

## GLOSSARY OF STREAM STABILIZATION TERMS

The purpose of this glossary is to define terms that are commonly used in streambank protection, and in a broader sense, stream and channel stabilization and restoration. Since streambank protection involves multiple sciences, as well as practical considerations of construction and operation, these terms originate from biology, construction technology, engineering design, environmental science, fluvial geomorphology, geology, hydraulics, hydrology, regulatory considerations, sedimentology, soil science, and the other overlapping and complementary disciplines which comprise river mechanics and streambank protection technology.

**Abrasion** - The process of wearing down, or wