipes, channels, structures and the ground. In highway drainage, the science addressing the characteristics of fluid mechanics involved with the flow of water in or through drainage facilities.

A branch of science that deals with practical applications (as the transmission of energy or the effects of flow) of water or other liquid in motion according to *Webster's New Collegiate Dictionary*. Compare with Hydraulic.

HYDRAULICS DESIGNER A hydraulics engineer or in some cases a technician who designs hydraulics structures under the supervision of a more experienced hydraulics engineer.

HYDRAULICS ENGINEER An engineer whose practice is limited primarily to hydraulics and river mechanics. See Hydraulic, Hydraulics, and River Mechanics.

HYDRIC SOIL Soil that, in its undrained condition, is saturated, flooded, or ponded long enough during a growing season to develop an anaerobic condition that supports the growth and regeneration of hydrophytic vegetation.

Some wetland biologists and/or regulators may prefer a soil that is saturated, flooded or ponded long enough during the growing season to develop anaerobic conditions in the upper part, which influences plant growth.

HYDROGRAPH The graph of stage or discharge versus time. A graph showing, for a given point on a stream or for a given point in any drainage system, the discharge, stage, velocity or other property of water with respect to time.

A graph showing [relating] stage, flow, velocity, or other property [characteristics] of water with respect to time *(37)* [Groundwater Subcommittee *(22)*].

A graph that shows some property of groundwater or surface water as a function of time *(20).* A graph showing, for a given point on a stream or for a given point in any drainage system, the discharge, stage, velocity, or other property of water with respect to time *(51).* A chart that shows the relationship between streamflow or water elevation to time at a certain location *(33).* Compare with Storm Hydrograph and Hyetograph.

HYDROGRAPH, COMPOSITE A plot of mean daily discharges for a number of years of record on a single year time base for the purpose of showing the average occurrence of high and low flows.

HYDROGRAPH, DISTRIBUTION A unit hydrograph of direct runoff modified to show the portions of the volume of runoff that occurs during successive equal units of time *(29).*

HYDROGRAPH, STORM A graph of the discharge of a stream over the time period when, in addition to direct precipitation, overland flow, interflow and return flow are adding to the flow of the stream. The storm hydrograph will peak due to the addition of these flow elements *(20).* Compare with Hydrograph.

HYDROGRAPH, SYNTHETIC A hydrograph determined from empirical rules. Usually a hydrograph based on the physical characteristics of the basin. A graph developed for an ungaged drainage area, based on known physical characteristics of the watershed basin.

HYDROGRAPH, UNIT The hydrograph of direct runoff from a storm uniformly distributed over the drainage basin during a specified unit of time; the hydrograph is reduced in vertical scale to correspond to a volume of runoff of 1 inch from the drainage basin *(2).*

The hydrograph of surface runoff (not including groundwater runoff) on a given basin due to an active rain falling for a unit of time *(61).* A discharge hydrograph coming from 1 inch of direct runoff distributed uniformly over the watershed, with the direct runoff generated at a uniform rate during the given storm duration. A watershed may have 1-hour, 2-hour, etc. unit hydrographs *(51).*

A typical streamflow hydrograph of a river basin produced by 1 inch of surface runoff uniformly distributed over the watershed during a specified period of time *(33).*

A hydrograph of a direct runoff resulting from 1 inch of effective rainfall generated uniformly over the watershed area during a specified period of time or duration. The discharge hydrograph resulting from 1 mm of direct runoff generated uniformly over the tributary area at a uniform rate during a specified period of time. Compare with Hyetograph.

HYDROLOGIC AREA A geographic area having homogeneous topographical, soil, vegetation and meteorological properties as they relate to its flood-frequency relationship; i.e., subareas within such an area have very similar flood-frequency relationships.

HYDROLOGIC BUDGET An accounting of the inflow to, outflow from and storage in, a hydrologic unit, such as a drainage basin, aquifer, soil zone, lake, reservoir, or irrigation project *(37).*

HYDROLOGIC CHARACTERISTICS OF WATERSHED The parameters that control the runoff [and flood-frequency relationship] in a watershed. These include [such things as] the basin size, ground cover conditions, slope of the land, stream lengths [, stream slopes, soil infiltration characteristics], topographic and geologic features and physical features constructed by man that alter runoff *(33).*

HYDROLOGIC CYCLE A convenient term to denote the circulation of water from the sea, through the atmosphere, to the land, and thence, with many delays, back to the sea by overland and subterranean routes and in part by way of the atmosphere; also, the many short circuits of the water that are returned to the atmosphere without reaching the sea *(48).*

HYDROLOGIC EQUATION The equation balancing the hydrologic budget *(37).* An expression of the law of mass conservation for purposes of water budgets which may be stated as inflow equals outflow plus or minus changes in storage.

HYDROLOGIC MODELS Mathematical equations, algorithms and/or logic that represents the rainfall runoff process in a watershed *(33).*

HYDROLOGIC SOIL GROUP A group of soils having the same runoff potential under similar storm and cover conditions *(51).* Compare with Hydrologic Soil-Cover Complex.

HYDROLOGIC SOIL-COVER COMPLEX A combination of a hydrologic soil group and a type of cover *(51).* Compare with Hydrologic Soil Group.

HYDROLOGIC STUDIES Studies to determine the runoff and flood characteristics to be expected at a highway drainage site. A most important step prior to the hydraulic design of a highway drainage structure. Such studies are necessary for determining the rate of flow, runoff, or discharge that the drainage facility will be required to accommodate.

HYDROLOGIC UNIT A geographic area representing part or all of a surface drainage basin or distinct hydrologic feature as delineated by the Office of Water Data Coordination on the State Hydrologic Unit Maps; each hydrologic unit is identified by an eight digit number *(52).*

HYDROLOGIST A person who studies water on or through the earth's surface *(33).*

HYDROLOGY The science and study concerned with the occurrence, circulation, distribution and properties of the waters of the earth and its atmosphere, including precipitation, runoff, and groundwater. The science dealing with the waters of the earth in their various forms: precipitation, evaporation, runoff and groundwater. In highway drainage, the science dealing with the runoff and flood-producing process. In practice the study of the water of the oceans

and the atmosphere is, in some cases, considered part of the sciences of oceanography and meteorology. Hydrologic (adj.). Hydrologically (adv.).

The science encompassing the behavior of water as it occurs in the atmosphere, on the surface of the ground and underground *(2).* The science that relates to the water of the earth *(47).* The science treating [dealing with] the waters of the earth, their occurrence, distribution and movements *(35).*

The science that deals with the occurrence and behavior of water in the atmosphere, on the ground and underground. Rainfall intensities, rainfall interception by trees, effects of crop rotations on runoff, floods, droughts, the flow of springs and wells, are some of the topics studied by a hydrologist *(51).*

HYDROLOGY, DETERMINISTIC [The] deterministic process of hydrology is the result of physical, chemical and biological deterministic laws, but primarily the result of fluid mechanics and thermodynamics laws and regularities *(74).* Compare with Hydrology, Stochastic.

HYDROLOGY LOSS In hydrology, a loss for one purpose is usually a gain for another, so that the net effect may be more important than the loss. At various times, evapotranspiration, initial abstraction, infiltration, surface storage, direct runoff, seepage, etc., have been called losses according to the aims of a water user. See Water Loss *(51).*

HYDROLOGY, STOCHASTIC [The] laws of chance and the sequence of various variables that describe [the] ...random phenomena [of such things as] precipitation, evaporation, runoff, groundwater levels, sediment transport, lake levels, snow and ice accumulation and melt, water quality properties and properties of porous environments, river basin geomorphic forms, etc. ...are stochastic processes *(74).*

HYDROMETEOROLOGY The branch of hydrology concerned with the relationship of precipitation and runoff to climate and weather.

HYDROMETRY, CHEMICAL See Chemical Gaging.

HYDROPHYTE Plant life growing in water or on a substrate that is periodically flooded, causing deficiency of oxygen. These plants are typically found in wetlands and other aquatic habitats. Compare with Hydrophytic Vegetation.

HYDROPHYTIC VEGETATION A plant growing in water or a substrate that is at least periodically deficient in oxygen during a growing season as a result of excessive water content. Compare with Hydrophyte.

HYDROSTATIC PRESSURE See Pressure, Hydrostatic.

HYETOGRAPH Graphical representation of rainfall intensity against time *(37).* A graph plotting rainfall amounts or intensities during various time increments versus time *(1).* A graphical

representation of average rainfall, rainfall-excess rates or volumes over specified areas during successive units of time during a storm. Compare with Hydrograph.

HYPOLIMNION The lower layer, noncirculating water, of a stratified lake. Compare with Thermal Stratification.

HW Acronym for Headwater Depth. Compare with AHW.

ICE, FRAZIL OR LOLLY See Frazil Ice.

ICING Masses or sheets of ice formed on the frozen surface of a river or floodplain. When shoals in the river are frozen to the bottom or otherwise dammed, water under hydrostatic pressure is forced to the surface where it freezes.

IFLOWS [Acronym] Abbreviation for Integrated Flood Observing and Warning System. A network of [100 county] automated local flood warning systems. The county systems consist of automatic radio reporting rain gages, radio relays or repeaters (if required), a radio receiver and system software. Each county is usually capable of collecting and displaying real-time precipitation data. All of the counties are linked to a designated State Emergency Operation Center and offices so data can be retrieved by any county, State, or NWS office *(33)*.

IMPACT The striking together of two masses. When particles or streams of water suffer impact, energy losses result. According to *Webster's New Collegiate Dictionary,* the force of impression or operation of one thing on another; Effect.

Impact can also refer to the short- and long-range changes and their significance to surface waters and related social and environmental relationships resulting from an effect(s) brought about by a highway drainage facility. Compare with Effect.

IMPACT LOSS The head lost as a result of the impact of particles of water; included in and scarcely distinguishable from eddy loss.

IMPERMEABLE STRATA A strata in which texture is such that water cannot move perceptibly through it under pressures ordinarily found in subsurface water.

IMPERVIOUS Impermeable to the movement of water.

IMPERVIOUSNESS That quality or condition of a material that minimizes percolation.

IMPROVED INLET See Inlet, Improved.

INCISED CHANNEL Those channels which have been cut relatively deep into underlying formations by natural processes. Characteristics include relatively straight alignment and high, steep banks such that overflow rarely occurs, if ever. See Stream, Incised.

INCISED REACH The stretch of river with an incised channel that only rarely overflows its banks. See Incised Channel.

INCISED STREAM See Stream, Incised.

INCLINED GAGE See Gage, Inclined.

INCOMPLETE RECORD A streamflow record in which some peak flows are missing because they were too low or high to record or the gage was out of operation for a short period because of flooding *(34).*

INDEPENDENT VARIABLE See Variable.

INDEX OF LOSS See Wetland Loss Index.

INDICATOR A device that shows by such things as an index, pointer and/or dial, the instantaneous value of such quantities as depth, pressure, velocity, or the movements or positions of water-controlling devices; a gage. Compare with Recorder, Register, and Gage.

INDIRECT METHOD (OF FLOW MEASUREMENT) A method of determining peak discharge, other than by current meter such as with the slope-area, contraction, culvert, dam, or critical-depth methods; methods are usually based on survey of highwater marks following the flood.

INERT Unable to move or react.

INFILTRATION The flow of a fluid into a substance through pores or small openings. It connotes flow into a substance in contradistinction to the word percolation, which connotes flow through a porous substance *(26).*

The downward entry of water into the soil or rock *(22).*

Rainfall minus interception, evaporation and surface runoff. The part of rainfall that enters the soil *(51).*

That part of rainfall that enters the soil. The passage of water through the soil surface into the ground. Compare with Percolation.

INFILTRATION CAPACITY The maximum rate at which a soil or rock is capable of absorbing water or limiting infiltration *(22).* The maximum rate at which the soil, when in a given condition, can absorb falling rain or melting snow *(25).*

The maximum rate at which infiltration can occur under specific conditions of soil moisture. For a given soil, the infiltration capacity is a function of the water content *(20).*

INFILTRATION INDEX An average rate of infiltration, in inches per hour, equal to the average rate of rainfall such that the volume of rainfall at greater rates equals the total direct runoff *(38).*

INFILTRATION RATE The rate at which water enters the soil under a given condition. The rate is usually expressed in inches per hour or inches per hour; feet per day or meters per day; cubic feet per second or cubic meters per second.

INFLOW The rate of discharge arriving at a point (in a stream, structure, or reservoir).

INFLOW DESIGN FLOOD An inflow design flood is the flood hydrograph (in combination with a starting lake level, spillway and outlet works operation and freeboard [where applicable]) that establishes the top of dam elevation [or highway drainage facility geometry and size] required to meet hydrologic requirements. In some older documents [of the Corps of Engineers] this may be referred to as a spillway design flood *(30).*

INFLUENT STREAM See Stream, Losing *(20).*

INITIAL ABSTRACTION When considering Surface Runoff [, the initial abstraction] I_a is all the rainfall before runoff begins. When considering direct runoff, I_a consists of interception, evaporation and the soil-water storage that must be exhausted before direct runoff may begin. Sometimes called "initial loss" *(51).* See Loss, Hydrology.

INITIAL LOSS See Initial Abstraction.

INLET Consider four definitions: 1. a surface connection to a closed drain; 2. a structure at the diversion end of a conduit; 3. the upstream end of any structure through which water may flow; 4. an inlet structure for capturing concentrated surface flow. Inlets may be located in such places as along the roadway, a gutter, the highway median, or a field.

INLET, COMBINATION Drainage inlet usually composed of two or more inlet types, e.g., such combinations as curb opening and grate inlet, grate, and slotted drain inlet.

INLET CONTROL A condition where the relation between headwater elevation and discharge is controlled by the upstream end of any structure through which water may flow. For example, a culvert on steep slope and flowing part full as in inlet control. Compare with Outlet Control.

INLET, CURB OPENING Drainage inlet consisting of an opening in a curb.

INLET, DROP Drainage inlet with a horizontal or nearly horizontal opening that is generally flush with the street or land surface.

INLET EFFICIENCY The ratio of flow intercepted by an inlet to the total flow.

INLET, FLANKING Inlets placed upstream and on either side of a storm drain inlet that is located at the low point in a sag-vertical curve. The purpose of these inlets is to intercept debris as the longitudinal gutter slope decreases and to act as an emergency relief for the sump inlet at the low point of the vertical curve.

INLET, FLARED A specially fabricated culvert end appurtenance at the inlet and outlet, or a special end feature of box culverts where the walls flare outward from the culvert sides at the culvert inlet and outlet. This type of inlet is effective in reducing the calculated headwater caused by less efficient inlet types where inlet control prevails. It also serves to retain the roadway embankment. The walls form an angle to the centerline of the culvert. A type of culvert design having an inlet or outlet larger than the main barrel. Compare with Improved Inlet and End Section.

INLET, FLUSH Culvert barrel whose entrance (or outlet) does not project beyond the plane of the slope or headwall.

INLET GRATE Drainage inlet composed of a grate in the roadway section or at the roadside, in a low point, swale, or ditch.

INLET, IMPROVED Flared, depressed, or tapered culvert inlets which decrease the amount of energy needed to pass the flow through the inlet and thus increase the capacity of culverts with inlet control or supercritical flow.

INLET, MITERED A flush-entrance culvert where the barrel is mitered to the slope of the embankment.

INLET, PARALLEL WING WALL A culvert with wing walls parallel to the culvert centerline.

INLET, PROJECTING Culvert barrel projects beyond the plane of the slope or headwall; sometimes referred to as a "re-entrant" entrance.

INLET, SLOTTED DRAIN Drainage inlet composed of a continuous slot built into the top of a pipe which serves to intercept, collect and transport the flow. Often used in conjunction with a single grate inlet for clean out access.

INLET, SQUARE-EDGED An approximately 90□ corner formed by the inside of the barrel and the upstream end of the culvert. Small chamfers ordinarily used in concrete construction are considered as producing a square-edged entrance; i.e., no hydraulic improvement.

INLET, SUBMERGED See Submerged Inlet.

INLET, SUMP Inlet located at the low point in a sag-vertical curve.

INLET, TAPERED A type of culvert design having an entrance face area larger than the main barrel.

INLET TIME The time required for stormwater to flow from the most distant point in a drainage area to the point at which it enters a storm drain.

INSTANTANEOUS DISCHARGE A discharge at a given moment. The discharge at a particular instant of time *(52).*

INSULATED STREAM See Stream, Insulated *(37).*

INTEGRATION METHOD A means of determining the mean velocity at a vertical depth of a stream by noting the total number of revolutions of a current meter vane and the time consumed, while the meter is slowly lowered from the surface to the bed and returned one or more times.

INTENSITY The rate of rainfall upon a watershed, usually expressed in inches per hour.

INTERCEPTING CHANNEL A channel excavated at the top of earth cuts, or at the foot of slopes, or at other critical places to intercept surface flow; sometimes termed a catch-drain.

INTERCEPTION The process and the amount of rain or snow stored on leaves and branches and eventually evaporated back to the air. Interception equals the precipitation on the vegetation minus stemflow and throughfall *(24).* See Stemflow and Throughfall.

Precipitation retained on plant or plant residue surfaces and finally absorbed, evaporated, or sublimated. That which flows down the plant to the ground is called stemflow and not counted as true interception *(51).*

INTERFLOW The lateral movement of water in the unsaturated zone during and immediately after a precipitation event. The water moving as interflow discharges directly into a stream or lake *(20).*

INTERMITTENT STREAM See Stream, Intermittent.

INTERRUPTED STREAM See Stream, Interrupted.

INTERSTICE A narrow or small space between things or parts, such as riprap; crevice.

INUNDATE To cover or fill as with a flood.

INVERT The flow line in a channel cross section, pipe, or culvert. The lowest point in the channel cross section or at flow control devices such as weirs or dams. The floor, bottom, or lowest part of the internal cross section of a conduit. Compare with Soffit.

INVERTEBRATES Animals that have no backbone or spinal column.

INVERTED SIPHON See Sag Culvert.

IRRIGATED AREA The gross farm area upon which water is artificially applied for the production of crops, with no reduction for access roads, canals, or farm buildings *(62).*

IRRIGATION The controlled application of water to arable lands to supply water requirements not satisfied by rainfall *(27).*

IRRIGATION EFFICIENCY The percentage of water applied that can be accounted for in soil-moisture increase *(54).*

IRRIGATION POOL Reservoir storage used to store water for release as needed for irrigation.

IRRIGATION REQUIREMENT The quantity of water, exclusive of precipitation, that is required for crop production. It includes surface evaporation and other economically unavoidable wastes *(8).*

IRRIGATION, SUPPLEMENTAL Commonly, irrigation as carried on in ...humid areas. The term means that the irrigation water is supplementary to the natural rainfall source of moisture as in the arid and semi-arid West. Supplementary irrigation is used generally to prevent retardation of growth during periods of drought *(30).*

IRRIGATION, SUPPLEMENTAL SOURCES When irrigation water supplies are obtained from more than one source, the source furnishing the principal supply is commonly designated the primary source and the sources furnishing the additional supplies, the supplemental sources *(27).*

ISLAND A permanently vegetated area, emergent at normal stage, that divides the flow of a stream. Some islands originate by establishment of vegetation on a bar and other originate by channel avulsion or at the junction of minor tributaries with a stream.

ISOHYET See Isohyetal Line.

ISOHYETAL LINE A line drawn on a map or chart joining points that receive the same amount of precipitation *(37).* A line on a map, connecting points of equal rainfall amounts *(51).*

JACK Devices cabled together in near parallel rows for flow control and protection of banks against lateral erosion. A Kellner jack has six mutually perpendicular arms formed by three steel struts rigidly fixed at the center. Steel jacks are strung with wire. Concrete jacks are made of three reinforced concrete beams bolted together at the midpoints, or sometimes cast as a monolithic unit. See Jack Field.

JACK FIELD Multiple rows of jacks tied together with cables. Generally one or more rows are parallel with the low flow bank or along a line where re-establishment of the low flow bank is desired. The remaining jack rows are placed perpendicular or at an angle to this row of low bank jacks. This combination of rows is termed a “jack field.” Jack fields may be placed outside a channel on the floodplain and/or within a channel where it is desired to re-establish a low flow channel bank and attendant floodplain. See Jack.

JACKSON TURBIDITY UNIT See Turbidity.

JETTY See Dike, Riparian Spur.

JTU Acronym for Jackson Turbidity Unit. See Turbidity.

JUMP See Hydraulic Jump.

JURISDICTIONAL SURFACE WATERS See Navigable Waters.

KARST TOPOGRAPHY Irregular topography characterized by sinkholes, streamless valleys and streams that disappear into the underground, all developed by the action of surface and underground water in soluble rock such as limestone.

KINETIC ENERGY See Energy, Kinetic.

KINEMATIC VISCOSITY Dynamic viscosity M (mu) divided by the mass density ρ (rho) of the liquid.

KUTTERS FORMULA An empirical formula expressing the value of the coefficient C, in the Chezy formula, in terms of the friction slope, hydraulic radius and a coefficient of roughness.

LACUSTRINE of or pertaining to a lake. See Lake. Compare with Limnology.

LAG See Lag Time.

LAG TIME [Lag time, T_L, is] Variously defined as time from beginning (or center of mass) of rainfall to peak (or center of mass) of runoff *(2).*

The difference in time between the centroid of the excess rainfall (that rainfall producing runoff) and the peak of the runoff hydrograph. Often estimated as 60 percent of the time of concentration ($T_L = 0.6T_c$) *(51).*

LAKE An area of open, relatively deep water sufficiently large to produce somewhere on its periphery a barren, wave-swept shore. See Lacustrine. Compare with Pond.

LAKE AREA See Lake Surface Area.

LAKE, DIMICTIC Lakes with a directly stratified epilimnion in summer and an inversely stratified epilimnion in winter. See Epilimnion.

LAKE, EUTROPHIC Lakes that have large supplies of nutrients and heavy layers of organic bottom sediment.

LAKE, MEROMICTIC Lakes in which some water remains partly or wholly unmixed with the main water mass at [during] circulation periods is said to be meromictic. The process leading to a meromictic state is termed meromixis. The perennially stagnant deep layer of a meromictic lake is called the monimolimnion. The part of a meromictic lake in which free circulation can occur is called the mixolimnion. The boundary between the monimolimnion and the mixolimnion is called the chemocline *(32).*

Lakes that have perennially stagnant water below a steep salinity gradient.

LAKE, MESOTROPHIC Lakes at an in-between stage nutritionally, with ecosystems functioning in a stable fashion, supporting a diverse community of aquatic plant and animal life.

LAKE, MONOMICTIC Lakes that have a temperature minimum of 4□C. Water circulates freely in the winter time and stratifies during the summer.

LAKE, OLIGITROPHIC Lakes where plant growth is limited by a low chemical concentration of nutrients.

LAKE, OXBOW Lakes formed by an oxbow. See Oxbow.

LAKE, PLAYA Lakes having a nearly level area at the bottom of a basin in an arid or semi-arid region; the beach or bank of a river. An intermittent pond or lake with no outlet. An undrained basin that, at times, becomes a temporary, shallow lake. The term "Playa" is more common. See Playa Lake.

LAKE SHORE See Coastal Zone and Shore.

LAKE SURFACE AREA That area of a lake outlined on the latest U.S. Geological Survey topographic map as the boundary of the lake and measured by a planimeter in hectares. In localities not covered by topographic maps, the areas are computed from the best maps available at the time planimetered. All areas shown are those for the stage when the planimetered map was made *(52).*

LAKE TURNOVER A seasonal change in heat distribution occurring in most North American Lakes. When air temperatures drop in the autumn, epilimnion, and hypolimnion temperatures equalize and achieve the same densities. As surface waters become cooler and heavier, they begin to mix with the water below. This mixing, combined with the movement due to winds and currents, results in a total turnover or reversing of the epilimnion and hypolimnion. Another turnover occurs in the spring in northern regions when ice melts and water temperatures become uniform throughout the lake.

LAMINAR FLOW See Flow, Laminar.

LAMINAR VELOCITY That velocity below which, in a particular conduit, laminar flow will always exist and above which the flow may be either laminar or turbulent depending on circumstances. See Flow, Laminar; and Flow, Turbulent.

LAND LINE Relates to communications: typically telephone service but includes any communication lines [land line].

LAND MANAGEMENT AGENCY A State or Federal government agency responsible for the process of planning, organizing, programming, coordinating, directing, and controlling land use actions for its government on lands for which it is responsible under the statutes, regulations, rules, and mandates that provide its authority.

LAND TREATMENT MEASURE A tillage practice, a pattern of tillage or land use, or any land improvement with a substantial effect of reducing runoff and sediment production or of improving use of drainage and irrigation facilities. Examples are contouring, improved crop rotations, controlled grazing, land leveling, [and] field drainage. In hydrologic computations, nonbeneficial measures (such as straight-row, poor-rotation corn) are included for convenience in evaluation. In general conservation work "land treatment measure" has a broader meaning that includes measures to improve the soil, control sheet erosion, [and] increase soil fertility *(51).* Compare with Development and Land Use.

LAND USE A term which relates to both the physical characteristics of the land surface and the human activities associated with the land surface *(1).* A highway facility to accommodate land uses is termed a land use structure or facility. See Land Use Facility.

A land classification. Cover, such as row crops or pasture, indicates a kind of land use. Roads may also be classified as a separate land use *(51).* Compare with Development and Land Treatment Measure.

LAND USE FACILITIES With highways, stockpasses and machinery passes under a road are often termed land use facilities. See Land Use.

LAND-SURFACE DATUM Is a datum plane that is approximately at the land surface at each groundwater observation well *(52).*

LAPLACE-GAUSS DISTRIBUTION or LAPLACEAN DISTRIBUTION See Normal Distribution.

LATERAL A conduit, ditch, canal, or channel conveying water diverted from a main conduit, canal or channel for delivery to distributaries; sometimes considered a secondary ditch. See Channel.

LATERAL EROSION See Erosion, Lateral.

LATERAL-FLOW SPILLWAY See Spillway, Side-Channel.

LAUNCHING Release of undercut material (stone riprap, rubble, slag, etc.) downslope; if sufficient material accumulates on the stream bank face, the slope can become effectively armored.

LAW, WATER See Water Law.

LEFT BANK OF A CHANNEL The left-hand bank of a channel when the observer is looking downstream. Compare with Right Bank of a Channel.

LEGAL LIABILITY Liability between litigants recognized and enforced by the courts. Compare with Liable.

LEVEE An embankment, generally landward of a top bank, that confines flow during highwater periods, thus preventing overflow into lowlands. A linear embankment outside a channel for containment of flow. Longer than a dike. Compare with Dike.

LEVEL OF SIGNIFICANCE The [statistically computed] probability of rejecting a hypothesis when it is in fact true. At a "ten-percent" level of significance the probability is 1/10 *(34).*

LEVEL OF PROTECTION This is the flood level at which flood damages and/or other adverse effects not eliminated by a project are considered relatively minor. Level of protection is a convenient term to express the flood control effectiveness of a project and may be based on flood discharge, stage, volume, duration, or any combination of factors that express project functional characteristics. Most commonly, it is expressed as the frequency (statistically estimated) of occurrence of the flood discharge and attendant levels thereof that the project will accommodate with acceptably minor residual flood damages in such an occurrence (e.g., ...the 1 percent chance or 100-year flood, etc). However, to fully define how a project is expected to function requires describing project impacts at several flood levels and locations. The terms "level of protection" and "project design flood" are not necessarily synonymous; separate reaches of a project may have different levels of protection (variance in the scope of project response to the flood threat) and level of protection may change over time (because of new upstream development or other changed conditions). There is no minimum level of protection required for Corps [COE] projects. However, in urban areas... ...it may well be desirable to consider alternatives providing a higher level of protection if... ...significant portions of the urban area [are] within the residual 100-year floodplain; or if, with overtopping or failure... ...there would be attendant risk to the lives of many, which could not be reasonably guarded against without a higher level of protection *(30).*

Not a term commonly used in highway drainage design. See Project Flood. Compare with Project Design Flood since it is not necessarily synonymous with this term. Also compare with Economic Analysis and Economic Assessment.

LIABLE Subject to civil action against, or for redress from infringement of private rights. Compare with Legal Liability.

LIABILITY See Liable.

LIMNETIC ZONE The deeper open water zones of lakes or lake size ponds. A relatively large expanse of open water above the profundal zone. Compare with Littoral Zone and Profundal Zone. See Pond.

LIMNOLOGY That branch of hydrology pertaining to the study of lakes. Compare with Lacustrine.

LINE OF SIGHT An unobstructed straight line from a radio transmitter to a receiver site *(33).*

LINEAR SYSTEM A system in which the principle of superposition applies and system response is only a function of the system itself (e.g., unit hydrograph model) *(1).*

LINING See Channel Lining. Compare with Blanket and Apron.

LITTORAL DRIFT The transport of material along a shoreline. Sometimes termed "long-shore sediment transport." The movement of sediments in the near shore zone by waves and currents. The movement can be parallel to the shore (long-shore transport) or perpendicular to the shore (onshore-offshore transport).

LITTORAL TRANSPORT See Littoral Drift.

LITTORAL ZONE A shore or coastal zone. Also the shallower depths of a lake where sunlight penetrates so that rooted plants can grow. Compare with Limnetic Zone and Profundal Zone.

LIVESTOCK Domestic animals, such as cattle, horses, hogs and chickens that are raised for home use or for profit. Compare with Wildlife.

LOAD (or SEDIMENT LOAD) Amount of sediment being moved by a stream.

LOCAL SCOUR See Scour, Local.

LOG PAPER Short for "full-logarithmic graph paper," which is a graph paper (available commercially) that has logarithmic scales on both horizontal and vertical axes. Sometimes called "log-log paper." The scales may be any number of cycles, but usually in [cycle] combinations like 1x1, 2x2, 3x3, 3x5, 4x7, etc. *(51).* Compare with Semilog Paper and Log-Normal Paper.

LOG PEARSON DISTRIBUTION See Probability Distribution.

LOGARITHMICALLY TRANSFORMED DISTRIBUTION See Probability Distribution.

LOG-LOG PAPER See Log Paper.

LOG-NORMAL Short for "logarithmic-normal probability distribution" *(51).*

LOG-NORMAL PAPER Graph paper used in estimating frequencies of floods, etc. Has a logarithmic scale for the flood (or other) amounts and a cumulative distribution scale (also called frequency or percent chance scale) for the probability plotting positions *(51).* Compare with Log Paper and Semilog Paper.

LOLLY ICE See Frazil Ice.

LONG-PERIOD VARIATIONS Secular when a cycle or a change in trend is completed within a century; climatic when the period of change runs through centuries or a few millennia; geologic when the period runs into geological time *(72).* See Trend.

LONG-SHORE SEDIMENT TRANSPORT See Littoral Drift.

LONG-TERM DEGRADATION See Short-Term Degradation.

LONGITUDINAL PROFILE The profile of a stream or channel drawn along the length of its centerline. In drawing the profile, elevations of the water surface or the thalweg are plotted against distance as measured from the mouth or from an arbitrary initial point.

LOSING STREAM See Stream, Losing.

LOSS, HYDROLOGY See Hydrology Loss.

LOST HEAD See Head, Lost.

LOW FLOW CHANNEL See Channel, Low Flow.

LOW HEAD See Head, Low.

LOW-FLOW FREQUENCY CURVE A graph showing the magnitude and frequency of minimum flows for a period of given length. Frequency is usually expressed as the average interval, in years, between recurrences of an annual minimum flow equal to or less than that shown by the magnitude scale. Compare with Flood-Frequency Curve.

LOWER BANK See Bank, Lower.

LUMPED SYSTEM A [statistical] system in which the variations in space either do not exist or have been ignored (opposite of distributed system) *(1)*.

LYSIMETER Structure containing a mass of soil and designed to permit the measurement of water draining through the soil *(23)*.

MACROPHILE Rooted aquatic plants.

MAIN STEM Main branch of the watershed (drainage area) stream system. Compare with Tributaries.

MAJOR IRRIGATION FACILITIES Major irrigation facility is an agency-specific term which might be defined by using arbitrary definitions such as where: 1. a water right is recorded for a conveyance facility, such as a canal and any appurtenant structures; 2. complex system and/or structure geometries are required; 3. significant sediment and/or erosion problems occur or are expected; or 4. complex hydraulic analysis practices are needed.

MAJOR STORM DRAIN A major storm drain system is an agency-specific term which might be defined by using arbitrary definitions such as where: 1. either three or more inlets enter a common trunkline and outfall; or 2. judgment indicates the need for a storm drain system to avoid a significant flood hazard. See Drain, Storm. Compare with Design Flood (or Storm) System.

MANHOLE Considered to be a gender-neutral term for a structure by which one may access a drainage system. Also referred to as access hole.

MANNING'S EQUATION An empirical formula devised by Manning, based upon original work by Ganguillet and Kutter, for computing flow in open channels and pipes. In its present form it has been modified to: $v = (1/n)R^{2/3}S^{1/2}$ where v = velocity, R = hydraulic radius or A/Wp where A = cross section area and Wp = wetted perimeter and S = Hydraulic Gradient. See Manning's n.

MANNING'S n A coefficient of roughness, used in a Manning's equation for estimating the capacity of a channel to convey water. Generally, "n" values are determined by inspection of the channel *(51).* The roughness coefficient, n, in the Manning equation for determination of a discharge. Compare with Hydraulic Roughness. See Manning's Equation.

MANOMETER A tube containing a liquid, the surface of which moves proportionally to changes of pressures; a tube type of differential pressure indicator; a pressure gage.

MASS CURVE A graph of the cumulative values of a hydrologic quantity (such as precipitation or runoff), generally as ordinate, plotted against time or date as abscissa *(34)*. See also Double-Mass Curve and Residual-Mass Curve.

MASS INFLOW Curve A graph showing the total cumulative volume of stormwater runoff plotted against time for a given drainage area.

MASS WASTING The collapse of a bank by undercutting due to wearing away of the toe or an erodible soil layer above the toe. The ongoing undercutting of stream banks by erosion and scour followed by the slumping and subsequent erosion of upper bank material. Sudden collapse of a bank due to an instability condition such as removal of a portion of the bank by scour. Compare with Erosion, Abrasion, Scour, and Sloughing.

MASTER DRAINAGE PLAN Planning model for drainage in a particular regional or local geographic area.

MATHEMATICAL MODEL A symbolic representation of a flow situation using mathematical equations.

MATTRESS A covering of concrete, wood, stone, or other material used to protect a stream bank against erosion. See Lining and Blanket.

MAXIMUM POSSIBLE FLOOD See Flood, Maximum Probable.

MAXIMUM PROBABLE FLOOD See Flood, Maximum Probable.

MEAN ANNUAL FLOOD, $Q_{2.33}$ See Flood, Mean Annual.

MEAN ANNUAL FLOW, Q_a See Flow, Mean Annual.

MEAN DAILY DISCHARGE The average of mean discharge of a stream for one day. Usually given in m^3/s *(51).* Compare with Flood, Mean Annual; Flow, Mean Annual; and Mean Monthly Flow.

MEAN DEPTH Cross section area of a channel divided by its surface width.

MEAN DISCHARGE The arithmetic mean of individual daily mean discharges during a specified period *(52).*

MEAN MONTHLY FLOW Average monthly flows, expressed in percent of annual flow, are determined for each of nearby gaged basins in the same hydrologic region. The overall percentage for each month is computed for the gaged sites, and these averages are multiplied by the estimate of mean annual flow, Q_a, to determine the mean monthly streamflows at the ungaged site. Compare with Flow, Mean Annual (Q_a); Mean Daily Discharge; and Flood, Mean Annual.

MEAN SEA LEVEL Mean sea level is the plane about which the tide oscillates. It is determined from tidal observations by averaging the recorded hourly heights of the tide over a period of several years. Mean sea level varies with locality of observation and method of computation, and hence it has no absolute constant value. in order to simplify the computation, mean tide level is sometimes used as a substitute for mean sea level *(14).* Compare with Mean Tide Level.

The mean of all hourly ocean elevations over a 19-year period *(33).*

MEAN TIDE LEVEL Mean Tide Level is simply equal to the average of the observed high and low waters, and it is considered a poor substitute [for the mean sea level] in many cases because of the appreciable influence of short-period tides *(14).* Compare with Mean Sea Level.

MEAN VELOCITY Two definitions are provided: 1. the velocity at a given section of a stream obtained by dividing the discharge of the stream by the cross section area at that section; 2. mean velocity may also apply to a reach of a stream by dividing the discharge by the average area of the reach.

MEAN-SQUARE ERROR Sum of the squared differences between the true and estimated values of a quantity divided by the number of observations. It can also be defined as the bias squared plus the variance of the quantity *(34).*

MEANDER The winding of a stream channel *(37).* The changes in direction and winding of flow, usually in an alluvial channel which is sinuous in character. Any reverse or letter-S channel pattern fashioned in alluvial materials by erosion of the concave bank, which is free to shift its location and adjust its shape as part of a stage in the migratory movement of the channel as a whole down an erodible, alluvial valley. A meander is characterized by curved flow patterns and alternating shoals and bank erosion.

MEANDER AMPLITUDE Distance between points of maximum curvature of successive meanders of opposite phase in a direction normal to the general course of the meander belt, measured between center lines of channels *(37).*

MEANDER BELT Area between lines drawn tangential to the extreme limits of fully developed meanders *(37).*

MEANDER BREADTH The distance between the lines used to define the meander belt *(37).*

MEANDER LENGTH Twice the distance between successive points of inflection of the meander wave *(42).* Distance, following the general, sinuous course of the meanders, between corresponding points of successive meanders of the same amplitude.

MEANDER LOOP An individual loop of a meandering or sinuous channel lying between inflection points with adjoining loops.

MEANDER PHASE See Meander Amplitude.

MEANDER PLUGS Deposits of cohesive materials in old channel bendways due to a cutoff. These plugs, sometimes termed "clay plugs," are sufficiently resistant to erosion to serve as essentially semipermanent geological controls to advancing channel migrations. See Clay Plug.

MEANDER SCROLL Topographical markings on old floodplains resembling a cross section of the edge pattern of a partly unrolled sheet of paper or having a spiral or coiled form, which have been left on a floodplain as a result of the historic migratory movement of the channel. Stated another way, low concentric ridges and swales on a floodplain, marking the successive positions of former meander loops.

MEANDERING CHANNEL A channel exhibiting a characteristic process of bank erosion, crossover and point bar deposition associated with systematically shifting meanders. See Meander and Meander Belt.

A channel having a sinuosity greater than some arbitrary value, herein placed at 1.25. The term also implies a moderate degree of pattern symmetry, imparted by regularity of size and repetition of meander loops.

MEANDERING STREAM See Meandering Channel.

MEASURABLE Computing or measuring a change that is more than the inherent error encountered in accepted hydraulics practices but exclusive of such errors found in flood predicting methods.

MEASURED SCOUR See Scour, Measured.

MEASURING POINT An arbitrary, permanent reference point from which the distance to the water surface in a well is measured to obtain the water level *(52)*.

MEASURING WEIR See Weir, Measuring.

MEDIAN DIAMETER See D_{50}.

MEROMICTIC LAKE See Lake, Meromictic.

MESOTROPHIC LAKE See Lake, Mesotrophic.

METEOR BURST Radio transmission uses the phenomenon of meteors entering the upper atmosphere to bounce signals back to earth *(33)*.

METEOROLOGICAL SENSOR DATA Collected weather data such as rainfall, humidity, temperature, and wind *(33)*.

METER, CURRENT See Current Meter.

METERS PER SECOND, m/s Velocity of flow.

METHOD OF MOMENTS A standard statistical computation for estimating the moment of a distribution from the data of a sample *(34)*.

mg/L Abbreviation for milligrams per liter (mg/L). See Parts Per Million.

MICROPROCESSOR A small computer that is usually more powerful in processing ability and more flexible in using other equipment than a typical home computer *(33)*.

MICROWAVE RADIO A radio whose transmission [frequency] requires line-of-sight. The frequency has high resistance to atmospheric interruption (telephone tower relay stations are an example) *(33)*.

MID-CHANNEL BAR See Bar, Middle.

MIDDLE BANK See Bank, Middle.

MIDDLE BAR See Bar, Middle.

MIGRATION, CHANNEL See Channel Migration.

MILD SLOPE See Slope, Mild.

MINIMIZE Reducing to the smallest practicable amount.

MINIMUM ENERGY LINE See Energy Line, Minimum.

MITERED ENTRANCE See Inlet, Mitered.

MITIGATE The act of lessening, offsetting, or compensating an impact on surface waters. To moderate (a qualifying or condition) in force or intensity. To decrease or rectify an adverse condition or action. See Mitigation Alternatives, Mitigation Measures, and Mitigation Methods.

MITIGATION ALTERNATIVES Environmental mitigation alternatives for surface waters in order of priority are currently (1992) defined as: 1. avoidance; 2. on-site mitigation; 3. off-site mitigation within the same drainage area; 4. off-site mitigation within the same drainage and biotic region; 5. no mitigation. See Biotic Region.

MITIGATION MEASURES Mitigation measures for surface waters are defined as the site-specific action or construction necessary to accomplish the mitigation to the extent practicable. See Practicable.

MITIGATION METHODS Mitigation methods for surface waters are defined as either the on-site or offsite: 1. construction of new surface waters; 2. enhancement of existing surface waters; 3. acquisition in perpetuity and enhancement of existing surface waters; 4. combinations thereof.

MOBILE BED AND BANKS (MODEL) A channel whose bed and banks are free to move under the forces of flowing water. Mobile bed and bank analyses and computer models estimate channel hydraulics taking into account this mobility. See Fix Bed and Banks (Model).

MODEL Reference 22 provides two definitions: 1. a conceptual, mathematical, or physical system obeying certain specified conditions, whose behavior is used to understand the physical system to which it is analogous in some way; 2. a conceptual description and the associated mathematical representation of a system, subsystem, components, or condition that is used to predict changes from a baseline state as a function of internal and/or external stimuli and as a function of time and space.

Relates output to input by attempting to describe the characteristics and processes of the system in the form of mathematical algorithms usually attempting to reflect real cause-effect relationships *(1).*

MODEL, COMPUTER The representation of a drainage system with computer software. Compare with Model, Physical.

MODEL PARAMETER A constant whose value varies with the circumstances of its application (e.g., Manning n-value) *(1).*

MODEL, PHYSICAL The representation of a drainage system with a hydraulically scaled laboratory model. Compare with Computer Model.

MODEL VARIABLE A term [which] has no fixed value (e.g., rainfall) *(1).*

MOISTURE Water diffused in the atmosphere or the ground.

MOISTURE EQUIVALENT The ratio of 1. the weight of water which the soil, after saturation, will retain against a centrifugal force 1000 times the force of gravity, to 2. the weight of the soil when dry. The ratio is stated as a percentage *(47).*

MOMENTUM The impetus of a moving body; the quantity of motion in a body as measured by the product of its mass by its velocity.

MOMENTUM COEFFICIENT (β) A correction factor (beta) applied to the flow momentum, to correct for non-uniformity of momentum in a cross section. For a fairly straight, nearly uniform channel β varies from 1.01 to 1.12 and as may be as high as 1.33 for overflooded river valleys *(13)*. Compare with Velocity Head Coefficient (α).

MONOMICTIC LAKE See Lake, Monomictic.

MORPHOLOGY The biological study of the form and structure of living organisms. May also be shortened term hydraulics engineers, for convenience, often used (or misused) when referring to fluvial geomorphology (technically this is incorrect but commonly used).

MORPHOLOGY PROBLEMS These are fluvial geomorphology problems related to such things as channel aggradation or degradation, bendway migration, bank erosion, bed scour and bendway cutoffs. See Fluvial Geomorphology, Geomorphology, and Morphology.

MUD A soft, saturated mixture mainly of silt and clay.

MUDFLOW A well-mixed mass of water and alluvium which, because of its high viscosity and low fluidity as compared with water, moves at a much slower rate, usually piling up and spreading over the [alluvial] fan like a sheet of wet mortar or concrete *(73).*

MUSSEL Any of several marine bivalve mollusks, especially the edible *Mytilus edulis,* having a blue-black shell.

n (MANNING'S), or n Value See Manning's n.

NAPPE A sheet or curtain of water overflowing such things as a weir or drop structure. A stable nappe has an upper and a lower water surface exposed to the atmosphere. See Nappe, Flapping.

NAPPE, FLAPPING A nappe whose lower water surface periodically loses contact with the atmosphere which results in a negative pressure thereby causing the nappe to oscillate up and down in a flapping motion. Hydraulic structures with overflows should be designed to insure the nappe remains aerated throughout the design range of flows. See Nappe.

NATIONAL GEODETIC VERTICAL Datum of 1929. A geodetic datum derived from a general adjustment of the first order level nets of both the United States and Canada. It was formerly called "Sea level Datum of 1929" or "mean sea level" [in the annual WRD data reports]. Although the datum was derived from the average sea level over a period of many years at 26

tide stations along the Atlantic, Gulf of Mexico and Pacific Coasts, it does not necessarily represent local mean sea level at any particular place *(52)*.

NATURAL AND BENEFICIAL FLOODPLAIN VALUES Such things as wildlife, plants, open space, natural beauty, outdoor recreation, agriculture, aquaculture, forestry and artifacts as well as natural flood control and water quality control features such as wetlands and groundwater recharge areas. Floodplains also provide these values as well as supporting foodchains for aquatic life as well as provide other aquatic-related needs.

NATURAL DRAINAGE DOCTRINE OR RULE The precept in civil law dealing with the management and use of naturally occurring waters, based on preservation and continuance of the natural drainage system and runoff conditions. Compare with Common Enemy Doctrine or Rule, Civil Law Doctrine or Rule, and Reasonable Use Doctrine and Rule.

NATURAL LEVEE A low ridge along a stream channel, formed by deposition as floods abate, that slopes gently away from the channel.

NATURAL SCOUR See Scour, Natural.

NATURAL WATERCOURSE See Channel, Natural.

NAVIGABLE WATERS Primarily a regulatory term as it applies to highway drainage planning, design and construction in jurisdictional surface waters. The term "navigable waters" refers to jurisdictional surface waters as used in PL 92-500 and defined in Section 502(7) as "waters of the United States including the territorial seas." The territorial seas; coastal and inland waters, lakes, rivers and streams that are navigable waters of the United States, including adjacent wetlands; tributaries to navigable waters of the United States, including adjacent wetlands; interstate waters and their tributaries, including adjacent wetlands; and all other waters not identified above, the degradation or destruction of which could affect interstate commerce (33 CFR 323.3, 42 FR 37144, 1977); also see 80 Stat. 941, Volume 80 of the U.S. Statutes at Large, page 941; 49 USC. 1651 et seq.: Title 49, United States Code, Section 1651 and that which follows (or "and following"); PL 92-500: Public Law number 500 enacted by the 92nd Congress; 40 FR 55810: Volume 40 of the *Federal Register*, page 55810; 40 CFR 126: Title 40 of the Code of Federal Regulations, part 126. Those waters of the United States that are subject to the ebb and flow of the tide and/or those waters of the United States that are presently used, or have been used in the past, or may be susceptible to use in the future to transport interstate or foreign commerce. (33 CFR 322.2, 42 FR 37139, 1977).

Further, navigable waters are considered to be territorial seas of the United States and internal waters of the United States that are subject to tidal influence and internal waters of the United States not subject to tidal influence that: 1. are or have been used, or are or have been susceptible for use by themselves or in connection with other waters, as highways for substantial interstate or foreign commerce, not withstanding natural or man-made obstructions that require portage, or 2. a governmental or non-governmental body, having expertise in

waterway improvement, determines to be capable of improvement at a reasonable cost (a favorable balance between cost and need) to provide, by themselves or in connection with other waters, highways for substantial interstate or foreign commerce (40 FR 49327; 33 CFR 2.05-25).

NECK CUTOFF See Cutoff.

NETWORK An assembly of gaging/sampling points located and operated in such a manner as to provide a representative and transferable "sample" of the spatial and temporal variability of processes occurring within a geographic region *(1).*

NEPHELOMETRIC TURBIDITY UNITS See Turbidity.

NFIP Acronym for National Flood Insurance Program.

NIBBLE EFFECT A minor or insignificant (see Significant) amount of detrimental change in the functions and values of surface waters which may not be immediately detrimental, but the accumulation of many such small changes over a period of time will eventually cause detrimental problems.

NICK POINT A relatively small, localized point of scour in the thalweg of a vegetated swale or channel characterized by a small or shallow vertical area of channel degradation. If nick points enlarge up- and downstream so as to join together, a headcut forms and headcutting begins. Nick points occur when the vegetation is unable, for various reasons, to resist the eroding action of the flows occurring in the swale.

NOMINAL SEDIMENT Equivalent spherical diameter of a hypothetical sphere of the same volume as a given stone or sand particle.

NON-LINEAR SYSTEM A system in which the system response depends both upon the system itself and the input intensity (e.g., equations of gradually varied, open channel flow) *(1).*

NON-STRUCTURAL MEASURES These include: 1. flood warning and preparedness; 2. temporary or permanent evacuation and relocation; 3. emergency flood fighting and financial relief; 4. land use regulations including floodway delineation, floodplain zoning, subdivision regulations, and building codes; 5. flood proofing with or without land use regulations; 6. area renewal and conversion to open space; 7. flood insuring. The fundamental goal is to develop, define and recommend a robust solution that has public and institutional support (having appropriately determined how well an economical plan can be made to function, how capable are the responsible interests to operate and maintain it and how safe will be the people who will depend on it). Methods of reducing damage from floods include local flood warning and response systems, temporary permanent evacuation and relocation of people or property, emergency flood fighting and financial relief, land use regulations and building codes, flood proofing, area renewal and conversion to open space and flood insurance *(30).* Compare with Structural Measures.

NON-UNIFORM CHANNEL See Channel, Non-Uniform.

NON-UNIFORM FLOW See Flow, Non-Uniform.

NONPARAMETRIC Statistically, the same as distribution-free.

NORMAL A central value (such as arithmetic average or median) of annual quantities for a 30-year period ending with [on] an even 10-year, thus 1921-50; 1931-60 and so forth. This definition accords with that recommended by the Subcommittee on Hydrology of the Federal Interagency Advisory Committee on Water Data (the Subcommittee on Hydrology was formerly under the Federal Interagency Committee on Water Resources) *(37).*

A mean or average value established from a series of observations, for purposes of comparison of some meteorological or hydrological event *(51).*

NORMAL DEPTH See Depth, Normal.

NORMAL DISTRIBUTION See Probability Distribution.

NORMAL FLOW Flow at normal depth. Average flow prevailing during the greater part of the year. See Normal Stage; and Depth, Normal.

NORMAL STAGE The average water stage prevailing during the greater part of the year. The water surface elevation corresponding to the Normal Flow. See Normal Flow; and Depth, Normal.

NORMAL VELOCITY Mean velocity of flow at normal depth. See Depth, Normal.

NORMAL WATER SURFACE The free surface associated with flow in natural streams. The natural water surface. See Depth, Normal.

NATURAL WATER SURFACE See Normal Water Surface.

NTU Acronym for Nephelometric Turbidity Units.

NEPHELOMETRIC TURBIDITY UNIT Used in the direct reading measurement of the suspended particles. See Turbidity.

NUTRIENT Something that nourishes, especially, a nourishing ingredient in a food. Something found in surface waters that nourishes aquatic life.

NWS Acronym for the National Weather Service. More specifically, the United States Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service; formerly the U.S. Weather Bureau.

OLIGITROPHIC LAKE See Lake, Oligitrophic.

ON-SHORE, OFF-SHORE TRANSPORT See Littoral Drift.

ONE-HUNDRED YEAR FLOOD See Flood, One-Hundred Year.

ONE-THOUSAND YEAR FLOOD See Flood, One-Thousand Year.

ONE-DIMENSIONAL WATER SURFACE PROFILE An estimated water surface profile which recognizes flow only in the upstream-downstream direction: vertical and transverse velocity vector components are ignored. Compare with Two-Dimensional Water Surface Profile.

OPEN CHANNEL See Channel, Open.

OPEN-CHANNEL CONSTRICTION In application the term is used to refer to width constrictions, such as a highway bridge with long approach fills across a floodplain. In a general sense it applies to any type of constriction in an open channel, whether natural or constructed such as a dam, bridge, or culvert.

OPEN CHANNEL FLOW Flow in any open or closed conduit where the water surface is free; that is, where the water surface is at atmospheric pressure. Compare with Channel, Open.

ORDINARY HIGHWATER (OHW) A term for defining a regulatory-related water surface for a natural channel or the shore of standing waters. This intersection reflects the highest level water reaches in an average runoff year as indicated by such things as erosion, shelving, change in the character of soil, destruction of terrestrial vegetation or its inability to grow, the presence of litter and debris; or in the absence of such evidence, an arbitrarily estimated water surface might be used such as that associated with the mean annual flood. For the purposes of this Glossary, in no instance will the ordinary highwater (OHW) be considered as exceeding the estimated water surface level of the mean annual flood unless so mandated by the cognizant regulatory agency(ies). The sum of the water right, flood right, and mean annual flood may be used to arbitrarily determine the maximum OHW for irrigation channels intercepting runoff.

ORGANIC MIXTURES AND MULCHES Any of a number of agents (e.g., petrochemicals or vegetative matter) used to stabilize a stream bank against erosion by providing protection and nutrients while vegetation becomes established. These agents, which may be in the form of liquids, emulsions, or slurries, are normally applied by mechanical means.

ORIFICE Two definitions are pertinent: 1. a hole or opening, usually in a plate, wall, or partition, through which water flows, generally for the purpose of control or measurement; 2. the end of a small tube, such as the orifice of a pitot tube, or piezometer.

ORIFICE PLATE A plate containing an orifice. In pipes, the plate is usually inserted between a pair of flanges. The orifice is smaller than the pipe and the drop in the hydraulic grade line caused thereby is an index of the discharge.

ORIFICE FLOW See Flow, Orifice.

OTHERS A generic term sometimes used for such things as another governmental agency or quasi governmental agency (such as a flood control district, or irrigation district), as well as party(ies) or individual(s) from the private (non-governmental) sector of society.

ORIFICE, SUBMERGED See Submerged Orifice.

OUTFALL The point where: 1. water flows from a conduit; 2. the mouth (outlet) of a drain or sewer; 3. drainage discharges from a channel or storm drain.

OUTLET CONTROL A condition where the relation between headwater elevation and discharge is controlled by the conduit, outlet, or downstream conditions of any structure through which water may flow. In culvert flow, outlet control exists for flow-type II, III, IV and VI. Compare with Inlet Control.

OUTLET, SUBMERGED See Submerged Outlet.

OUTLIER Outliers (extreme events) are data points which depart from the trend of the rest of data *(34).* See Extreme Events and Probability Distribution.

OVERBANK FLOW See Flow, Overbank.

OVERLAND FLOW See Flow, Overland.

OVERTOPPING FLOOD See Flood, Overtopping.

OXBOW The abandoned bow-shaped or horseshoe-shaped reach of a former meander loop, that is left when the stream cuts a new shorter channel across the narrow neck (see Cutoff) between closely approaching bendways of the meander. See Oxbow Lake.

PALIOLIMNOLOGISTS Those whose study the history of lakes.

PARALLEL WING WALL INLET See Inlet, Parallel Wing Wall.

PARAMETER A characteristic descriptor, such as a mean or standard deviation *(34).* Sometimes considered as a variable comprised of the product of two or more variables.

The *Reader's Digest Great Encyclopedic Dictionary* offers three mathematical definitions: 1. a constant whose value determines the operation or characteristics of a system. In $y = ax^2 + bx + c$, a, b and c are the parameters of a family of parables; 2. a variable t, such that each of a related system of variables may be expressed as a function of t; 3. a fixed limit or guideline.

[Statistically], a number which describes the universe is called a parameter. [As an example] the value of 66 mm, which we found as the standard deviation of the heights of the Harvard students is a statistic. But if we were to say that the average birth weight of all newborn male babies is 3.4 kg, our number would be a parameter *(69).* Compare with Variable and Statistic.

PARSHALL MEASURING FLUME See Flume, Parshall Measuring.

PARTIAL-DURATION FLOOD SERIES A list of all flood peak discharges that exceed a chosen base stage or discharge, regardless of the number of peaks occurring in a year (also called basic-stage flood series, or floods above a base) *(37).* Compare with Partial-Duration Series.

A list of all events, such as floods, occurring above a selected base, without regard to the number, within a given period. In the case of floods, the selected base is usually equal to the smallest annual flood of a series, in order to include at least one flood in each year *(51).* Compare with Partial-Duration Flood Series.

PARTIAL-DURATION SERIES See Partial-Duration Flood Series.

PARTS PER MILLION The ratio used in expressing the concentration of suspended sediment ...given in either parts per million (PPM) or percent. Methods of determination: 1. weight of dried sediment divided by weight of sample; 2. weight of the dried sediment divided by weight of distilled water with a volume equal to that of the sampler; 3. weight of the dried sediment divided by the weight of the water in the sample, including the dissolved material. Either method 1. or 2. is used when the concentration is less than one percent. Current practice is to use milligrams per liter (mg/L) rather than parts per million.

PARTIAL-RECORD STATION A particular site where limited streamflow and/or water-quality data are collected systematically over a period of years for use in hydrologic analyses *(52).*

PARTIALLY BOUNDED DISTRIBUTION See Probability Distribution.

PARTICLE SIZE See D_{16}, D_{50}, and D_{85}.

PATHOGENS Any agent that causes diseases, especially a microorganism such as a bacterium or fungus.

PAUCITY Smallest of number, fewness, lack of.

PAVEMENT See Blanket and Mattress. Compare with Apron.

PAVING See Channel Lining.

PDF Acronym for Project Design Flood.

PEAK DISCHARGE The highest value of the stage or discharge attained by a flood; thus, peak stage or peak discharge. Flood crest has nearly the same meaning, but since it connotes the top of the flood wave, it is properly used only in referring to stage—thus, crest stage, but not crest discharge *(37).*

Maximum discharge rate on a runoff hydrograph for a given flood event. The instantaneous, maximum discharge of a particular flood at a given point along a stream.

In a frequency study of annual floods, it is the maximum instantaneous discharge rate reached during the year.

PEAK FLOOD See Peak Discharge.

PEAK STAGE See Flood Stage.

PEAKED STONE DIKE Riprap placed parallel to the toe of a stream bank (at the natural angle of repose of the stone) to prevent erosion of the toe and induce sediment deposition behind the dike. Compare with Reinforced Revetment.

PEARSON DISTRIBUTION See Probability Distribution.

PERCENT CHANCE A probability multiplied by 100 *(34).*

A name often given to the probability scale on log-normal paper. A 2-percent chance flood is a 50-year frequency flood (see Frequency) since 100 (percent chance = frequency in years) *(51).* See Log-Normal Paper.

PERCHED GROUNDWATER See Groundwater, Perched.

PERCHED STREAM See Stream, Perched.

PERCHED WATER TABLE See Groundwater, Perched; and Water Table.

PERCOLATING WATERS Those waters which pass through the ground beneath the surface of the earth without any definite channel and do not form a part of the body or flow of any surface or subterranean water course. They may be either infiltrating rain waters or snowmelt, or waters that have seeped through the banks or bed of a stream to a distance where they lose their character as streamflow.

PERCOLATION The flow of a fluid through a substance via pores or small openings. Two definitions are offered by the Groundwater Subcommittee: 1. the downward movement of water through the unsaturated zone; 2. the downward flow of water in saturated or nearly saturated porous medium at hydraulic gradients of the order of 1.0 or less.

Movement of water through the interstices of a substance, as through soils. The movement or flow of water through the interstices or the pores of a soil or other porous medium.

The movement, under hydrostatic pressure, of water through the interstices of a rock or soil, except the movement through large openings such as caves *(47).* Compare with Infiltration.

PERENNIAL FLOW OR STREAM See Stream, Perennial.

PERMAFROST Perennially frozen ground, occurring wherever the temperature remains at or below 0□C for two or more years in a row *(20).*

PERMEABILITY The property of a material that permits appreciable movement of water through it when it is saturated and movement is actuated by hydrostatic pressure of the magnitude normally encountered in natural subsurface water.

PERMISSIBLE VELOCITY See Velocity, Permissible.

PERVIOUS SOIL Soil containing voids through which water will move under hydrostatic pressure, percolate, or infiltrate.

pH The reciprocal of the logarithm of the hydrogen ion concentration. The concentration is the weight of hydrogen ions, in grams, per liter of solution. Neutral water (or soil) has a pH value of 7.

PHOTOSYNTHESIS The process by which chlorophyll-containing cells in green plants convert incident light to chemical energy and synthesize organic compounds from inorganic compounds, especially carbohydrates from carbon dioxide and water with the simultaneous release of oxygen.

PHREATIC LINE The upper boundary of the seepage water surface landward of a stream bank.

PHYSICAL MODEL See Hydraulic Model.

PHYSIOGRAPHIC REGION In highway hydrology considerations, a geographic area whose pattern of landforms and other runoff-producing features for its contiguous subregions are homogeneous but differ significantly from such feature(s) of an adjacent physiographic region(s).

PIER SHAFT The main part of a pier above the footing or foundation.

PIEZOMETER An instrument for measuring pressure head, usually consisting of a small pipe tapped into the side of a closed or open conduit and flush with the inside, connected with a pressure gage, mercury, water column, or other device for indicating pressure head.

PIEZOMETRIC HEAD See Head, Piezometric.

PILE An elongated member, usually made of such things as timber, concrete, or steel, that serves as a structural component of a river-training structure or bridge foundation. Compare with Pile Bin.

PILE BIN A pier composed of piles capped or decked with a timber grillage or with a reinforced-concrete slab forming the bridge foundation. See Pile.

PILE PIER See Pile Bin.

PIPING The action of water passing through or under an embankment and carrying some of the finer material with it to the surface at the downstream face. Removal of soil material through subsurface flow or seepage water that develops channels or “pipes” within the soil bank.

PITOT TUBE A device for measuring and observing the velocity head of flowing water, consisting essentially of an orifice held so as to point upstream in flowing water and connected with a tube by which the rise of water in the tube above the water surface may be observed. It may

be constructed with an upstream and a downstream orifice and two water columns, the difference of water levels being an index of the velocity head.

PLANKTON Plant and animal organisms, generally microscopic, that float or drift in great number in fresh or salt water.

PLANNING MODELS Models used in large-scale applications such as for metropolitan master plans *(1).*

PLAYA See Lake, Playa.

PLAYA LAKE Playa means playa lake thereby making this term redundant. See Lake, Playa.

PLOTTING POSITION The point computed by an equation and used to locate given data on probability [graph] paper *(51)*. See Probability Plotting Position.

PMF Acronym for Probable Maximum Flood.

PMP Acronym for Probable Maximum Precipitation.

POINT BAR See Bar, Point.

POINT GAGE See Gage, Point.

POINT RAINFALL See Rainfall, Point.

POISED STREAM See Stream, Poised.

POLLUTANT Anything that pollutes, such as grease, oil and toxic substances.

POLICY A definite course of action or method of action, selected to guide and determine present and future decisions whereas criteria are the standards by which a policy is carried out or placed in action; design criteria are needed for design, policy statements are not. Compare with Design Criteria.

POND Very small, very shallow bodies of standing water in which quiescent water and extensive occupancy by higher aquatic plants are common characteristics. Regional usage may refer to a lake as a pond. Compare with Lake.

PONDAGE Small-scale storage at a water power plant to equalize daily or weekly fluctuations in riverflow or to permit irregular hourly use of the water for power generation to accord with fluctuations in load *(37)*.

POOL A small, rather deep body of quiescent water, as a pool in a stream.

A deep reach of a stream. The reach of a stream between two riffles. Natural streams often consist of a succession of pools and riffles *(37).*

POPULATION The entire (usually infinite) number of data from which a sample is taken or collected. The total number of past, present and future floods at a location on a river is the population of floods for that location even if the floods are not measured or recorded *(34).* Compare with Sample.

PORE WATER PRESSURE See Pressure, Pore Water.

POROSITY Reference 22 offers two definitions: 1. the ratio, usually expressed as a percentage, of the total volume of voids of a given porous medium to the total volume of the porous medium; 2. the volume percentage of the total bulk not occupied by solid particles.

The ratio of the volume of void spaces in a rock or sediment to the total volume of the rock or sediment *(20).*

Stated two other ways: 1. an index of the void characteristics of a soil or stratum as pertaining to percolation; degree of perviousness; 2. ratio of void volume to total volume of a soil, or rock, generally expressed in percentages.

POSSIBLE MAXIMUM FLOOD See Flood, Maximum Possible.

POTENTIAL ENERGY See Energy, Potential.

POTENTIAL EVAPOTRANSPIRATION Water loss that will occur if at no time there is a deficiency of water in the soil for use of vegetation *(65).*

POTENTIAL NATURAL WATER LOSS The water loss during years when the annual precipitation greatly exceeds the average water loss. It represents the approximate upper limit to water loss under the type and density of vegetation native to a basin, actual conditions of moisture supply and other basin characteristics, whereas potential evapotranspiration represents the hypothetical condition of no deficiency of water in the soil at any time for use of the type and density of vegetation that would develop *(66).*

POTENTIAL RATE OF EVAPORATION See Evaporativity.

POTOMOLOGY The science of surface streams *(14).* Compare with River Mechanics.

PPM Acronym for Parts Per Million.

PRACTICABLE Capable of being accomplished within prudent natural, social, or economic constraints using readily available resources and reasonably reliable technology and practices: available and can be economically applied.

PRECIPITATION The process by which water in liquid or solid state falls from the atmosphere. The total measurable supply of water received directly from clouds, as rain, snow and hail; usually expressed as depth in a day, month, or year and designated as daily, monthly, or annual precipitation. Not synonymous with Rainfall. Compare with Rainfall.

As used in hydrology, precipitation is the discharge of water, in liquid or solid state, out of the atmosphere, generally upon a land or water surface. It is the common process by which atmospheric water becomes surface or subsurface water. The term "precipitation" is also commonly used to designate the quantity of water that is precipitated *(47).* Precipitation includes rainfall, snow, hail and sleet and is therefore a more general term than rainfall *(37).*

PRECIPITATION, EFFECTIVE Two definitions from "General Introduction and Hydrologic Definitions" *(37)* are: 1. that part of the precipitation that produces runoff; 2. a weighted average of current and antecedent precipitation that is "effective" in correlating with runoff. As described by U.S. Bureau of Reclamation, that part of the precipitation falling on an irrigated area that is effective in meeting the consumptive use requirements. Compare with Runoff, Direct; and Rainfall, Effective.

PRECIPITATION, PROBABLE MAXIMUM Probable Maximum Precipitation (PMP) is an estimate that approaches the theoretically largest storm physically possible. Development of the PMP considers all storms of record and the observed precipitation is increased by maximizing the moisture inflows to the storm system. Generalized depth, area, duration and season relationships for the continental U.S. are published by the National Weather Service in a series of hydrometeorological reports (HMR).

PREDATOR An animal that lives by preying upon others.

PRESCRIPTION Acquirement of the title or right to something through its open and continued use or actual possession from time immemorial or over a legally recognized or prescribed period. Also the diversion of water by a person at a point upstream from the land of a riparian owner, under the above conditions would give such person an appropriate right, perfected by prescription, to the use of the water, as against the owner.

PRESCRIPTIVE DRAINAGE EASEMENT A prescription (prescriptive right) which has been established through long, uninterrupted and undisputed use of a drainage facility or channel and thus precludes increasing the existing flood hazard, or changing the drainage pattern or amount at such a drainage facility or channel for any recurrence interval. The free or unencumbered use of some drainage facility for drainage or other purposes.

PRESCRIPTIVE RIGHT See Prescription.

PRESERVE To perpetuate an existing condition. In highway drainage design, maintaining the natural environmental functions of surface waters as close as practicable to their existing state. See Practicable.

PRESSURE Total load or force acting upon a surface; also appropriately used to indicate intensity of pressure or force per unit area.

PRESSURE HEAD See Head, Pressure. See Subsurface-Water Flow and Solute Transport in the Federal Glossary of Selected Terms *(22).*

PRESSURE, HYDROSTATIC The pressure exerted by the weight of water at any given point in a body of water at rest *(22).*

PRESSURE AND MOMENTUM FORCE The force due to the sum of the pressure and momentum forces caused by moving (flowing) water. See Pressure and Momentum.

PRESSURE, PORE WATER Unit stress (pressure) carried by the water in the pores of a soil mass. Excess negative pressure will displace soil particles. Can be measured with piezometers.

PRESSURE RIDGES Ridges on an ice-sheet over a body of water caused by expansion and consequent upheaval of the ice.

PRINCIPAL SPILLWAY See Spillway, Principle.

PROBABILITY [The science that] deals with the measure of chance or likelihood based on the sampled data *(14).* Compare with Statistic and Statistics.

The ratio of observed or expected events to all possible events; it is expressed as a decimal less than or equal to one *(33).* See X-Percent Chance Flood and Probability.

PROBABILITY DISTRIBUTION Function describing the relative frequency with which events of various magnitudes occur *(34).*

Probability distributions of interest to a hydraulics engineer are: Normal Distribution; Pearson Distributions; Extremal [Extreme] Distributions; Logarithmically Transformed Distributions.

Normal Distribution—A probability distribution that is symmetrical about the mean, median and mode (bell-shaped). It is the most studied distribution in statistics (even though most data are not exactly normally distributed) because of its value in theoretical work and because many other distributions can be transformed into normal. It is also known as Gaussian, the Laplacean, the Gauss-Laplace, the Laplace-Gauss distribution, or the Second Law of Laplace.

This is a symmetrical, bell-shaped, continuous distribution, theoretically representing the distribution of accidental errors about the mean, or so-called Gaussian law of errors [the area under the probability curve is between the variates of -□ and x].

Pearson Distributions—Karl Pearson ...derived a series of probability functions to fit virtually any distribution. Although these functions have only slight theoretical basis, they have been used widely in practical statistical works to define the shape of many distribution curves, [under certain conditions] the resulting Pearson distribution is identical with the normal distribution. Types I and III distributions are often used in hydrologic frequency analysis *(14).*

· Type I—This is a skew [probability] distribution with limited range in both directions, usually bell-shaped but may be J-shaped or V-shaped.

· Type III—This is a skew [probability] distribution with limited range in the left direction, usually bell-shaped but may be J-shaped.

Extremal Distributions—The probability distribution of extreme values. See Extreme Values and Probability Distributions. Extreme value distributions of interest are Type I, II and III *(14).*

· Type I—This [extreme value probability] distribution results from any initial distribution of exponential type which converges to an exponential function as x increases. [-□ < x < □]. Examples of such distributions are normal, the chi-square and the log normal distributions. The Type I distribution is sometimes known as Gumbel distribution since Gumbel first applied it to flood frequency analysis.

· Type II—This [extreme value probability] distribution results from an initial distribution of [the] Cauchy type which has no moments from a certain order and higher [0 □ x < □].

· Type III—This [extreme value probability] distribution results from a type of initial distribution in which x is limited by x □ ε [-□ < x □ ε]. Type III is known as Weibull distribution since Weibull first applied it to the description of the strength of brittle materials although Gumbel also applied it later to drought frequency analysis.

Logarithmically Transformed Distributions—Many probability distributions can be transformed by replacing the variate with its logarithmic value. Three transformed distributions commonly used in hydrologic studies are [Log normal; Log extremal; Truncated Log normal] *(14).*

· Log normal—This is a transformed normal [probability] distribution in which the variate is replaced by its logarithmic value. This distribution represents the so-called Law of Galton because it was first studied by Galton as early as 1875.

· Log extremal—[This is a probability distribution where the] variate x in [the] Type I [Pearson] distribution is replaced by a linear function of the logarithm of x and x - ε [so that] the resulting logarithmically transformed distributions become [Pearson] Type II and Type III distributions respectively.

· Truncated Log normal—[These are] two truncated and shifted logarithmically transformed normal distributions for hydrologic frequency analysis. One is called the partly bounded distribution which has the positive direction of the variate. The other is called the totally bounded distribution which has the maximum and minimum limits of fluctuations from the mean.

Student's t Distribution—A distribution used in [the] evaluation of variables which involve sample standard deviation rather than population standard deviation *(34).* Sometimes referred to as t distribution.

PROBABILITY OF EXCEEDANCE See Exceedance Probability.

PROBABILITY PAPER Any graph paper prepared especially for plotting magnitudes of events versus their frequencies or probabilities. See Log-Normal Paper *(51).*

The cumulative probability of a distribution may be represented graphically on a probability paper which is designed for the distribution. On such paper the ordinate usually represents the value of x [flood magnitude] in [a] certain scale and the abscissa represents the probability P(X □ x) or P(X □ x) [actually P(X > x) or P(X < x)—Ed.] or the recurrence interval T [or frequency T]. The ordinate and abscissa scales are so designed the distribution plots as a straight line and the data to be fitted appear close to a straight line. The objective of using the probability paper is to linearize the distribution so that the plotted data can be easily analyzed for extrapolation or comparison purposes. In the case of extrapolation, however, the effect of sampling errors is often magnified *(14).* See Probability Distribution and Probability Plotting Position.

PROBABILITY PLOTTING POSITION When a probability paper is chosen for use, the plotting of data on the paper requires the knowledge of [probability] plotting positions. Numerous methods have been proposed for the determination of plotting positions. Most of them are empherical *(14).* Nine probability plotting position formulae are of interest to hydrologists. With N = total number of items, m = order number of items arranged in descending magnitude (i.e., m = 1 for the largest item): 1. California, N/m; 2. Hazen, 2N/(2m - 1); 3. Weibull (and Gumbel), (N + 1)/m; 4. Beard, $1/(1 - 0.5^{1/n})$; 5. Chegodayev, (N + 0.4)/(m - 0.3); 6. Blom, (N + 1/4)/(m - 3/8); 7. Tukey, (3N + 1)/(3m - 1); 8. Gringorten, (N + 0.12)/(m - 0.44). Paraphrased from *Handbook of Applied Hydrology (14).*

PROBABLE MAXIMUM FLOOD See Flood, Probable Maximum.

PROBABLE MAXIMUM PRECIPITATION See Precipitation, Probable Maximum.

PROFILE A graphical representation of elevation plotted against distance. In open channel hydraulics a water surface profile is a plot of water surface elevation against channel distance. See Hydraulic Grade Line and Water Surface Profile.

PROFILE GRADE The trace of a vertical plane intersecting any given roadway surface as shown on the plans. Profile grade means either elevation or gradient of such trace according to the context.

PROFUNDAL ZONE The underlying deep, dark region of the waterbody where light penetration is insufficient to support the production of green plants. Compare with Littoral Zone and Limnetic Zone.

PROJECT The specific section of highway, together with all appurtenances and construction to be performed under a contract.

PROJECT DESIGN FLOOD See Flood, Project Design.

PROJECT FLOOD See Flood, Project.

PROJECT HYDROLOGY The designated design flood predicting practice(s) to be used for the design of drainage facilities on a particular highway project.

PROJECTING ENTRANCE See Inlet, Projecting.

PROMONTORY A high ridge of land or rock extending out into a sea or other expanse of water.

PROTOZOA Any of the single-celled, usually microscopic organisms of the phylum or subkingdom.

PULS METHOD See Storage-Indication Method.

QUARRY-RUN-STONE Natural material, often used for stream bank protection, as received from a quarry without regard to gradation requirements.

RACK A screen composed of parallel bars to catch floating debris.

RADIO RELAYS Repeating or relaying devices that transfer data from a self-reporting gage to a base stations *(33).*

RADIO REPEATERS See Radio Relays.

RAILBANK PROTECTION A type of countermeasure composed of rock-filled wire fabric and supported by steel rails or posts driven into the channel bed and used for such things retards, riparian spur dikes and training dikes.

RAIN Liquid precipitation *(37).* Also, precipitation in the form of water. Usage includes snow and hail in the term.

RAINFALL The quantity of water that falls as rain only. Not synonymous with precipitation *(37).* Compare with Precipitation.

RAINFALL, EFFECTIVE [Sometimes used as] another term for direct runoff. Usually not the same quantity on upland streams as on downstream rivers because of variability of seepage flows *(51).* Compare with Runoff, Direct; and Precipitation, Effective.

RAINFALL EXCESS The volume of rainfall available for direct runoff. It is equal to the total rainfall minus interception, depression storage and absorption *(2).* Not the same as excessive rainfall. Direct runoff at the place where it originates *(51).* Compare with Rainfall, Excessive; and Rainfall, Effective.

RAINFALL, EXCESSIVE Rainfall in which the rate of fall is greater than certain adopted limits, chosen with regard to the normal precipitation (excluding snow) of a given place or area. In

the National Weather Service, it is defined, for States along the southern Atlantic coast and the Gulf coast, as rainfall in which the depth of precipitation is 0.9 inches (22 mm) at the end of 30 minutes and 1.5 inches (38 mm) at the end of an hour and for the rest of the country as rainfall in which the depth of precipitation at the end or each of the same periods is 0.5 inch (13 mm) and 0.8 inch (20 mm), respectively *(37).*

Standard USWB (NWS) term for "rainfall in which the rate of fall is greater than certain adopted limits, chosen with regard to the normal precipitation (excluding snow) of a given place or area." Not the same as excess rainfall *(51).* Compare with Rainfall, Excess.

RAINFALL INTENSITY Amount of rainfall occurring in a unit of time, converted to its equivalent in inches per hour at the same rate.

RAINFALL, POINT Rainfall at a single rain gage *(51).*

RAPID DRAWDOWN See Drawdown, Rapid.

RAPIDLY VARIED FLOW See Flow, Rapidly Varied.

RAPIDS One of two definitions may apply: 1. a term used by some for "chute"; 2. swift and turbulent flow, without pronounced falls.

RAPTOR A bird of prey.

RARE SURFACE WATERS See Surface Waters, Rare.

RATE OF RISE Indicates how quickly a stream is rising, typically expressed in feet per hour or meters per hour; feet per day or meters per day *(33).*

RATING Three definitions are provided: 1. the relation, usually determined experimentally, between two mutually dependent quantities, such as stage and discharge of a stream; 2. a calibration of current-meter vane revolutions versus water velocity, etc.; calibration; 3. the taking of measurements or the making of observations to establish a rating or calibration.

RATING CURVE A graph of the discharge of a river at a particular point as a function of the elevation of the water surface *(33).* A graphic (or tabular) representation of rating; a calibration; a curve (table) relating stage to discharge. Compare with Stage-Discharge Curve.

RATING FLUME There are two types of rating flumes: 1. an open conduit built in a channel to maintain a consistent regime for the purpose of measuring the flow and developing stage-discharge relation; 2. a flume containing still water for rating current meters, Pitot tubes, etc.

RATIONAL FORMULA An empherical equation for estimating the flood discharge given as Q = CIA/360, where Q = peak discharge, C = a runoff coefficient, I = rainfall intensity in inches per hour for a duration equal to the concentration time of the basin and A = area of basin in

acres. The original formula is based on the approximation that 1 inch/hour/acre = 1 cubic foot a second

RE-REGULATING RESERVOIR See Reservoir Re-Regulating.

REACH A segment of stream or valley, selected with arbitrary bounds for purposes of study. A comparatively short length of a stream or channel.

"General Introduction and Hydrologic Definitions" *(37)* offers five definitions: 1. the length of channel uniform with respect to discharge, depth, area and slope; 2. the length of a channel for which a single gage affords a satisfactory measure of the stage and discharge; 3. the length of a river between two gaging stations; 4. more generally, any length of a river; 5. a length of stream or valley, selected for convenience in a study. See Damage Reach and Stream Reach.

REASONABLE USE DOCTRINE AND RULE A rule under which, in some jurisdictions, a riparian owner, acting in good faith and for a legitimate purpose, may use and/or alter the natural flow of water from his land without liability to other owners, so long as such use and action is reasonably necessary and beneficial and reasonable care is taken to avoid unnecessary injury or hindrance to the use of the land below. Compare with Common Enemy Doctrine or Rule, Civil Law Doctrine or Rule, and Natural Drainage Doctrine and Rule.

RECEIVING WATER "Natural" [Any—Ed.] body of water that one or more catchments enter into (i.e., stream, tributary, river, estuary, bay, lake, et cetera) *(1).*

RECESSION CURVE [That portion of] a hydrograph showing the decreasing rate of runoff following a period of rain or snowmelt. Since direct runoff and base runoff recede at different rates, separate curves, called direct runoff recession curves and base runoff recession curves, respectively are generally drawn. The term "depletion curve" in the sense of base runoff recession is not recommended *(37).*

The receding portion of a hydrograph, occurring after excess rainfall has stopped *(51).*

RECHARGE Addition of water to the zone of saturation from precipitation or infiltration *(22).* The process of adding water to the saturated zone; also, the water added. For constructed recharge facilities, see Basin, Recharge.

RECHARGE AREA An area in which water reaches the zone of saturation by surface infiltration *(22).* See Recharge.

An area in which there are downward components of hydraulic head in the aquifer. Infiltration moves downward into the deeper parts of an aquifer in a recharge area *(20).*

RECHARGE BASIN See Basin, Recharge.

RECORDER A device that makes a graph of the stage, pressure, depth, velocity, or the movement or position of water-controlling devices. See Indicator and Register.

RECORDING GAGE See Water-Level (Stage) Recorder.

RECOVERY AREA A clear zone which includes the total roadside border area, starting at the edge of the traveled way, available for safe use by errant vehicles. This area may consist of a shoulder, a recoverable slope, a non-recoverable slope and/or a clear run-out area. The desired width is dependent upon the traffic volumes and speeds and on the roadside geometry.

RECTANGULAR WEIR See Weir, Rectangular.

RECURRENCE INTERVAL See Flood Frequency.

REFUSAL Erosion-resistant material placed in a trench (excavated landward) at the upstream end of a revetment to prevent flanking.

REGIME The condition of a stream and its channel as regards to their stability. A river or canal is "in regime" if its channel has reached a stable form as a result of its flow characteristics.

General pattern of variation around a mean condition, as in such things as flow regime, tidal regime, channel regime and sediment regime; used also to mean a set of physical characteristics of a river. The system or order characteristic of a stream; its behavior with respect to such things as velocity and volume, form of and changes in channel, capacity to transport sediment and amount of material supplied for transportation. Compare with Regime Channel; Channel, Stable; and Stream, Poised.

REGIME CHANGE A change in channel characteristics resulting from such things as changes in imposed flows, sediment loads or slope.

REGIME CHANNEL Alluvial channel that has attained more or less a state of equilibrium with respect to erosion and deposition. Compare with Stream, Poised; and Channel, Stable.

REGIME FORMULA A formula relating stable alluvial channel dimensions or slope to discharge and sediment characteristics.

REGIME OF A STREAM The system or order characteristic of a stream; in other words, its habits with respect to velocity and volume, form of and changes in channel, capacity to transport sediment and amount of material supplied for transportation. The term is also applied to a stream which has reached an equilibrium between erosion and deposition or, in other words, to a graded stream *(11).* See Stream, Poised; Stream Graded; and Regime Channel.

REGIME THEORY "Regime theory" is a theory of the forming of channels in material carried by the streams. As used in this sense, the word "regime" applies only to streams that make at least part of their boundaries from their transported load and part of their transported load from their boundaries, carrying out the process at different places and times in any one stream in a balanced or alternating manner that prevents unlimited growth or removal of boundaries. A stream, river, or canal of this type is called a "regime stream, river, or canal." A regime channel is said to be "in regime" when it has achieved average equilibrium; that is, the

average values of the quantities that constitute regime do not show a definite trend over a considerable period (generally of the order of a decade). In unspecialized use, "regime" and "regimen" are synonyms *(10).* See Stream, Poised; Regime, Channel; and Channel, Stable.

REGIMEN In unspecialized use "regime" and "regimen" are synonyms *(37).* See Regime, Regime Theory, and Regime of a Stream.

REGIONAL ANALYSIS Flood-frequency [relationships] lines for gaged watersheds in a similar [homogeneous physiographic] area or region are used to develop a flood-frequency line for an ungaged watershed in that [same] region. Also used with other types of hydrologic data. Method is a simple (usually graphical and freehand) form of "regression analysis" used by statisticians *(51).*

A statistically based regional study of gaged stream data from a homogeneous physiographic region which produces regression equations relating various watershed and climatological parameters to such things as discharge frequency for application on ungaged streams. Used to formulate methods of predicting flood-frequency relationships for the hydraulic design of drainage facilities in hydrologically similar ungaged watersheds having characteristics similar to those used in the regression analysis.

REGIONAL FLOOD OF RECORD Maximum flood known or recorded in a drainage area. Peak flood flows from thousands of sites (Crippin and Bue, WSP-1987) in the conterminous U.S. were plotted against drainage area. An enveloping curve for each hydrologic area provides an estimate of maximum floods within drainage basins *(16).*

REGISTER One of two definitions may apply: 1. a device that notes quantities; it may make a graph or a printed or stamped record by figures or symbols on a dial or on an assembly of dials, indicate by pointer, index, or otherwise note such quantities as stage, pressure, velocity, depth, or quality; it may note the movement or position of water-controlling devices as gates or valves; a gage, indicator, or recorder; 2. to note such quantities. See Indicator, Recorder, and Gage.

REGULATED RIVER OR STREAM See River, Regulated.

REGULATION The artificial manipulation of the flow of a stream *(37).*

REGULATIONS Formal instructions or rules governing the application and administration of specified legislative acts, which have the force and effect of law. As used in the CFR, rule and regulation have the same meaning.

REGULATORY FLOOD The 100-year flood, which was adopted by the FEMA, as the base flood for most floodplain management purposes. See Flood, Base.

REGULATORY FLOODWAY The floodplain area that is reserved in an open manner by Federal, State, or local requirements, i.e., unconfined or unobstructed either horizontally or vertically,

to provide for the discharge of the base flood so that the cumulative increase in water surface elevation is no more than a designated amount. May also be considered as: 1. a channel and floodplain regulated by an agency having jurisdiction over dredge and fill activities; or 2. a channel and floodplain requiring approval for a channel change or flood storage. Compare with Floodway.

REGULATORY WATERS See Navigable Waters.

REINFORCED REVETMENT A channel bank protection method consisting of a continuous stone toe-fill along the base of a bank slope with intermittent fillets of stone placed perpendicular to the toe and extending back into the natural bank. Compare with Peaked Stone Dike.

REINFORCED-EARTH RETAINING WALL A retaining structure consisting of vertical panels and attached to reinforcing elements embedded horizontally in compacted backfill for supporting a natural or artificial channel bank (a specific type of bulkhead).

RELIEF BRIDGE See Bridge, Relief.

RESERVOIR A pond, lake, or basin, either natural or artificial, for the storage, regulation and control of water *(37).* Reservoirs regulate floods downstream from the dam by temporarily storing some part of the flood volume and releasing it later. The impact downstream is to lower flood stages, increase the duration of flooding and shift the flood to a later time. It is normal for dam and reservoir projects to effect some control on and lower flood stages for, all magnitudes of floods *(30).*

RESERVOIR, RE-REGULATING A reservoir for reducing diurnal fluctuations resulting from the operation of an upstream reservoir for power production *(37).*

RESERVOIR, RETARDING Ungated reservoir for temporary storage of floodwaters. Sometimes called detention reservoir *(37).* Compare with Floodwater Retarding Structure; Basin, Retention; and Basin, Detention.

RESERVOIR ROUTING Flood routing through a reservoir *(51).* Flood routing of a hydrograph through a reservoir taking into account reservoir storage, spillway, and outlet works discharge relationships.

RESIDENCE TIME The time that water stays in lake with no outlet, or with a very limited outlet. May also refer to the time floodwaters for a given frequency flood are expected to be detained in a retention basin, retarding reservoir, recharge basin, or flood control reservoir.

RESIDUAL-MASS CURVE A graph of the cumulative departures from a given reference such as the arithmetic average, generally as ordinate, plotted against time or date, as abscissa *(37).* See Mass Curve.

RESPONSE SYSTEM The planned protective reaction to flooding or the threat of flooding *(33).*

RESTORABLE SURFACE WATERS Surface waters and wetlands having functions and values diminished by human impacts that can be restored through various management techniques.

RESTORE To re-establish to the extent practicable a geometry, setting, or environment in which the essential elements of the natural surface waters such as floodplains, shores, riparian areas, and channel as well as any previously existing constructed features can again function as they did prior to a highway action. See Practicable.

RETAINING WALL With drainage design, a structure used to maintain an elevation differential between the water surface and top bank while at the same time preventing bank erosion and instability.

RETARD A channel bank protection technique consisting of such things as wire mesh, chain-link, steel rails, or timber-framed fence attached to a series of posts, sometimes in double rows; the space between the rows may be filled with rock, brush, or other suitable permeable materials. Fences may be placed either parallel to the bank and/or extended into the channel; in either case these structures decrease the stream velocity and encourage sediment deposition as the flow passes through the fence. Explained another way, a frame structure, filled with earth or stone ballast, designed to absorb energy and to keep erosive channel flows away from a bank. A retard is designed to decrease velocity and induce sediment deposition or accretion. Retard type structures are permeable structures customarily constructed at and parallel to the toe of a highway fill-slope and/or channel banks. A permeable or impermeable linear structure in a channel, parallel with the bank and usually at the toe of the bank, intended to reduce flow velocity, induce deposition, or deflect flow from the bank.

RETARDING RESERVOIR See Reservoir, Retarding.

RETENTION BASIN See Basin, Retention.

RETURN FLOW OR WATER See Flow, Return.

RETURN PERIOD See Flood Frequency.

REVETMENT Rigid or flexible armor placed on a bank or embankment as protection against scour and lateral erosion. Compare with Armor, Blanket, and Mattress.

REVIEW FLOOD (OR STORM) SYSTEM Drainage facility (or storm drain system) that uses both natural terrain and constructed features to provide for conveyance of runoff in excess of the design flood (or storm system) so as to minimize an increase in the flood hazard from a catastrophic flood (or storm). Flood control facility (or storm drain system) designed through use of prudent judgment and the review flood (or storm runoff).

REVIEW FLOOD (OR STORM) See Flood (or Storm), Review.

REVIEW STORM SYSTEM See Review Flood (or Storm) System.

REYNOLDS NUMBER The effect of viscosity relative to inertia or R = (VL)/v where V is the velocity of flow, L is a characteristic length, and v (nu) is the kinematic viscosity of the liquid.

RFR Acronym for Regional Flood of Record or Review Flood of Record.

RI Acronym for Recurrence Interval.

RIFFLE A rapid in a stream *(37).* Shallow rapids in an open channel, where the water surface is broken into waves by obstructions wholly or partly submerged. A natural shallow flow area extending across a channel bed in which the surface of flowing water is broken by waves or ripples. Typically, riffles alternate with pools along the length of a channel.

RIFFLE-POOL RATIO The sum of the riffle lengths divided by the sum of the pool lengths expressed in percent for a given reach. These lengths are usually measured at a relatively low stage.

RIGHT BANK OF A CHANNEL The right-hand bank of a channel when the observer is looking downstream. Compare with Left Bank of a Channel.

RILL Very small brook or channel made by a small stream, according to *Webster's New Collegiate Dictionary.* A small trickle flowing well within the low flow channel or thalweg.

RIGHT-OF-WAY A general term denoting land, property, or interest acquired for, or devoted to highway purposes.

RIPARIAN Pertaining to the banks of a stream *(37).* Of, on, or pertaining to the bank of a channel or the shore of a pond or a lake. Pertaining to anything connected with or adjacent to the banks of a channel or other body of water; a riparian owner is one who owns the banks.

RIPARIAN DOCTRINE OR RULE A doctrine that holds that the property owner adjacent to a surface water body has first right to withdraw and use the water *(20).* This doctrine may be set aside by a state's statutory law that holds that all surface waters are the property of the state. See Water Right, Flood Right, and Statutory Law.

RIPARIAN OWNER A riparian proprietor who owns land on the bank of a river, lake, channel or other body of water. An owner of land, in part bounded generally by a stream or river of water and having a qualified property in the soil to the [thalweg] thread of the channel with the privileges annexed thereto by law. Compare with Riparian Doctrine or Rule and Water Right.

RIPARIAN PROPRIETOR See Riparian Owner.

RIPARIAN RIGHTS The rights of the owners of lands along a watercourse, relating to such things as water, its use, ownership of soil under the stream or river and accretions. The legal right of a riparian owner to use the water on his riparian land originated in the common law, which

permitted him to require that the waters of a stream or river reach his land undiminished in quantity and unaffected in quality except for minor domestic uses. Compare with Riparian Doctrine or Rule and Water Right.

RIPARIAN SPUR DIKE See Dike, Riparian Spur.

RIPARIAN WATER Water which is below the highest line of normal flow of a river or stream, as distinguished from floodwaters. Compare with Floodwaters.

RIPPLE Two definitions may apply: 1. the light fretting or ruffling of a water surface caused by a breeze; 2. undulating ridges and furrows, or crests and troughs formed by action of the flow.

RIPRAP Stones, masonry, or similar constructed material such as broken concrete placed in a loose assemblage along such things as the banks and bed of a channel or the shore of a lake, pond, gulf, bay, or ocean to inhibit erosion and scour. Broken stone or concrete placed on earth surfaces for their protection against the erosive action of water; also, sometimes applied to brush or pole mattresses, or brush and stone, or other similar materials used for protection. In the restricted sense, layer or facing of broken rock or concrete dumped or placed to protect a structure or embankment from erosion and scour; also, the broken rock or concrete suitable for such use. The term "riprap" has also been applied to almost all kinds of armor, including such things as wire-enclosed riprap, grouted riprap, sacked concrete and concrete slabs. Compare with Riprap, Stone; Riprap, Wire-Enclosed; and Riprap, Plated.

RIPRAP, PLATED A dense layer of riprap which results from the successive dropping of a heavy, steel plate onto the riprap from a position above the riprap. The plate is raised into dropping position by a crane or similar machine.

RIPRAP, STONE Natural cobbles, boulders, or rock preferably of a specified gradation dumped or placed on a channel bank and/or channel bed (commonly with an underlying filter) as protection against erosion. Compare with Riprap, Blanket, and Mattress.

RIPRAP, WIRE-ENCLOSED Relatively flat mattresses, cylindrical wire cages, or baskets filled with stone or other suitable material of a specified gradation and placed on a stream bank or bed, often with an underlying filter and used as protection against erosion and scour. Sometimes staked in-place with steel pipe or rail that passes through the mattresses, cages or baskets into the underlying embankment. Usually used as a mattress (see Mattress) rather than in combinations to construction stream and river structures using gabions. Compare with Gabion.

RISE Terminology used with culverts (and similar type openings) as the vertical height dimension of a box, pipe-arch, and arch structure, as in Span X Rise. Compare with Span. Can also mean the increase in river stage; a flood; a peak.

RISING LIMB The rising portion of a hydrograph preceding a crest *(33).*

RIVER Natural stream of water of considerable volume. Depending on local usage, a larger form of a stream. See Channel.

RIVER, CONTROLLED A river and attendant floodplain that is regulated by such constructed devices as dams, flood control measures, navigational locks and diversions. Occasionally natural controls may exist such as natural diversions, sinks, deep sand beds, porous geology strata, etc. that also exert some measure of control or regulation of a river. Sometimes a controlled river is referred to as a regulated river. Compare with River, Regulated.

RIVER FORECAST CENTERS The organizational units within the National Weather Service that forecast floods *(33).*

RIVER MECHANICS Term for the practices that relate the physical laws governing channels, streams, and rivers to practicable engineering applications. Compare with Potomology.

RIVER, REGULATED A river and attendant floodplain that is subject to such things as governmental regulations and/or interstate compacts. May also be a river that is controlled by constructed or natural measures. Compare with River, Controlled.

RIVER TRAINING The practice of employing structural measures to try and force a stream or river channel to perform in a specified manner. See Channelization and River Training Structures. Compare with Non-Structural Measures.

RIVER TRAINING STRUCTURE Any configuration of structural measures constructed in a channel or placed on, adjacent to, or in the vicinity of a channel bank that is intended to deflect currents, induce sediment deposition, induce scour, or in some other way alter the flow and sediment regimes of a stream, or river channel.

RIVER TRAINING WORKS See River Training Structures.

ROAD A general term denoting a public way for purposes primarily of vehicular travel and includes the entire area within the right of way; generally with emergency parking areas adjacent to the traveled ways (shoulders), but without curb and gutters. The portion of a road within the limits of construction. Compare with Street.

ROADBED The graded portion of a highway within top and side slopes, prepared as a foundation for the pavement structure and shoulder.

ROADWAY CROSS-SLOPE Transverse slope and/or superelevation described by the roadway section geometry. Usually provided to facilitate drainage and/or resist the centrifugal force of a moving vehicle.

ROADSIDE A general term denoting the area adjoining the outer edge of the roadway. Extensive area between the roadways of a divided highway (not necessarily the median) may also be considered roadside.

ROADSIDE DEVELOPMENT Those items necessary to complete a highway which provide for: 1. preservation of landscape materials and features; 2. the rehabilitation and protection against erosion of all areas disturbed by construction, seeding, sodding, mulching and the placing of other ground covers; and 3. such suitable planting and other improvements as may increase the effectiveness and enhance the appearance of the highway.

ROCK-AND-WIRE MATTRESS See Riprap, Wire-Enclosed.

ROD-FLOAT A rod or staff designed to float in a practically vertical position for the purpose of observing velocities.

ROOT ZONE The zone from the land surface to the depth penetrated by plant roots. The root zone may contain part or all of the unsaturated zone, depending upon the depth of the roots and the thickness of the unsaturated zone *(20).*

ROUGHNESS See Roughness Coefficient.

ROUGHNESS COEFFICIENT The estimated measure of texture at the perimeters of channels and conduits. Usually represented by the "n value" coefficient used in Manning's channel flow equation. Numerical measure of the frictional resistance to flow in a channel, as in the Manning or Strickler equations. See Channel Coefficient, Manning's Equation, Manning's n, and Chezy Equation.

RUBBLE Rough, irregular fragments of random size placed on a channel bank or shore to retard erosion. The fragments may consist of broken concrete slabs, masonry, or other suitable refuse.

RULE An established guide for action. A rule may not be authoritatively enforced, but is generally observed in the interest of such things as order and uniformity. A formal decree, as by court decision. Such rules constitute a large portion of the body of common law. Compare with Rule of Law and Doctrine.

RULE OF LAW A legal principle of general application, sanctioned by the recognition of authorities and usually expressed as a maxim or a logical proposition. Called a "rule" because in doubtful or unforeseen cases it is a guide or norm for making decisions. Compare with Rule and Doctrine.

RUN Term of regional geographic use. See Channel.

RUNOFF Surface Water, Stream Water and Floodwater as defined in Volume V of the *Highway Drainage Guidelines.* That part of the precipitation which runs off the surface of a drainage area after accounting for all abstractions. The portion of precipitation that appears as flow in streams; total volume of flow of a stream during a specified time.

That part of the precipitation that appears in surface streams. It is the same as streamflow unaffected by artificial diversions, storage, or other works of man in or on the stream channels *(37).*

The total amount of water flowing in a stream. It includes Overland Flow, Return Flow, Interflow and Base Flow *(20).*

Runoff may be classified as to:

speed of appearance after rainfall or snow melting:

· direct runoff and
· base runoff; and

source:

· surface runoff (see Overland Flow),
· storm seepage, and
· groundwater runoff.

Compare with Discharge; Runoff; and Runoff, Base.

RUNOFF, ANNUAL The total natural discharge of a stream for a year, usually expressed in inches of depth or acre feet.

The total amount of water obtained in a year from such things as a stream, spring, or artesian well. Usually expressed in inches or inches of depth; acre feet; millions of gallons or liters; cubic feet or cubic meters *(51).*

The runoff from the drainage basin, including groundwater outflow that appears in the stream plus groundwater outflow that bypasses the gaging station and leaves the basin underground. Water yield is the precipitation minus the evapotranspiration *(37).*

The actual streamflow, at a given place, from a watershed. This is natural annual runoff that may be affected by irrigation uses, reservoir losses, diversions into or out of the watershed, etc. *(51).*

RUNOFF, BASE Sustained or fair weather runoff. In most streams, base runoff is composed largely on groundwater effluent. [Other terms] are often used in the same sense as base runoff groundwater runoff, direct runoff, base discharge and base flow. However, the distinction is the same as that between streamflow and runoff. When the concept in the terms base flow and base runoff is that of the natural flow in a stream, base runoff is the logical term *(37).*

That part of the stream discharge that is not attributable to direct runoff from precipitation or melting snow; it is usually sustained by groundwater discharge *(22).* That part of a stream

discharge derived from groundwater seeping into the stream *(20).* Contribution of groundwater to runoff *(1).*

Stream discharge derived from groundwater sources. Sometimes considered to include flows from regulated lakes or reservoirs. Fluctuates much less than storm runoff *(51).* See Runoff. Compare with Runoff, Direct.

RUNOFF COEFFICIENT A factor representing that portion of runoff which results from a unit of rainfall. Dependent on terrain and topography. The rate of runoff to precipitation.

RUNOFF, DIRECT The runoff entering stream channels promptly after rainfall or snowmelt. Superposed on base runoff, it forms the bulk of the hydrograph of a flood. See Surface Runoff. The terms base runoff and direct runoff are time classifications of runoff. The term surface runoff is classified according to source *(37).*

The water that enters the stream channels during a storm or soon after, forming a runoff hydrograph. May consist of rainfall on the stream surface, surface runoff and seepage of infiltrated water (rapid subsurface flow) *(51).*

See Runoff. Compare with Runoff, Base.

RUNOFF, "FIRST FLUSH" The condition, often occurring, in which a disproportionately high pollution load is carried in the first portion of urban runoff *(1).*

RUNOFF IN INCHES The depth to which the drainage area would be covered if all the runoff for a given time period were uniformly distributed on it *(52).*

RUNOFF, SUBSURFACE Water that infiltrates the soil and reappears as seepage or spring flow and forms part of the flood hydrograph for that storm. Difficult to determine in practice and seldom worked with separately. See Direct Runoff *(51).* See Storm Seepage.

RUNOFF, SURFACE That part of the runoff which travels over the soil surface to the nearest stream channel. It is also defined as that part of the runoff of a drainage basin that has not passed beneath the surface since precipitation. The term is misused when applied in the sense of direct runoff. See also Runoff, Overland Flow, Direct Runoff, Groundwater Runoff, and Surface Water *(37).*

Total rainfall minus interception, evaporation, infiltration and surface storage and which moves across the ground surface to a stream or depression *(51).*

RUNOFF, URBAN Storm-generated surface runoff from an urban drainage area. The term may relate to either the quantity or quality of the runoff or both, depending upon its application *(1).*

RUN-UP, WAVE See Wave Run-up.

S.D. (s.d.) Acronym for standard deviation *(51).*

SACK REVETMENT Stream bank protection consisting of sacks (e.g., burlap, paper, or nylon) filled with such things as mortar, concrete, sand, stone, or other available material placed on a bank to serve as protection against erosion.

SALTATING Bed load particles that skip along the bed while being transported by streamflows. See also Bed Load.

SALTATION LOAD That portion of the total sediment load bounced along the stream bed by energy and turbulence of flow and by other moving particles. Compare with Bed Load and Sediment Load.

SAMPLE An element, part, or fragment of a population. Every hydrologic record is a sample of a much longer record *(34).* Compare with Population.

SAMPLING See Gaging/Sampling.

SAND Soil material that can pass the No. 4 (4.76 mm) U.S. Standard Sieve and be retained on the No. 200 (0.074 mm) sieve. FHWA, HIRE, 1987. Granular material that is smaller than 2.0 mm and coarser than 0.062 mm. FHWA, HIRE, 1990.

SATURATED SOIL Soil that has its interstices, pores, or void spaces filled with water to the point at which runoff occurs.

SATURATED ZONE See Zone of Saturation.

SCOUR The displacement and removal of channel bed material due to flowing water; usually considered as being localized as opposed to general bed degradation or headcutting. The result of the erosive action of running water which excavates and carries away material from a channel bed. Compare with Erosion, Abrasion, Lateral Erosion, Mass Wasting, and Sloughing.

SCOUR, BENDWAY That component of natural scour consisting of the removal of material from the channel bed or banks which occurs along the concave (outside) bank in a channel bendway located, generally, across the channel from any point bar.

SCOUR, CONTRACTION The response of a river or drainage facility (such as bridge) to the change in its bed load requirement as a result of a natural or constructed contraction of flow; i.e., the flow contraction is due to an encroachment of either the main channel or the floodplain by a natural constriction or the highway embankment. Compare with Scour, General.

SCOUR, GENERAL Scour in a channel or on a floodplain that is not localized at a pier, abutment, bendway, or other obstruction to flow. In a channel, general scour usually affects all or most of the channel width; i.e., general scour involves the removal of material from the bed across

all or most of the width of a channel as a result of a natural flow contraction which causes increased velocities and bed shear stress. Compare with Scour, Contraction.

SCOUR, LOCAL Removal of material from the channel bed or banks which is restricted to a relatively minor part of the width of a channel. Scour in a channel or on a floodplain that is localized at a pier, abutment, or other obstruction to flow. Local scour is caused by the acceleration of the flow and the development of a vortex system induced by the obstruction to the flow. Does not include the additional scour caused by any contraction, natural channel degradation, or bendway.

SCOUR, MEASURED The measured depth to which a surface is lowered by scour below a reference elevation.

SCOUR, NATURAL Removal of material from the channel bed or banks which occurs in channels due to the migration of bed forms, shifting of the thalweg, and at bendways and natural contractions. Scour which occurs along a channel reach due to natural causes or an otherwise unstable stream; i.e., no external, constructed causes.

SCOURED DEPTH Total depth of the water from water surface to a scoured channel bed. Compare with Depth of Scour.

SCUPPER A device and/or vertical hole through such things as bridge decks or roofs for the purpose of deck or roof drainage. Sometimes a horizontal opening in the curb or barrier is called a scupper.

SEASONAL STREAM See Stream, Intermittent.

SECCHI DISK A disk-type device that, when lowered into surface waters, measures their clarity.

SECOND LAW OF LAPLACE See Probability Distribution.

SECOND-FOOT Same as cubic foot per second. Generally, this term is no longer used in published reports of Federal agencies *(37).*

See cfs in the *National Engineering Handbook (51).* A term, although incorrect, which is sometimes used in verbal discussions in place of "cubic feet per second." Compare with Cubic Feet Per Second.

SEDIMENT Fragmental material that originates from weathering of rocks and is transported by, suspended in, or deposited by water or air or is accumulated in beds by other natural agencies *(15).* Compare with Sediment, Fluvial.

SEDIMENT CONCENTRATION Weight or volume of sediment relative to quantity of transporting or suspending fluid or fluid-sediment mixture.

SEDIMENT DISCHARGE, SUSPENDED The rate at which the dry weight of sediment passes a section of a stream [or river,] or is the quantity of sediment (as measured by dry weight, or by volume) that is discharged in a given time *(15).* The quantity of sediment that is carried past any cross section of a stream or river above the bed layer in a unit of time. Discharge may be limited to certain sizes of sediment or to a specific part of the cross section. Compare with Bed Load Discharge; Sediment Load, Suspended; Sediment Yield; and Wash Load.

SEDIMENT DISCHARGE, TOTAL The sum of suspended sediment discharge and bed load discharge or the sum of bed material discharge and wash load discharge of a stream or river. See Wash Load.

SEDIMENT, FLUVIAL Fragmental material transported, suspended, or deposited by water. Compare with Sediment.

SEDIMENT LOAD, SUSPENDED Sediment that is supported by the upward components of turbulent currents in a stream and that stays in suspension for an appreciable length of time. Compare with Sediment Discharge, Suspended; and Wash Load.

SEDIMENT POOL [That portion of the total] reservoir storage [expressedly] provided for sediment, thus prolonging the usefulness of floodwater or irrigation pools *(51).*

SEDIMENT YIELD The total sediment outflow from a watershed or a drainage area at a point of reference and in a specified time period. This outflow is equal to the sediment discharge from the drainage area. Compare with Sediment Discharge, Suspended.

SEDIMENTATION The process involving the deposition of soil particles which have been carried by floodwaters. Sometimes erroneously termed "silting" by those unfamiliar with sediment transport and deposition as the deposited material does not necessarily contain much, if any material classified as silt. Compare with Aggradation.

SEDIMENTATION BASIN See Basin, Sedimentation.

SEEPAGE The slow movement of water through small cracks and pores of the bank material.

SEICHE The free oscillation of the bulk of water in a lake and the motion caused by it on the surface of the lake *(7).*

Long-period oscillation of a lake or similar body of water. An oscillation of the water surface of a lake or other large land-locked body of water due to unequal atmospheric pressure, wind, landslides, earthquakes, or other causes, which sets the surface in vibration. Waves that oscillate in lakes, bays, and gulfs from a few minutes to a few hours. Also associated with hurricanes on waters which are not landlocked.

SEISMIC WAVE A gravity wave caused by an earthquake.

SELF-REPORTING GAGE See Gage, Self-Reporting.

SEMI-ARID Geographic areas characterized by light rainfall. More specifically, having from about 10 inches (250 mm) to about 20 inches (500 mm) of annual precipitation. Compare with Arid and Desert.

SEMILOG PAPER Short for "semilogarithmic graph paper," which is graph paper having an arithmetic scale along one axis and a logarithmic scale along the other. Either scale is used for the independent variable, as the data require. Commercially available paper has various divisions for the arithmetic scale and various cycles for the logarithmic side [scale] *(51).* Compare with Log Paper and Log-Normal Paper.

SENSITIVE SURFACE WATERS See Surface Waters, Sensitive.

SET-DOWN See Wind Set-Down.

SET-UP See Wind Set-Up.

SEWER A conduit for conveying sanitary waste flows. Compare with Storm Sewer; Sewer, Combined; and Drain, Storm.

SEWER, COMBINED A sewer that conveys stormwater and, at times, sanitary sewage. See Sewer; and Drain, Storm.

SEWER, STORM Principally a drain for conveying stormwater, but at least part of the time, a drain which also conveys raw sewage is termed a storm sewer. Compare with Design Flood (or Storm) System; Sewer; and Sewer, Combined.

SHALLOW WATER WAVE See Wave, Shallow Water.

SHARP-CRESTED WEIR See Weir, Sharp-Crested.

SHEAR FORCE See Tractive Force.

SHEET FLOW See Flow, Overland.

SHIFTING CONTROL See Control *(37).*

SHOAL A place in any body of water where the water is especially shallow. A sandbank or sandbar. Compare with Shoaling.

SHOALING The process of deposition of alluvial material resulting in areas with relatively shallow depth (shoals). Compare with Shoal.

SHOOTING FLOW See Flow, Supercritical.

SHORE Interface between the land and the waters of a lake or pond. See Coast Line.

SHOULDER The portion of the roadway contiguous with the traveled way for accommodating stopped vehicles, for emergency use, and for lateral support of the road's base and surface courses.

SHORE LINE See Coast Line and Shore.

SHORT-TERM DEGRADATION A regulatory term for adverse surface water impacts or losses (generally associated with surface water quality) which essentially disappear within some arbitrary period of time (usually one year) following the disturbance from a highway action.

SIDE SLOPES The slope of the sides of a canal, dam, or embankment. Currently sanctioned the naming of the vertical distance first as 1 to 2 (or, frequently, 1:2) meaning a vertical distance of 1 m to 2 m horizontal. Another form, not as subject to misinterpretation by thoughtless transposition, is 1V on 2H.

For slopes less than 45□, the vertical component should be unitary (for example, 1:20). For slopes over 45□, the horizontal component should be unitary (for example, 5:1)

SIDE-CHANNEL SPILLWAY See Spillway, Side-Channel.

SIDEWALK WIDTH Unobstructed space for exclusive pedestrian use between barriers or between a curb and a barrier.

SIGNIFICANCE See Significant.

SIGNIFICANCE TEST See Test of Significance.

SIGNIFICANT Determined by relating an effect to such things as risk (probability or frequency of occurrence) and cost. Included in environmental determinations are such things as past or expected future accumulative effects (often termed "nibble" effect). See Effect.

SIGNIFICANT ENCROACHMENT An encroachment or any direct support of likely base floodplain development by a highway action which: 1. causes a potentially significant flood hazard by adversely impacting natural and beneficial floodplain values; 2. interrupts or terminates the use of a transportation facility needed for emergency vehicles or a community's only evacuation route; 3. is in environmentally sensitive surface waters; or 4. is in regulatory waters.

SIGNIFICANT FLOOD HAZARD Where it can be shown with reasonable hydrologic certainty that the 1. expected floodplain limits; or 2. roadway encroachment of the review flood (or storm) caused by an existing or proposed drainage facility will measurably exceed existing or natural floodplain limits or, in the case of guttered stormwaters, encroach on a traveled way (see Spread) to where either prudent judgment, regulatory criteria, an economic analysis, or political considerations indicate an unacceptable flood hazard. The base flood (or storm) will be used to review the design flood (or storm) system to judge if there might be an

unacceptable flood hazard. The 500-year flood is used for this review flood when evaluating bridge scour rather than the 100-year flood.

SIGNIFICANT WAVE See Wave, Significant.

SILL A grade control structure. See Grade Control Structure. Also a device placed across a channel, or generally transverse to flow in a steep culvert to provide a fishway.

SILT Material passing the No. 200 (0.074 mm) U.S. Standard Sieve that is nonplastic or very slightly plastic and exhibits little or no strength when air-dried (Unified Soil Classification System) according to the FHWA's "Highways in the River Environment Manual," January 1987. According to the FHWA's "Highways in the River Environment Manual" (February 1990), material finer than 0.062 mm and coarser than 0.004 mm...

Two other definitions may have some application: 1. waterborne sediment which refers to material that is generally confined to fine earth, sand, or mud, but is sometimes broadened to include all material carried, including both suspended and bed load; 2. deposits of waterborne material, as in a reservoir, on a delta, or on overflowed lands.

SILTING An incorrect term for sedimentation, or sediment deposition. See Sedimentation.

SINKS Geological provinces [areas] characterized by carbonate rocks or evaporite rocks [that] are susceptible to solution by groundwater, which results eventually in the formation of rock basins called sinks *(14).*

SINK HOLES See Sinks.

SINUOUS FLOW See Flow, Turbulent.

SINUOSITY The ratio of the length of the river thalweg to the length of the valley proper.

SIPHON, OR INVERTED SIPHON See Culvert, Sag.

SKEW The measure of the angle of intersection between a line normal to the roadway centerline and the direction of the flow in a channel at flood stage in the lineal direction of the main channel.

SKEW COEFFICIENT A numerical measure [statistical] or index of the lack of symmetry in a frequency distribution. Function of the third moment of magnitudes about their mean, a measure of a symmetry. Also called coefficient of skew or skew coefficient *(34).*

SKEWNESS When data plot in a curve on log-normal paper, the curvature is an indication of data skewness *(51).* See Coefficient of Skewness. Compare with Skew Coefficient.

SLIPLAW The initial and separate publication in brochure form of a statute upon enactment, prior to its formal publication in the *U.S. Statutes at Large.*

SLOPE, ADVERSE A conduit is on an adverse slope when its slope is positive (slopes upward) in the downstream direction. Compare with Slope, Mild; and Slope, Steep.

SLOPE, CHANNEL See Channel Slope.

SLOPE, CRITICAL See Critical Slope.

SLOPE, FILL See Fill Slope.

SLOPE GAGE See Gage, Slope.

SLOPE, MILD A conduit is on mild slope when its slope is less than the critical slope for a particular value of discharge. Whether a conduit slope is steep or mild depends on the discharge under consideration as well as the conduit slope—the conduit may be steep for one discharge and mild for another. A conduit is on mild slope if, for a given discharge, the normal depth is greater than critical depth. Compare with Slope Steep; and Slope, Adverse.

SLOPE, STEEP A conduit is on steep slope when its slope is greater than the critical slope for a particular value of discharge. Whether a conduit slope is steep or mild, depends on the discharge under consideration as well as the conduit slope—the conduit may be steep for one discharge and mild for another. A conduit is on steep slope if, for a given discharge, the normal depth is less than critical depth. See Flow, Supercritical; Flow, Subcritical; and Critical Flow. Compare with Slope, Mild; and Slope, Adverse.

SLOPE, SURFACE The inclination of the water surface expressed as change of elevation per unit of slope length; the sine of the angle which the water surface makes with the horizontal. The tangent of that angle is ordinarily used, with no appreciable error resulting except for the steeper slopes.

SLOPE-AREA METHOD A method of estimating unmeasured flood discharges in a uniform channel reach using observed highwater levels. More explicitly a flow measurement method based on an indirect measurement of peak discharge by field survey of a reach of channel and highwater marks, usually after a flood has passed. Discharge is computed by the Manning equation, modified to account for non-uniform flow. See Indirect Methods of Flow Measurement.

SLOTTED DRAIN INLET See Inlet, Slotted Drain.

SLOUGHING Shallow, transverse movement of a soil mass down a stream bank as the result of an instability condition at or near the surface (also called slumping and sometimes, perhaps incorrectly, mass wasting). Conditions leading to sloughing are: bed degradation, attack at the bank toe, rapid drawdown and slope erosion to an angle greater than the angle of repose of the material. Compare with Mass Wasting, Erosion, Abrasion, and Scour.

SLUICE FLOW See Flow, Sluice.

SLUMPING See Sloughing.

SNOW A form or precipitation composed of ice crystals *(37).*

SNOW COURSE A line or series of connecting lines along which snow samples are taken at regularly spaced points *(37) (68).*

SNOW DENSITY Ratio between the volume of melt water derived from a sample of snow and the initial volume of the sample; this is numerically equal to the specific gravity of the snow *(37).* The waste content of snow expressed as a percentage by volume. In snow surveys it is the ratio of the scale reading (inches of water) to the length of the snow sample in inches.

SNOWLINE The general altitude to which the continuous snow cover of high mountains retreats in summer, chiefly controlled by the depth of the winter snowfall and by the temperature of the summer *(37).*

SNOWLINE, TEMPORARY A line sometimes drawn on a weather map during the winter showing the southern limit of the snow cover *(37).*

SODDING The act of covering the ground with a section of grass-covered soil held together by matted roots.

SOFFIT The inside top of a conduit such as a culvert or storm drain pipe. Compare with Invert.

SOIL Finely divided material composed of disintegrated rock mixed with organic matter; the loose surface material in which plants grow. Compare with Dirt. Dirt, an incorrect term, is not soil as it contains humus and other foreign material.

SOIL GROUP See Hydrologic Soil Group.

SOIL-CEMENT A designed mixture of soil and portland cement compacted at a proper water content to form a veneer or structure that can prevent the erosion of such things as a channel bank, dam face, or inlet and outlet of a drainage structure.

SOIL COLLOIDS Suspended, finely divided particles in a continuous medium. The particles do not settle out of the substance readily and are not readily filtered.

SOIL EVAPORATION Evaporation of water from moist soils.

SOIL MOISTURE Water diffused in the soil; the upper part of the zone of aeration from which water is discharged by the transpiration of plants or by soil evaporation *(37).* The water contained in the unsaturated zone *(20).* Subsurface liquid water in the unsaturated zone expressed as a fraction of the total porous medium volume occupied by water; it is less than or equal to the porosity *(22).*

SOIL POROSITY The percentage of the soil (or rock) volume that is not occupied by solid particles, including all pore space filled with air and water. See Porosity.

SOIL WATER See Soil Moisture *(22).*

SOIL-COVER COMPLEX See Hydrologic Soil-Cover Complex.

SOIL-WATER-STORAGE The amount of water the soils (including geologic formations) of a watershed will store at a given time. Amounts vary from watershed to watershed. The amount for a given watershed is continually varying as rainfall or evapotranspiration takes place *(51).*

SPAN Terminology used with culverts (and similar type openings) as the horizontal width dimension of such things as a box, pipe-arch, or arch structure, as in Span X Rise. May also be the horizontal distance between bridge piers or abutments. Compare with Rise.

SPATIAL CONCENTRATION The dry weight of sediment per unit volume of water-sediment mixture in place or the ratio of dry weight of sediment or total weight of water-sediment mixture in a sample or unit volume of the mixture.

SPAWNING The act of depositing eggs or producing spawn.

SPECIFIC ENERGY See Energy, Specific.

SPF Acronym for Standard Project Flood.

SPS Acronym for Standard Project Storm.

SPILLTHROUGH ABUTMENT A bridge abutment having a fill slope on the channel side. The term originally referred to the "spillthrough" of fill at an open abutment but is now applied to any abutment having such a slope. Compare with Embankment End Slope, Fill Slope, and Vertical Abutment. See Abutment.

SPILLWAY A passage for spilling surplus water; a wasteway.

See Spillway, Principal; and Spillway, Emergency *(51).*

SPILLWAY, CONTROLLED A reservoir outlet works wherein the outflow is controlled by gates, valves, or similar flow control devices.

SPILLWAY DESIGN FLOOD See Inflow Design Flood *(30).*

SPILLWAY, EMERGENCY A rock or vegetated earth waterway around a dam, built with its crest above the normally used principal spillway. Used to assist [or supplement] the principal spillway in conveying extreme amounts of runoff safely past the dam [so as to minimize damage and flood hazards] *(51).* Compare with Spillway, Principal. See Spillway, Uncontrolled.

SPILLWAY, LATERAL-FLOW See Spillway, Side Channel.

SPILLWAY, PRINCIPAL Conveys all ordinary discharges coming into a reservoir and that portion of an extreme discharge that does not pass through the emergency spillway or outlet works. See Spillway, Uncontrolled.

A concrete or metal pipe or conduit used with a drop inlet dam or floodwater retarding structure. It conveys, in a safe and nonerosive manner, all ordinary discharges coming into a reservoir and all of an extreme amount that does not pass through the emergency spillway *(51).* Compare with Spillway, Emergency.

SPILLWAY, SIDE-CHANNEL A spillway in which the initial and final flow are approximately at right angles to each other; a side-channel spillway.

SPILLWAY, UNCONTROLLED A spillway for a reservoir at which floodwater discharge is governed only by the inflow and resulting head in the reservoir. Usually the emergency spillway is uncontrolled.

SPLASH-OVER That portion of frontal flow at a grate which splashes over the grate and is not intercepted. Compare with Flow, Frontal.

SPREAD The accumulated flow in and next to the roadway gutter. The transverse encroachment of stormwater onto a street. See Street. This water often represents an interruption to traffic flow, splash-related problems and a source of hydroplaning during rainstorms. The lateral distance, in feet or meters, of roadway ponding extending out from the curb or edge of the traveled way. See Encroachment. Compare with Significant Encroachment.

SPREAD FOOTING A pier or abutment footing that transfers load directly to the earth.

SPRIGGING The act of planting a woody vegetation such as bushes and trees by using sprigs (twigs cut from live vegetation) stuck into the prepared ground. Sprigging must be "greenside up."

SPRING A discrete place where groundwater flows naturally from a rock or the soil onto the land surface or into a body of surface waters *(22).*

SPRING BOX An enclosure constructed to protect or otherwise contain a flow of water emerging from the ground.

SPS Acronym for Standard Project Storm.

SPUR OR SPUR DIKE See Dike; Dike, Spur; Dike, Riparian Spur; Dike, Embankment Spur; and Guide Bank.

SQUARE-EDGED ENTRANCE See Inlet, Square-Edged.

STABLE CHANNEL See Channel, Stable.

STAFF GAGE See Gage, Staff.

STAGE Height of water surface above a specified datum. Water surface elevation of a channel with respect to a reference elevation. The elevation of a water surface above its minimum; also above or below an established "low-water" plane; hence, above or below any datum of reference; gage height.

The height of a water surface above an established datum plane *(37).* See also Gage Height. The depth of water in a river or stream above the gage datum, or 0.0 level *(33).*

STAGE, FLOOD See Flood Stage.

STAGE-CAPACITY CURVE A graph showing the relation between the surface elevation of the water in a reservoir, usually plotted as ordinate, against: 1. the volume below that elevation, plotted as abscissa; or 2. amount of water flowing in a channel, expressed as volume per unit of time, plotted as abscissa. Compare with Stage-Discharge Curve and Rating Curve.

STAGE-DAMAGE GRAPHS [Charts or graphs that] show the relation between flood depth or elevation and damages in the area *(33).*

STAGE-DISCHARGE CURVE A graph showing the relation between the gage height, usually plotted as ordinate and the amount of water flowing in a channel, expressed as volume per unit of time, plotted as abscissa *(37).*

The relation expressed by the Stage-Discharge Curve *(37).* The relation between gage height (stage) and the volume of water, per unit of time, flowing in a channel *(52).*

The relation between stage and the discharge of a stream or river at a particular site, usually presented in the form of a graph or table. Sometimes referred to as the rating curve of a channel cross section. A correlation between channel flow rates and corresponding water surface elevations. A rating curve showing the relation between stage and discharge of a channel.

The relation expressed by the stage-discharge curve. Note that stage-discharge (stage versus discharge) is hyphenated when referring to a curve or relationship; for a particular event, it is more appropriate to refer to the discharge stage (not hyphenated). Compare with Rating Curve and Stage-Capacity Curve.

STANDARD DEVIATION(S) Statistician's name for an important measure [statistic] of dispersion, abbreviated s.d. Data grouped closely about their mean have a small s.d.; grouped less closely, they have a larger s.d. *(51).* See S.D. (s.d.).

The standard deviation measures the spread of a probability distribution [i.e., the spread of a sample of data] *(50).*

A measure [statistic] of the dispersion or precision of a series of statistical values such as precipitation or streamflow. It is the square root of the sum of squares of the deviations from the arithmetic mean divided by the number of values or events in the series. It is now standard

practice in statistics to divide by the number of values minus one in order to get an unbiased estimate of the variance from the sample data *(34).*

STANDARD ERROR An estimate of the standard deviation of a statistic. Often calculated from a single set of observations. Calculated like the standard deviation but differing from it in meaning *(34).*

Two definitions are paraphrased from Reference 50. The standard error of estimate σ or S_e is a measure (statistic) of the vertical (Y axis) variance about a least squares line (a least squares line describing the relationship between a dependent and independent variable/parameter); 2. The standard error of the mean is a measure (statistic) of the reliability the mean (x) as measured by $S/(n)^{1/2}$.

STANDARD PLANS Supplementary drawings of standard construction details that are not unique to any one project and are included with the project plans for construction.

STANDARD PROJECT FLOOD A totally theoretical ("deterministic" is better term) flood. The magnitude of the flood is computed by taking the precipitation from the greatest storm in the hydrologic region and transposing it to the stream basin and hydraulically routing it through the point of interest. It is [a term] in common usage by the U.S. Army Corps of Engineers. It has no frequency associated with it, but studies indicate that it is usually about half the Probable Maximum Flood and usually has about a 200- to 500-year (COE uses 500- to 1000-year) recurrence interval *(16).*

A Standard Project Flood (SPF) is a relationship of discharge and/or water surface elevation versus time and is developed by applying Standard Project Storm (SPS) runoff (SPS rainfall minus observed infiltration and other losses) to a watershed model. A base flow is usually added and snowmelt runoff may be added to obtain the total flood hydrograph. Depending on the watershed and river channel physical characteristics, available data and study needs, the watershed model may be a simple unit hydrograph or a complex flood routing technique. Then, various techniques are used, ranging from stage versus discharge curves to step backwater calculations to unsteady flood routing, to convert the flood discharge to an SPF water surface elevation. The SPF is used as one convenient way to compare levels of protection between projects, calibrate watershed models and provide a deterministic check of statistical flood frequency estimates *(16) (30).*

STANDARD PROJECT STORM The Standard Project Storm (SPS) is a relationship of precipitation versus time that is intended to be reasonably characteristic of large storms that have occurred or could occur in the locality of concern. It is developed by studying the major storm events in the region, excluding the most extreme. For areas east of 105 longitude, the [findings] of SPS studies are published in [the COE] EM 1110-2-1411 as generalized regional relationships for depth, duration and area of precipitation. For areas west of 105 longitude, special studies are made to develop the appropriate SPS estimates. These special studies may

involve transportation and adjustment of a large storm from its observed location to the locality of concern *(30).*

STANDARD RAIN GAGE See Gage, Standard Rain.

STANDING WAVE A sudden, rise in the water surface, generally fixed in position, such as a hydraulic jump; a standing wave may exist, however, where the principles of the hydraulic jump are not involved. More specifically, a term which when used to describe the upper flow regime in alluvial channels, means a vertical oscillation of the water surface between fixed nodes without appreciable progression in either an upstream or downstream direction. To maintain the fixed position, the wave must have a celerity (velocity) equal to the approach velocity in the channel, but in the opposite direction. See Celerity, Wave; and Froude Number.

STATIC HEAD See Head, Static.

STATION IDENTIFIER Information transmitted with data to identify the sending station *(33).*

STATISTIC [In computing] a number which describes a sample (such a number, for example, as an arithmetic mean, a median, a standard deviation, or a coefficient of variation) we call the number a statistic *(69).* Compare with Parameter, Variable, and Statistics.

STATISTICS [The science that] deals with the computation of [a statistic from] sampled data *(14).* Compare with Statistic and Probability.

STATUTE See Statutory Law.

STATUTORY LAW Law established by a legislative body and set forth in a formal document. In its specific application, law implies prescription and enforcement by a ruling authority.

STATUTORY LIABILITY Liability by virtue of a legislative act as differentiated from liability based on the contract of the parties.

STEADY FLOW See Flow, Steady.

STEEP SLOPE See Slope, Steep.

STEM, MAIN See Main Stem.

STEMFLOW Rainfall or snowmelt led to the ground down the trunks or stems of plants *(24).* See Interception. Compare with Throughfall.

STILLING BASIN A device or structure placed at or near the outlet of a structure for the purpose of inducing energy dissipation where flow velocities are expected to cause unacceptable channel bed scour and bank erosion.

STILLING WELL A pipe, chamber, or some other type of compartment with closed sides and bottom except for a comparatively small inlet or inlets communicating with a main body of water. Its purpose is to dampen waves or surges while permitting the water level within the well to rise and fall with the major fluctuations of the main body.

STOCHASTIC See Hydrology, Stochastic. Compare with Hydrology, Deterministic.

STONE RIPRAP See Riprap, Stone.

STOP-LOGS Devices used for temporary closure of an opening in a hydraulic structure. A generic term which is not intended to imply wood logs are used exclusive of other material; i.e., a log, wood plank, cut timber, steel, or concrete slab, or beam of some synthetic material fitting into end guides between walls or piers to close or limit an opening to the passage of water.

STORAGE "General Introduction and Hydrologic Definitions" *(37)* suggests two definitions: 1. water artificially impounded in surface or underground reservoirs, for future use (the term regulation refers to the action of this storage in modifying streamflow; see also Conservation Storage, Total Storage, Dead Storage, and Usable Storage); 2. water naturally detained in a drainage basin, such as groundwater, channel storage and depression storage [where] the term "drainage basin storage" or simply "basin storage" is sometimes used to refer collectively to the amount of water in natural storage in a drainage basin.

STORAGE, BANK The water absorbed into the banks of a stream channel when the stages rise above the water table in the bank formations; then the water returns to the channel as effluent seepage when the stages fall below the water table *(27)*.

STORAGE, BASIN Term sometimes used to refer collectively to the amount of water in natural storage in a drainage basin. See Storage. Compare with Surface Storage.

STORAGE, CHANNEL The volume of water at a given time in the channel or over the floodplain of the streams in a drainage basin or river reach. Channel storage is [occurs] during the progress of a flood event [and thus is transient in nature] *(37)*.

STORAGE, CONSERVATION Storage of water for later release for useful purposes such as municipal water supply, power, or irrigation in contrast with storage capacity used for flood control *(37)*.

STORAGE, DEAD The volume in a reservoir below the lowest controllable level *(37) (64)*.

STORAGE, DEPRESSION The volume of water contained in natural depressions in the land surface, such as puddles *(25)*. Water from precipitation which collects in puddles at the land surface *(20)*. Rainfall which is temporarily stored in land surface depressions within a watershed.

STORAGE RATIO The net available storage divided by the mean flow for one year *(64)*.

STORAGE, TOTAL The volume of a reservoir below the maximum controllable level, including dead storage *(64).*

STORAGE, USABLE The volume normally available for release from a reservoir below the stage of the maximum controllable level *(64).*

STORAGE-INDICATION METHOD Name often given to a flood-routing method. Also often called the Puls method (after Lows G. Puls), though it is actually a variation of the method devised by Puls *(51).*

STORAGE-REQUIRED FREQUENCY CURVE A graph showing the frequency with which storage equal to or greater than selected amounts will be required to maintain selected rates of regulated flow.

STORM A disturbance of the ordinary average conditions of the atmosphere which, unless specifically qualified, may include any or all meteorological disturbances, such as wind, rain, snow, hail, or thunder *(37).*

STORM, BASE See Flood, Base.

STORM, CATASTROPHIC See Flood, Catastrophic.

STORM DRAIN See Drain, Storm.

STORM DURATION The period or length of storm.

STORM HYDROGRAPH See Hydrograph, Storm.

STORM SEEPAGE That part of precipitation which infiltrates the surface soil and moves toward the streams as ephemeral, shallow, perched groundwater above the main groundwater level. Storm seepage is usually part of the direct runoff *(37).*

STORM SEWER See Sewer, Storm.

STORM SURGE Oceanic tidelike phenomenon resulting from wind and barometric pressure changes.

STORMFLOW See Runoff, Direct *(37).*

STORMWATER See Runoff, Urban *(1).*

STRATIFICATION The act or process of becoming layered.

STREAM A general term for a body of flowing water. In hydrology the term is generally applied to the water flowing in a natural channel as distinct from a canal. More generally as in the term "stream gaging," it is applied to the water flowing in any channel, natural or artificial *(37).*

To flow in or as if in a stream. Depending on local or regional usage, a lesser form of a river. A body of water that may range in size from a large river to a small rill flowing in a channel. See Rill. By extension, the term is sometimes applied to a natural channel or drainage course formed by flowing water whether it is occupied by water or not. A body of flowing water, whether in an open or closed conduit, a jet of water as from a nozzle; the term is incorrectly used to designate the conduit in which the stream flows.

Streams in natural channels may be classified as follows *(48)* [these and other stream types are defined in more detail on subsequent pages]:

relation of a stream (or river) to time:

· perennial—one which flows continuously or

· ephemeral—one that flows only in direct response to precipitation and whose channel is at all times above the water table;

relation of a stream (or river) to space:

· continuous—one that does not have interruptions in space or

· interrupted—one which contains alternating reaches, that are either perennial, intermittent, or ephemeral; and

relation of a stream (or river) to groundwater:

· gaining—a reach that receives water from the zone of saturation,

· losing—a reach that contributes water to the zone of saturation,

· insulated—a reach that neither contributes water to the zone of saturation nor receives water from it; it is separated from the zones of saturation by an impermeable bed, or

· perched—a reach that is either a losing or insulated and is separated from the underlying groundwater by a zone of aeration.

See Channel and River. Compare with Canal and Ditch.

STREAM, ANABRANCHED A stream or river whose flow is divided at normal and lower stages by large islands or, more rarely, by large bars; the width of individual islands or bars is greater than about three times the average bankfull water surface width, and the channels are more widely and distinctly separated than those of a braided stream or river. Compare with Stream, Braided; and Stream, Anastomosing. See Anabranch and Braid.

STREAM, ANASTOMOSING Successive division and rejoining (of riverflow) with accompanying islands is the important characteristic denoted by the synonymous terms, braided or anastomosing stream *(42).* Not a common term. A braided stream is composed of

anabranches. Compare with Stream, Braided; and Stream, Anabranched. See Anabranch and Braid.

STREAM BANK See Bank.

STREAM BED See Bed.

STREAM, BRAIDED A stream whose surface is divided at normal stage by small middle bars or small islands. The individual width of bars and islands is less than three times the water width. A braided stream has the aspect of a single large channel within which are subordinate channels. The visual signature of an unstable channel. Braided streams have multiple subordinate channels, which are within the main stream channel. Anabranched streams have more than one channel. Compare with Stream, Anabranched; and Stream, Anastomosing. See Anabranch and Braid.

STREAM, CONTINUOUS A stream that does not have interruptions in space *(37).*

STREAM CONTRACTION A narrowing of a natural channels waterway. Usually in reference to a drainage facility installed in the roadway embankment.

STREAM CONSTRICTION See Stream Contraction.

STREAM, EFFLUENT See Stream, Gaining.

STREAM, ENTRENCHED Stream or river cut into bedrock or consolidated deposits.

STREAM, EPHEMERAL A stream [or river] that flows only in direct response to precipitation and whose channel is at all times above the water table *(37).* A stream or reach of a stream that does not flow continuously for most of the year. A stream or reach of a stream that does not flow for parts of the year. As used here, the term includes intermittent streams or rivers whose flow is less than perennial but more then ephemeral.

STREAM, FLASHY Stream characterized by a rapidly rising and falling stage, as indicated by a sharply peaked hydrograph. Most flashy streams are ephemeral but some are perennial.

STREAM FLOW DEPLETION The amount of water that flows into a valley or onto a particular land area, minus the water that flows out the valley or off from the particular land area *(8).*

STREAM GAGE See Gage, Stream; and Stream-Gaging Station.

STREAM GAGING The process and art of measuring the depths, areas, velocities and rates of flow in natural or artificial channels *(17).*

STREAM, GAINING A stream or reach of a stream that receives water from the zone of saturation *(37).* A stream or reach of a stream whose flow is being increased by inflow of groundwater *(22).* Also known as an effluent stream *(20).*

STREAM, GRADED See Regime of a Stream.

STREAM, INCISED A stream or river that flows in an incised channel with high banks; say, banks that stand above the 50-year to 100-year water surface stage are arbitrarily regarded as high. Sometimes termed an entrenched stream or river. See Incised Channel and Incised Reach.

STREAM, INFLUENT See Stream, Losing.

STREAM, INSULATED A stream or reach of a stream that neither contributes water to the zone of saturation nor receives water from it. It is separated from the zones of saturation by an impermeable bed *(37).*

STREAM, INTERMITTENT A stream which flows only at certain times of the year when it receives water from springs or from some surface source such as melting snow in mountainous areas *(37).*

STREAM, INTERRUPTED A stream which contains alternating reaches, that are either perennial, intermittent, or ephemeral *(37).*

STREAM, LOSING A stream or reach of a stream that contributes water to the zone of saturation *(37).* A stream or reach of a stream in which water flows from the channel bed into the ground *(22).* A stream or reach of a stream that is losing water by seepage into the ground; also known as an Influent Stream.

STREAM, MEANDERING See Meandering Channel.

STREAM ORDER A method of numbering [ordering] streams as part of a drainage basin network. The smallest, unbranched, mapped tributary is called first order, the stream receiving the tributary is called second order and so on. It is usually necessary to specify the scale of the map used. A first-order stream on a 1:62 500 map, may be a third-order stream on a 1:12 000 map *(41).*

Tributaries which have no branches are designated as of the first order, streams which receive only first-order tributaries are of the second order, larger branches which receive only first-order and second-order tributaries are designated third order and so on. The main stream being always of the highest order *(26).*

STREAM, PERCHED A perched stream is either a losing stream or an insulated stream that is separated from the underlying groundwater by a zone of aeration: "General Introduction and Hydrologic Definitions" *(37).*

STREAM, PERENNIAL A stream or reach of a stream that flows continuously for all or most of the year.

STREAM, POISED A term used by river engineers as applying to a stream that over a period of time is neither degrading nor aggrading its channel. A stream nearly in equilibrium as to

sediment transport and supply. See Regime Theory; Regime Channel; Channel, Stable; and Stream, Graded.

STREAM POWER An expression used in predicting bed forms and hence bed load transport in alluvial channels—a parameter comprised of the mean velocity, the specific weight of the water-sediment mixture, the normal depth of flow and the channel slope. A parameter that reflects the ability of a stream to distort its bed to produce such things as bed forms, scour, or deposition.

STREAM REACH A length of stream channel selected for use in hydraulic or other computations *(51).*

STREAM REGIME See Regime of a Stream.

STREAM RESPONSE Changes in the dynamic equilibrium of a stream by any one, or combination of various causes.

STREAM, STABLE See Channel, Stable.

STREAM, SEASONAL See Stream, Intermittent.

STREAM-GAGING STATION A gaging station where a record of discharge of a stream [or river] is obtained. Generally, this term is used only for those gaging stations where a continuous record of discharge is obtained: "General Introduction and Hydrologic Definitions" *(37).*

STREAM BANK EROSION Removal of soil particles or a mass of particles from a bank surface due primarily to water action. Other factors such as weathering, ice and debris abrasion, chemical reactions and land use changes may also directly or indirectly lead to stream bank erosion. Compare with Mass Wasting and Sloughing.

STREAM BANK FAILURE See Mass Wasting and Sloughing.

STREAM BANK PROTECTION Any technique used to prevent erosion or failure of a channel bank. See and compare with Armor, Apron, Blanket, Channel Lining, Mattress, and Revetment.

STREAM BED See Bed.

STREAMFLOW The discharge that occurs in a natural channel. Although the term discharge can be applied to the flow of a canal, the word streamflow uniquely describes the discharge in a surface stream course. The term "streamflow" is more general than runoff, as streamflow may be applied to discharge whether or not it is affected by diversion or regulation *(37) (52).* Compare with Discharge and Runoff.

STREAMFLOW RECORD A tabulation of the flow of a stream. Streamflow records are published annually by the United States Geological Survey in their Water-Supply Papers.

Such things as daily, monthly, annual and instantaneous extremes of discharge are shown therein, along with information about the stream gage.

STREAMING FLOW See Flow, Subcritical.

STREAMLINE FLOW See Flow, Laminar.

STREET A general term denoting a public way for purposes of vehicular travel, usually including curb and gutters, to include the entire area within the right-of-way. Compare with Road.

STRUCTURES Such things as bridges, culverts, catch basins, drop inlets, retaining walls, cribbing, access holes, endwalls, buildings, storm drains, service pipes under drains, foundation drains and other appurtenant features.

STRUCTURAL MEASURES Methods of reducing damage from floods include [such things as] dams and reservoirs, levees, dikes, floodwalls, diversion channels, bridge modifications, channel alterations, pumping stations and land treatment. [Also] for flood prevention work, any form of earthwork (dam, ditch, levee, etc.) or installation of concrete, masonry, metal, or other material (drop spillway, jetties, riprap, etc.); or installation for forest fire protection (firetowers, roads, firebreaks); or, in some cases, a special planting for nonfarm purposes (stabilization of critical sediment-producing area, etc.) *(33).*

Structural measures reduce the frequency of damaging overflows. Different types of structural flood damage reduction measures have different primary and secondary impacts on flooding. Plan formulation and impact assessment should take into account all impacts and residual flooding from all sources. (The dominant flooding may be from a different source without and with project conditions.) In project planning, both the primary beneficial effects and the secondary effects of the alternatives must be borne in mind and appropriately accommodated. Compare with Non-structural Measures.

STRUCTURAL METHODS See Structural Measures.

STUDENT'S t DISTRIBUTION See Probability Distribution.

SUB-BASE The layer or layers of specified or selected material of designed thickness placed on a subgrade to support a base course. Compare with Sub-Bed Material and Subgrade.

SUBGRADE The top surface of a roadbed upon which the pavement structure and shoulders are constructed. Compare with Sub-Bed Material and Sub-Base.

SUB-BED MATERIAL Material underlying that portion of the channel bed which is subject to the direct action of the flow. Compare with Subgrade and Sub-Base.

SUB-SURFACE FLOAT A submerged body which is attached by a line to and the movement of which is indicated by, a surface float; used for the purpose of observing velocities or the direction of flow.

SUBCRITICAL FLOW See Flow, Subcritical.

SUBLIMATE In the hydrology sense, the loss of moisture from snow before it can infiltrate due to evaporation and wind.

SUBMEANDER Small meander contained within the low flow banks of a main channel, associated with relatively low discharges and rills.

SUBMERGED INLET Inlets of culvert like structures having a headwater greater than about 1.2 D, where D is the culvert rise. See Rise.

SUBMERGED ORIFICE An orifice which in use is drowned by having the tailwater higher than all parts of the opening. See Orifice.

SUBMERGED OUTLET Submerged outlets are those culvert-like outlets having a tailwater elevation greater than the soffit of the culvert.

SUBMERGED WEIR See Weir, Submerged.

SUBMERGENCE The ratio of the tailwater elevation to the headwater elevation, when both are higher than the crest, the overflow crest of the structure being the datum of reference. The distances upstream or downstream from the crest at which headwater and tailwater elevations are measured are important, but have not been standardized. In culvert terminology, the condition where tailwater or headwater elevation are greater than elevation of the conduit top (soffit).

SUBSECTION Part of a cross section; for example, the left floodplain section of a total cross section. Commonly defined as those contiguous portions of the total cross section having the same conveyance characteristics.

SUBSOIL The material lying below the surface soil, generally devoid of humus or organic matter. See Soil and Dirt.

SUBSTITUTE WETLANDS See Wetlands, Substitute.

SUBSTRATE A surface (such as a bed or bank) within surface waters, or beds, banks or shores which are periodically covered by surface waters on which a plant or animal may live, grow, or be attached. Compare with Bed.

SUBSTRUCTURE All of the structure below the bearings of simple and continuous spans, skewbacks of arches and tops of footings or rigid frames, together with the backwalls, wingwalls and wing protection railings.

SUBSURFACE RUNOFF See Runoff, Subsurface.

SUBSURFACE WATER See Water, Subsurface.

SUBWATERSHED A watershed that is part of a larger watershed [or drainage area]. It is worked on [analyzed] separately when necessary in order to improve computational accuracy for results on a whole watershed basis or to get results for that [sub] area only *(51)*.

SUMP INLET See Inlet, Sump.

SUMP, WET WELL See Wet Well Sump.

SUPERELEVATION The increase in water surface elevation at the outside of open channel bendways. May also be a transverse tilting of the channel bed (in lined channels with predominately supercritical flow) or the increase in the elevation at the outside edge of a road or traveled way located in a horizontal curve.

SUPERFLOOD Any flood or tidal flow with a flow rate greater than that of the 100-year flood. Flood used to evaluate the effects of a rare flow event; a flow exceeding the 100-year flood. It is recommended that the superflood be on the order of the 500-year event or a flood 1.7 times the magnitude of the 100-year flood if the magnitude of the 500-year flood is not known or predictable with available hydrology methods. Compare with Flood, Review; Flood, Catastrophic Flood; Five-hundred Year Flood; Flood, One-Thousand Year; Flood, Probable Maximum; and Design Discharge.

SUPERSTRUCTURE The portion of a structure above the substructure. See Substructure.

SUPPLEMENTAL IRRIGATION See Irrigation, Supplemental.

SUPPLEMENTAL SOURCES See Irrigation, Supplemental Sources.

SUPPRESSED WEIR See Weir, Suppressed.

SURF ZONE See Breakers.

SURFACE AREA (LAKE) See Lake Surface Area.

SURFACE CURVE See Water Surface Profile.

SURFACE FLOAT A float on a water surface used to indicate velocity or direction of flow.

SURFACE RUNOFF See Runoff, Surface.

SURFACE SLOPE See Slope, Surface.

SURFACE STORAGE Natural or constructed roughness of a land surface, which stores some or all of the surface runoff of a storm. [Such things as] natural depressions, contour furrows and terraces are usually considered as producing surface storage, but stock ponds, reservoirs, stream channel storage, etc. are generally excluded *(51)*.

Stormwater that is contained in surface depressions or basins. Compare with Storage, Basin.

SURFACE WATER COURSE, NATURAL WATERWAY See Natural Watercourse.

SURFACE WATER ENHANCEMENT Improving existing or new surface water functions and values with practicable measures.

SURFACE WATER FUNCTION See Function of Surface Waters.

SURFACE WATER MITIGATION The on-site and/ or off-site construction of new surface waters, enhancement of existing surface waters, acquisition and enhancement of existing surface waters, or combinations thereof.

SURFACE WATER QUALITY The findings from an evaluation of the importance and degree of excellence of surface water functions, values and features.

SURFACE WATER VALUE The various essential and nonessential aesthetics, products and services of sometimes definable value which surface waters provide to society, including such things as fish and wildlife habitat, water supply, improvement of water quality, flood control, bank erosion and shoreline protection, outdoor recreation opportunities, education and research and beauty.

The value, economic or environmental, of a surface water function. Compare with Function of Surface Waters.

SURFACE WATERS Water on the surface of the earth *(51).* Any stream, river, lake, pond, or reservoir. Some include wetlands in surface waters.

For regulatory purposes, navigable waters of the U.S. as currently defined by the U.S. Army Corps of Engineers (COE). See Navigable Waters.

A more legally based description might be, depending on the context, water appearing on the land surface in a diffused state for a considerable time, with no permanent source of supply or regular course; as distinguished from water appearing in watercourses, lakes, or ponds. Sometimes considered as overland flow or surface flow. See Overland Flow and Surface Flow. Compare with Streamflow, Discharge, and Runoff.

SURFACE WATERS, JURISDICTIONAL See Navigable Waters.

SURFACE WATERS, RARE Surface waters or wetlands having features, functions, values, or quality that are uncommon, unique, or seldom occur in the ecoregion. Compare with Surface Waters, Sensitive.

SURFACE WATERS, SENSITIVE Those surface waters or wetlands which, by their nature and setting, are inherently important, unique, or rare due to such things as their environment, public use and flood control function. Waters that, without mitigation measures, would be threatened by a highway action. Compare with Surface Waters, Rare.

SURFACE WATERS THREAT The likelihood that surface waters or wetlands, or a portion thereof, will be destroyed, degraded, or otherwise adversely impacted, directly or indirectly, through a highway action.

SURFACE WATERS, UNIQUE See Surface Waters, Rare.

SURFICIAL BED MATERIAL The part (1.2 inches to 2.4 inches) (30 mm to 60 mm) [in dimension]) of the bed material that is sampled using U.S. Series Bed Material Samplers *(52).*

SUSPENDED Used in tables of chemical analyses, this term refers to the amount (concentration) of undissolved material in a water-sediment mixture. It is associated with the material retained on a 0.45-micrometer filter *(52).*

SUSPENDED SEDIMENT DISCHARGE See Sediment Discharge, Suspended.

SUSPENDED SEDIMENT LOAD See Sediment Load, Suspended.

SWALE A wide, shallow ditch usually grassed or paved and without well-defined bed and banks. A slight depression in the ground surface where water collects and which may be transported as a stream. Often vegetated and shaped so as not to provide a visual signature of a bank or shore.

SYNTHETIC FILTER Fabric of synthetic material that serves the same purpose as a granular filter blanket.

SYNTHETIC HYDROGRAPH See Hydrograph, Synthetic.

SYNTHETIC MATTRESS, MATTING, OR TUBING A grout, or sand-filled, manufactured, semiflexible casing placed on a channel bank to prevent erosion. See Blanket and Mattress. Compare with Apron.

SYNTHETIC SERIES A storm or flood series obtained by taking selected values from a frequency line based on historical data according to the National Engineering Council.

t DISTRIBUTION See Probability Distribution.

TAILWATER Tailwater (TW) is the depth of flow in the channel directly downstream of a drainage facility. Often calculated for the discharge flowing in the natural stream without the highway effect (but may include other local effects from development), unless there is a significant amount of temporary storage that will be (or is) caused by the highway facility; in which case, a flood routing analysis may be required. The tailwater is usually used in such things as culvert and storm drain design and is the depth measured from the downstream flow line of the culvert or storm drain to the water surface. May also be the depth of flow in a channel directly downstream of a drainage facility as influenced by the backwater curve from an existing downstream drainage facility. With such things as releases from a dam, the water just downstream from a structure.

TALUS Rock debris collecting at the base of a cliff.

TALUS SLOPE Slope (talus slope) formed by an accumulation of rock debris at the base of a cliff.

TANK An artificial reservoir for stock water; local usage generally in the Southwest U.S. *(37).*

TAPERED ENTRANCE See Inlet, Tapered.

TEMPORARY SNOWLINE See Snowline, Temporary.

TERRACE A berm or discontinuous segments of a berm, in a valley at some height above the floodplain, representing a former abandoned floodplain of the stream *(37).*

TEST OF SIGNIFICANCE A [statistical] test made to determine the probability that a result is accidental or that a result differs from another result. For all the many types of tests there are standard formulas and tables. In making a test it is necessary to choose a "level of significance," the choice being arbitrary but generally not less than the low level of ten percent nor more than the high level of one percent *(34).*

TETRAHEDRON Component of river training works made of six steel or concrete struts fabricated in the shape of a pyramid.

TETRAPOD Bank protection component of precast concrete consisting of four legs joined at a central joint, with each leg making an angle of 109.5□ with the other three.

TEXAS CROSSING A low class road crossing of a channel designed to pass low, frequently occurring flows through a relatively small culvert type opening with large, more rare floods being conveyed over the road with little or no road damage; such damage often being precluded by: 1. an erosion protection blanket on the downstream fillslope of the road (keyed into the floodplain and channel bottom); and 2. the blanket being monolithic with the shoulder.

THALWEG The line or path (such as a rill) connecting the lowest flow points along the bed of a channel. The line does not include local depressions. The path very low flows would follow in proceeding down a stream, river, swale, or channel. The line extending along a channel profile that follows the lowest elevation of the bed.

THALWEG, WANDERING A thalweg whose position in the channel shifts during floods and typically serves as an inset channel (or rill) that transmits all or most of the channel flow at normal or lower stages.

THERMAL STRATIFICATION Vertical temperature stratification [in a lake or pond] that shows the following: 1. the upper layer of the lake, known as the epilimnion, in which the water temperature is virtually uniform; 2. a stratum next below, known as the thermocline, in which there is a marked drop in temperature per unit of depth; and 3. the lowermost region or

stratum, known as the hypolimnion, in which the temperature from its upper limit to the bottom is nearly uniform *(70).*

THREAT, SURFACE WATERS See Surface Waters Threat.

THERMOCLINE A central layer of rapid temperature transition that is located between the epilimnion and the hypolimnion of a lake or pond. See Thermal Stratification.

THRESHOLD VALUE The value beyond which a significant, adverse effect or impact would probably occur; generally a term applicable to the quality of surface waters.

THROUGHFALL In a vegetated area, the precipitation that falls directly to the ground or the rainwater or snowmelt that drops from twigs or leaves *(24).* See Interception. Compare with Stemflow.

THROUGHFLOW The lateral movement of water in an unsaturated zone during and immediately after a precipitation event. The water from throughflow seeps out at the base of slopes and then flows across the ground surface as return flow, ultimately reaching a stream or lake *(20).*

TIDAL AMPLITUDE Generally, half of the tidal range.

TIDAL CYCLE One complete rise and fall of the tide.

TIDAL INLET A body of water with an opening to the sea, but otherwise enclosed.

TIDAL PASSAGE A tidal channel connecting with the sea at both ends.

TIDAL PERIOD Duration of one complete tidal cycle.

TIDAL PRISM Volume of water contained in a tidal inlet or estuary, between low and high tide levels.

TIDAL RANGE Vertical difference between specified low and high tide levels.

TIDES, ASTRONOMICAL Variations in sea level due to the motion of heavenly bodies.

TIEBACK Structure connected to such things as a retard, or revetment paralleling a bank, or a blanket located on a bank. Tiebacks extend into or are otherwise tied to the bank to prevent flanking by streamflow.

TIMBER OR BRUSH MATTRESS Such things as a revetment, blanket, or armor made of such things as brush, poles, logs, or lumber interwoven or otherwise lashed together. The completed mattress is then placed on the bank of a stream or river and weighted with ballast. See Blanket and Mattress.

TIME OF CONCENTRATION The time [T_c] required for water to flow from the farthest point on the watershed to the gaging station *(55).* The time that it takes for water to flow from the most distant part of the drainage basin to the measuring point *(20).*

The time (T_c) it takes water from the most distant point (hydraulically) to reach a watershed outlet. T_c varies, but [is] often used as a constant *(51).*

The estimated time required for runoff to flow from the most remote section of the drainage area to the point at which the discharge is to be determined. Stated another way, the time it takes water from the most distant point (hydraulically) to reach a watershed outlet.

Not synonymous with Travel Time. Compare with Travel Time.

TIPPING BUCKET See Gage, Tipping Bucket.

TOE That portion of a stream cross section where the lower bank terminates and the channel bottom or the opposite lower bank begins.

TOE DIKE See Dike, Toe.

TOPSOIL Surface soil which is suitable for the germination of seeds and the support of vegetative growth.

TORRENTIAL FLOW See Flow, Supercritical.

TORT A private or civil wrong committed upon the person or property independent of contract. The elements of every tort action are: 1. existence of legal duty from defendant to plaintiff; 2. breach of duty; and 3. damage as proximate result.

TORT ACTION See Tort.

TORTUOUS CHANNEL See Channel, Tortuous.

TORTUOUS FLOW See Flow, Turbulent.

TOTAL ENERGY See Energy.

TOTAL FISH LENGTH The greatest possible length of a fish between the mouth with mouth closed and compressed (i.e., squeezed together) and the tail fin to give the maximum overall measurement. See Fish; and Fish, Design.

TOTAL HEAD See Head, Total.

TOTAL HEAD LINE See Energy Grade Line.

TOTAL SEDIMENT DISCHARGE See Sediment Discharge, Total.

TOTAL STORAGE See Storage, Total.

TOTALLY BOUNDED DISTRIBUTION See Probability Distribution.

TRACTIVE FORCE The drag on a stream bank caused by passing water which tends to pull soil particles along with the streamflow. The force or drag developed at the channel bed by flowing water. For uniform flow, this force is equal to a component of the gravity force acting in a direction parallel to the channel bed on a unit wetted area. Usually expressed in units of stress; i.e., force per unit area. The force per unit area on a stationary boundary exerted by a fluid flowing past that boundary. Compare with Critical Shear Stress.

TRAINING DIKE See Dike, Training.

TRANQUIL FLOW See Flow, Subcritical.

TRANSFORMATION The change of numerical values of data to make later computations easier, to linearize a plot or to normalize a skewed distribution by making it more nearly a normal distribution. The most common transformation are those changing ordinary numerical values into their logarithms, square roots, or cube roots; many others are possible *(34).*

TRANSITION A short conduit and/or channel uniting two other conduits and/or channels having different hydraulic elements; a conversion; a variable conduit or channel section connecting one uniform conduit or channel to another of different cross section form.

TRANSMISSION LOSS A reduction in volume of flow in a stream, canal, [channel,] or other waterway, due to infiltration or seepage into the channel bed and banks. Evaporation is also a transmission loss, but it is ordinarily neglected under the assumption that it is small *(51).*

TRANSPIRATION The quantity of water absorbed and transpired and used directly in the building of plant tissue in a specified time. It does not include soil evaporation *(8).*

The process by which water vapor escapes from the living plant, principally the leaves and enters the atmosphere. The process by which plants give off water vapor through their leaves *(20).*

TRAPEZOIDAL WEIR See Weir, Trapezoidal.

TRASH RACK A device used to capture debris, either floating, suspended, or rolling and saltating along the bed, before it enters a drainage facility. A grid or screen across a stream or entrance to a drainage facility designed to catch debris.

TRAVEL TIME The average time for water to flow through a reach or other stream or valley length that is less than the total [stream or valley] length. A travel time is part of a T_C [Time of Concentration] but never the whole T_C *(51).*

The average time for water to flow through a reach or other stream or valley length.

Not synonymous with Time of Concentration. Compare with Time of Concentration.

TRAVELED WAY That portion of the roadway for the movement of vehicles, exclusive of shoulders and auxiliary lanes (such as turning lanes and parking lanes).

TRENCH-FILLED REVETMENT Stone, concrete, or masonry material placed in a trench dug behind and parallel to an eroding stream bank. When the erosive action of the stream reaches the trench, the material placed in the trench armors the bank and thus retards further erosion. Compare with Windrow Revetment and Revetment.

TREND A statistical term referring to the direction or rate of increase or decrease in magnitude of the individual members of a time series of data when random fluctuations of individual members are disregarded *(37).* Compare with Probability Distribution and Cycle.

TRIANGULAR WEIR See Weir, Triangular.

TRIBUTARIES Lesser branches of the watershed stream system. Compare with Main Stem.

TROUGH The long, narrow depression between waves.

TSUNAMI A gravity wave caused by an underwater seismic disturbance (such as sudden faulting, landsliding, or volcanic activity). Long period, ocean wave resulting from earthquake or other seismic disturbance. Waves created by earthquakes or other tectonic disturbance on the ocean bottom.

TUKEY DISTRIBUTION See Probability Distribution.

TURBIDITY Muddy water, having sediment or foreign particles stirred up or suspended. Measured by the Jackson Turbidity Unit (JTU) or Nephelometric Turbidity Unit (NTU). NTU is current (1992) practice.

TURBULENCE Motion of fluids in which local velocities and pressures fluctuate irregularly in a random manner as opposed to laminar flow where all particles of the fluid move in distinct and separate streamlines. A state of flow wherein the water is agitated by cross-currents and eddies; opposed to a condition of flow that is quiet or quiescent.

TURBULENT FLOW See Flow, Turbulent; and Turbulence.

TURBULENT VELOCITY That velocity above which, in a particular conduit, turbulent flow will always exist and below which the flow may be either turbulent or laminar, depending on circumstances.

TURNOVER See Lake Turnover.

TW Acronym for Tailwater (depth). [Also an acronym for] Actual Warning Time which is something less than potential warning time (TWP) *(33).*

TWO-DIMENSIONAL WATER SURFACE PROFILE An estimated water surface profile with recognizes flow only in the upstream-downstream and transverse direction; vertical velocity vector components are ignored. Compare with One-Dimensional Water Surface Profile.

TWP [Acronym for] The maximum time available for warning local communities prior to impending flooding *(33).*

UNCONTROLLED CROSSING A bridge crossing that imposes no constraints on the natural width of the stream or on its ability to shift its channel.

UNCONTROLLED SPILLWAY See Spillway, Uncontrolled.

UNDERFLOW The downstream flow of water through the permeable deposits that underlie a stream and that are more or less limited by rocks of low permeability. See Discharge.

UNDERGROUND WATERCOURSE See Watercourse, Underground.

UNDEVELOPED FLOODPLAIN See Floodplain, Undeveloped.

UNGAGED STREAM SITES Locations at which no systematic records are available regarding actual stream flows or water quality information.

UNIFORM CHANNEL See Channel, Uniform.

UNIFORM FLOW See Flow, Uniform.

UNIQUE SURFACE WATERS See Surface Waters, Rare.

UNIT DISCHARGE See Discharge, Unit.

UNIT HYDROGRAPH See Hydrograph, Unit.

UNIT SHEAR FORCE See Tractive Force.

UNITGRAPH See Hydrograph, Unit.

UNSATURATED ZONE See Zone, Unsaturated.

UNSTEADY FLOW See Flow, Unsteady.

UPLIFT The upward water pressure force on the base of a structure.

UPPER BANK See Bank, Upper.

URBAN As used in this [Glossary] ...this term includes suburban areas *(1).*

URBAN RUNOFF See Runoff, Urban.

USABLE STORAGE See Storage, Usable.

USFS Acronym for U.S. Forest Service.

USGS [Acronym for] United States Department of the Interior, Geological Survey *(51)*.

USWB [Acronym for] United States Department of Commerce, Weather Bureau. [Weather Bureau changed to National Oceanic and Atmospheric Administration, National Weather Service (see NWS) *(51)*].

V-NOTCH WEIR See Weir, Triangular.

VADOSE ZONE See Zone, Unsaturated *(22)*.

VALUE OF SURFACE WATERS See Surface Water Value.

VARIABLE A quantity susceptible of fluctuating in value or magnitude under different conditions according to the *Reader's Digest Great Encyclopedic Dictionary*. Given an equation or relation involving two or more variables (X, Y, Z ... n), the variable(s) which are assigned values {y = f(x, z...n)—in this case x, z...n} are called independent variables and the variable which takes on values (in this case y) is called the dependent variable.

Compare with Parameter.

VARIABLE, DEPENDENT, OR INDEPENDENT See Variable.

VARIANCE A [statistical] measure of the amount of spread or dispersion of a set of values around their mean, obtained by calculation of the mean value of the squares of the deviations from the mean and hence equal to the square of the standard deviation *(34)*.

VARIED FLOW See Flow, Unsteady.

VEGETATION Woody or nonwoody plants. Such vegetation is commonly used to stabilize a channel bank, floodplains and other ground areas exposed during highway construction in order to retard erosion.

VELOCITY The rate of motion of a stream or river or of the objects or particles transported therein, usually expressed in distance per time. Rate of travel; distance per unit of time.

VELOCITY, AVERAGE Velocity at a given cross section determined by dividing the total discharge at that point by the total cross section area.

VELOCITY, CROSS SECTION AVERAGE See Velocity, Average.

VELOCITY, FALL The velocity of a particle falling alone in quiescent, distilled water of infinite extent.

VELOCITY HEAD See Head, Velocity.

VELOCITY HEAD COEFFICIENT (α) A correction factor, α, (alpha) applied to the velocity head for the mean velocity, to correct for non-uniformity of velocity in a cross section. The factor is 1.0 where velocities are identical across a section and greater than 1.0 where velocities vary across a section. Regular channels have coefficients as low as 1.10 whereas overflooded river valleys may have coefficients as high as 2 *(13).* Compare with Momentum Coefficient, β (beta).

VELOCITY, LOCAL AVERAGE Local discharge intensity divided by depth of flow.

VELOCITY, MEAN See Velocity, Average.

VELOCITY OF APPROACH The mean velocity in the conduit or channel immediately upstream from a weir, dam, Venturi throat orifice, or other structure; the mean velocity in the approach section.

VELOCITY, PERMISSIBLE The highest velocity at which water may be carried safely in a canal or other conduit without channel bed scour or bank erosion.

VELOCITY-WEIGHTED SEDIMENT CONCENTRATION The dry weight of sediment discharged through a cross section during a unit of time.

VENA CONTRACTA The most contracted section area of a stream, jet, or nappe beyond the plane of the constriction through which it issues.

VENTURI FLUME See Flume, Venturi.

VERIFICATION The process of testing a model to an observed set of data using the model parameters derived during calibration. Model calibration and verification must be performed on separate sets of data *(1).*

VERTICAL ABUTMENT An abutment, usually with wingwalls, that has no fill slope on its channel side. See Abutment. Compare with Spillthrough Abutment.

VERTICAL-VELOCITY CURVE A graph of the relation between depth and velocity along a vertical line in a stream, as determined by a set of observations or estimated by computations.

VICE "Instead of," or "in lieu of."

VISCOUS FLOW See Flow, Laminar.

VISTAS The passage framing the approach to such things as a scene, scenic landscape, or surface waterscape.

WANDERING CHANNEL See Channel, Wandering.

WANDERING THALWEG See Thalweg, Wandering.

WASH Term of local geographic usage. See Channel.

WASH LOAD That part of the total sediment discharge which is composed of particle sizes finer than those found in appreciable quantities in the bed material. Large quantities of fine materials that could be carried easily by stream flow. That part of the total sediment load that is composed of particle sizes finer than those represented in the bed. Normally the fine-sediment load is finer than 0.062 mm for a sand bed channel. Silts, clays, and sand could be considered as wash load in coarse gravel and cobble bed channels. Wash load sediments commonly originate on uplands and are carried into a channel by overland flows. Compare with Bed Load; Sediment Load, Suspended; Sediment Discharge, Total; and Sediment Discharge, Suspended.

WATER BALANCE See Hydrologic Budget.

WATER BUDGET An evaluation of all the sources of supply and the corresponding discharges with respect to an aquifer or a drainage basin *(20).* See Hydrologic Budget.

WATER CONTENT The amount of water lost from the soil after drying it to constant weight at 105□C, expressed either as the weight of water per unit weight of dry soil or as the volume of water per unit bulk volume of soil *(22).*

The ratio of the volume of soil moisture to the total volume of the soil. This is the volumetric water content; also called volume wetness *(20).*

WATER CONTENT OF SNOW See Water Equivalent of Snow.

WATER CROP See Water Yield.

WATER CUSHION A pool of water maintained to take the impact of water overflowing a dam, chute, drop, or other spillway structure.

WATER DRAINAGE RIGHTS The right which a land owner has, under the law, to dispose of excess or surplus water which accumulates upon his land, over the lands of others. Such rights are of several classes—see Common Enemy Doctrine or Rule; Civil Law Doctrine or Rule; Natural Drainage Doctrine or Rule; and Reasonable Use Doctrine or Rule.

Not to be confused with water right. Compare with Water Right and Flood Right.

WATER EQUIVALENT OF SNOW Amount of water that would be obtained if the snow should be completely melted. Water content may be merely the amount of liquid water in the snow at the time of observation *(37).*

The depth of water obtained by melting a given thickness of snow *(20).* The depth of water, in inches, that results from melting a given depth of snow *(51).*

WATER LAW See Doctrine, Rule, Riparian Doctrine or Rule, Water Right, Flood Right, Common Law, Civil Law, Common Enemy Doctrine or Rule, Civil Law Doctrine or Rule, Natural Drainage Doctrine or Rule, Reasonable Use Doctrine or Rule, Rule of Law, and Water Drainage Rights.

WATER LEVEL A water surface; also, its elevation above any datum; gage height; stage.

WATER LOSS The difference between the average precipitation over a drainage basin and the water yield from the basin for a given period. The basic concept is that water loss is equal to evapotranspiration, that is water that returns to the atmosphere and thus is no longer available for use. However, the term is also applied to differences between measured inflow and outflow even where part of the difference may be seepage *(37).*

Variable meaning, depending on personal interest of water users. Farmers and ranchers usually think of flood runoff as a water loss; many river engineers think of infiltration as a water loss *(37).* Compare with Loss, Hydrology.

WATER REQUIREMENT The quantity of water, regardless of its source, required by a crop in a given period of time, for its normal growth under field conditions. It includes surface evaporation and other economically unavoidable wastes *(8).*

WATER, RETURN See Flow, Return.

WATER RIGHT An adjudication of waters (usually by a State agency) to a specified user for a beneficial purpose. Compare with Flood Right. See Beneficial Use.

WATER, SUBSURFACE All water that occurs below the land surface *(22).*

WATER SUPPLY PAPER (WSP) An annual publication of the USGS, in which streamflow for the water year is given for all gaged streams in a geographical region of the United States.

WATER TABLE The upper surface of a zone of saturation. No water table exists where that surface is formed by an impermeable body *(47) (37).*

The upper surface of a zone of saturation except where that surface is formed by a confining unit. The upper surface of the zone of saturation on which the water pressure in the porous medium equals atmospheric pressure. Means that surface in a groundwater body at which the water pressure is atmospheric. Upper surface of a zone of saturation, where the body of groundwater is not confined by an overlying impermeable zone.

The surface in an unconfined aquifer or confining bed at which the pore water pressure is atmospheric. It can be measured by installing shallow wells extending a few feet into the zone of saturation and then measuring the water level in those wells *(20).*

The upper surface of groundwater *(51).*

The upper surface of a zone of saturation in soil or in permeable strata or beds. The upper surface of the zone of saturation, except where that surface is formed by an impermeable body. Compare with Groundwater, Perched.

WATER YEAR In the Federal agency reports dealing with surface-water supply, the 12-month period, October 1 through September 30. The water year is designated by the calendar year in which it ends and which includes 9 of the 12 months. Thus, the year ended September 30, 1959, is called the "1959 water year" *(37).*

The year taken as beginning October 1. Often used for a convenience in streamflow work, since in many areas streamflow is at its lowest at that time. Used by the U.S. Geological Survey in their WSP National Engineering Handbook *(51).*

WATER YIELD See Annual Runoff.

WATER-LEVEL (STAGE) RECORDER A device for producing a graphic record of the rise and fall of a water surface with respect to time. Compare with Gage and Crest-Stage.

WATER SURFACE PROFILE A graph of water levels plotted against stream distance at a particular time or for a particular condition, such as for a flood peak or for a low-flow period. Two other definitions are appropriate: 1. the longitudinal profile assumed by the surface of a stream of water flowing in an open conduit (the surface curve of a stream of water is the curve of equilibrium of all forces acting on the flowing water); 2. the hydraulic grade line. See Hydraulic Grade Line. Water-surface curves or profiles are generally catalogued into twelve classifications, three of which are designated strictly as backwater curves. The classifications are accounted for by the different bottom slopes and relative values of normal and critical depth. The curves are classified by the nomenclature; M1, M2, and M3 for mild slope (backwater curves); C1 and C3 for critical slope; H2 and H3 for horizontal (zero slope); S1, S2, and S3 for steep slope; and A2 and A3 for adverse slope. Compare with Backwater Curve.

WATERCOURSE A stream, river, or channel in which a flow of water occurs, either continuously or intermittently, with some degree of regularity. See Channel, River, and Stream.

WATERCOURSE, NATURAL See Channel, Natural.

WATERCOURSE, UNDERGROUND A geological formation which contains water flowing in a known and defined channel. A water right for water in underground watercourses are in most States similar to the water right for water in natural surface watercourses.

WATERS OF THE UNITED STATES See Navigable Waters.

WATERSHED See Drainage Area.

WATERSHED MEASURES Any vegetative or structural means (including earthwork) of directly improving or conserving the soil and water resources of a watershed. See Land Treatment Measure and Structural Measure *(51).*

WATERWAY Any stream, river, lake, pond, or ocean that can be traversed for purposes of commerce or recreation. May also refer to a channel. See Channel and Watercourse.

WATERWAY OPENING See Waterway Opening Area.

WATERWAY OPENING AREA Area of bridge opening at (below) a specified stage, measured normal to principal direction of flow.

WATERWAY OPENING DEPTH Depth corresponding to a waterway opening area. Requires clarification in some cases as to whether this is the average depth, maximum depth, minimum depth, normal depth, or some other measure of depth.

WATERWAY OPENING WIDTH Width corresponding to a waterway opening area. Requires clarification in some cases as to whether this is a top width, bottom width, average width, or some other measure of width.

WAVE ATTACK Impact of waves on a channel bank or shore.

WAVE CELERITY See Celerity, Wave.

WAVE FREQUENCY Wave frequency, n, is the number of waves passing a point in the liquid per unit time *(14).*

WAVE PERIOD Time period between arrivals of successive wave crests at a point.

WAVE RUN-UP Height to which water rises above still-water level when waves meet such things as a beach, wall, embankment, or causeway. Compare with Wave Set-Up and Wind Set-Up.

WAVE SET-UP The creation of waves from wind. Compare with Set-Up, Wind Set-Up, Wind Set-Down, and Wave Run-Up.

WAVE, SHALLOW WATER Water of such a depth that waves are noticeably affected by bottom conditions; customarily, water shallower than half the wavelength.

WAVE, SIGNIFICANT A statistical finding for denoting surface water waves with the average height and period of the one-third highest wave of a given wave group.

WEEPHOLE An opening left in such things as an impermeable wall, revetment, apron, lining, or foundation, to relieve the neutral stress or pore water pressure and permit drainage.

WEIBULL DISTRIBUTION See Probability Distribution.

WEIGHTED MEAN [Statistical] value [or statistic] obtained by multiplying each of a series of values by its assigned weight and dividing the sum of those products by the sum of the weights *(34).*

WEIR A dam across a channel for diverting flows or for measuring the flow.

WEIR, BROAD-CRESTED An overflow structure on which the nappe is supported for an appreciable length; a weir with a significant dimension in the direction of the stream. Highways generally function as broad-crested weirs when overtopped by floodwaters.

WEIR, CIPOLLETTI A contracted measuring weir, in which each side of the notch has a slope of 1 horizontal to 4 vertical, to compensate for end contractions; named after Caesar Cipolletti, an Italian engineer.

WEIR FLOW Free surface flow over a control surface which has a defined discharge versus depth relationship.

WEIR, MEASURING A device for measuring the flow of water. It generally consists of rectangular, trapezoidal, triangular, or other shaped notch in a thin plate in a vertical plane through which the water flows. The weir head is an index of the rate of flow. Unless a suppressed weir is specified the term may be taken to mean a contracted weir. See Weir, Cipolletti; Weir, Rectangular; and Weir, Triangular.

WEIR, RECTANGULAR A contracted measuring weir with a rectangular notch.

WEIR, SHARP-CRESTED A contracted measuring weir with its crest at the upstream edge or corner of a relatively thin plate, generally of metal.

WEIR, SUBMERGED A weir which in use has the tailwater level equal to, or higher than the weir crest. See Weir, Measuring.

WEIR, TRAPEZOIDAL A contracted measuring weir with a trapezoidal notch. See Weir, Cipolletti.

WEIR, TRIANGULAR A contracted measuring weir notch with sides that form an angle with its apex downward; the crest is the apex of the angle; a V-notch weir.

WELLS Shallow to deep vertical excavations, generally with perforated or slotted pipe backfilled with selected aggregate. The bottom of the excavation terminates in pervious strata below the water table.

WET WELL SUMP The feature in a pump station in which runoff waters are temporarily stored.

WETLAND ACQUISITION As used in the National Wetlands Priority Conservation Plan, any purchase of complete or partial interest in a wetland site obtained with total or partial government funding.

WETLAND BANK That document maintained to reflect wetland credit that may be available for use in the mitigation of a wetland impacted by a future highway action.

WETLAND BANKING Although not required at the time of a highway action, the process of creating, restoring or enhancing a wetland in conjunction with the highway action to

compensate for unavoidable and at the time unknown wetland impacts from some future highway action and then obtaining approval from the cognizant resource and regulatory agencies for this work as a wetland credit to be entered into the wetland bank.

WETLAND CREDIT The credited value in the wetland bank for substitute wetlands in a particular geographic area and biologic region as approved by the cognizant resource and regulatory agencies.

WETLAND LOSS INDEX Measure of loss of a wetland type within an ecoregion expressed by the equation:

$$\left[\frac{(Y - X)\,(100)}{N}\right]\left[\frac{(Y - X)(100)}{Y}\right]$$

$$\left[\frac{(\text{Unit Loss})(100)}{(\text{Net National Loss})}\right]\left[\frac{(\text{Unit Loss})(100)}{(1954\ \text{Unit Base})}\right]$$

Where

Y	=	1954 Unit Base km^2 per wetland type and unit area;
X	=	1974 Remaining km^2 per wetland type and unit area;
Y - X	=	Unit Loss (e.g., 1954-74 State loss per wetland type);
N	=	1954-74 Net National Loss per wetland type;
Unit	=	Area of comparison (e.g., ecoregion, State); and
Base	=	km^2 of wetlands in 1954 for the unit.

WETLAND LOSSES, HISTORIC The losses of wetlands from a particular site or loss of a specific type of wetlands within a region from the time of European settlement of the United States through the present.

WETLANDS Those lands having: wetland hydrology; hydric soils; and hydrophyte type vegetation as delineated by current editions of the *Federal Manual for Identifying and Delineating Jurisdictional Wetlands.* These include wetlands subject to Federal law regardless of whether they involve Federal, State, or private lands.

More generally, an area that is inundated or saturated by surface waters or groundwater at a frequency and duration sufficient to support and under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas. Mudflats, sand flats, rocky shores, gravel beaches and sand bars, although they often do not support vegetation, can also be considered wetlands. Wetlands typically have hydric soils, phreatic vegetation and wetland hydrology.

Some regulatory agencies may prefer land that has a predominance of hydric soils that is inundated or saturated by surface or groundwater at a frequency and duration sufficient to support "and that under normal circumstances does support," a prevalence of hydrophytic vegetation typically adapted for life in saturated soil conditions.

WETLANDS, JURISDICTIONAL See Jurisdictional Surface Waters.

WETLANDS, REPLACEMENT Replacement wetlands provided through mitigation methods to replace wetlands to be destroyed or adversely impacted on a specific highway project. Not synonymous with substitute wetlands. Compare with Wetlands, Substitute.

WETLANDS, SUBSTITUTE Wetlands that were created or acquired and developed (enhanced) in perpetuity through application of wetland mitigation methods on previously constructed highway projects. Not synonymous with replacement wetlands. Compare with Wetlands, Replacement.

WETTED PERIMETER The boundary over which water flows in a channel, stream, river, swale, or drainage facility such as a culvert or storm drain. The boundary is taken normal to the flow direction of the discharge in question. The length of the wetted contact between a stream of water and its containing conduit, measured along a plane at right angles to the flow in question; that part of the periphery of the cross section area of a stream in contact with its container. See Hydraulic Radius.

WIDTH CONSTRICTION A constriction whereby the flow is contracted in the horizontal plane only; no bottom contraction; a bridge with approach embankments across a floodplain is an example of a width constriction.

WILDLIFE Living things that are neither human or domesticated; mammals, birds and fishes [that may be] hunted by man according to the *Webster's New Collegiate Dictionary.* Compare with Livestock and Aquatic Life.

WIND SET-DOWN Lowering of the level of surface waters due to wind action. Corresponding fall in level at the windward side of a surface water body due to wind stresses on the surface. Compare with Wind Set-Up.

WIND SET-UP Raising of the level of surface waters due to wind action. Rise in level at the leeward side of a surface water body due to wind stresses on the surface. See Set-up. Compare with Wind Set-Down, Wave Run-Up, and Wave Set-Up.

WINDROW REVETMENT A row of stone (called a windrow) placed on top of the bank landward of an eroding stream bank. As bank erosion and mass wasting continues the windrow is eventually undercut, launching the stone downslope, thus armoring the bank face. Compare with Trench-Filled Revetment and Revetment.

WIRE-ENCLOSED RIPRAP See Riprap, Wire-Enclosed.

WIRE MESH Wire woven to form a mesh, the openings of which are of a suitable size, shape and durability to serve as an enclose for such things as rock, rubble, or broken concrete used as a mattress, gabion, or wire enclosed riprap. Also used as fencing on riparian spur dikes and retards.

WITHDRAWAL USE OF WATER The water removed from the ground or diverted from a stream or lake for use *(45).*

WSP Acronym for Water Supply Paper. See Water Supply Paper or Water Surface Profile.

X-PERCENT CHANCE FLOOD A flood magnitude that has X chances in 100 of being exceeded in any 1-year period. The occurrence of floods is assumed to be random in time; no schedule or regularity of occurrence is implied. The exceedance of a 1-percent chance flood is no guarantee, therefore, that a similar size flood will not occur next week or next year. Over time periods longer than 1 year, the risks of experiencing large floods increase in a nonadditive fashion. For example, the risk of exceeding a 1-percent chance flood one or more times during a 3-year period is 25 percent and during a 70-year period is 50 percent *(31).* Compare with Flood, One-Hundred Year; Flood, One-Thousand Year; and Flood-Frequency. See Probability Distribution.

YEAR See Climatic Year and Water Year *(37).*

ZONE OF AERATION The zone above the water table. Water in the zone of aeration does not flow into a well *(37).*

ZONE OF BREAKUP See Breakers.

ZONE, COASTAL See Coastal Zone.

ZONE, FLOOD See Flood Zone.

ZONE OF SATURATION The zone in which the functional permeable rocks are saturated with water under hydrostatic pressure *(47).* Water in the zone of saturation will flow into a well and is called groundwater *(37).* The Groundwater Subcommittee offers three definitions: 1. those parts of the earth's crust in which all voids are filled with water under pressure greater

than atmospheric; 2. that part of the earth's crust beneath the regional water table in which all voids, large and small, are filled with water under pressure greater than atmospheric; 3. means that part of the earth's crust beneath the regional water table in which all voids, large and small, are ideally filled with water under pressure greater than atmospheric.

The zone in which the voids in the rock or soil are filled with water at a pressure greater than atmospheric. The water table is the top of the saturated zone in an unconfined aquifer *(20).*

ZONE, LIMNETIC See Limnetic Zone.

ZONE, LITTORAL See Littoral Zone.

ZONE, PROFUNDAL See Profundal Zone.

ZONE, RECOVERY See Recovery Zone.

ZONE, UNSATURATED The Groundwater Subcommittee offers five definitions: 1. the zone between the land surface and the water table; 2. the zone between the land surface and the deepest water table which includes the capillary fringe (generally water in this zone is under less than atmospheric pressure and some of the voids may contain air or other gases at atmospheric pressure; also, beneath flooded areas or in perched water bodies, the water pressure locally may be greater than atmospheric); 3. the zone between the land surface and the regional water table (generally, water in this zone is under less than atmospheric pressure and some of the voids may contain air or other gases at atmospheric pressure; also, beneath flooded areas or in perched water bodies, the water pressure locally may be greater than atmospheric); 4. the zone between the land surface and the regional water table (generally, fluid pressure in this zone is less than atmospheric pressure and some of the voids may contain air or other gases at atmospheric pressure; also, beneath flooded areas or in perched water bodies the fluid pressure locally may be greater than atmospheric); 5. the zone between the land surface and the water table (generally, water in this zone is under less than atmospheric pressure and some of the voids may contain air and other gases at atmospheric pressure; also, beneath flooded areas or in perched water bodies, the water pressure locally may be greater than atmospheric).

The zone between the land surface and the water table. It includes the root zone, intermediate zone and capillary fringe. The pore spaces contain water at less than atmospheric pressure, as well as air and other gases. Saturated bodies, such as perched groundwater, may exist in the unsaturated zone *(20).*

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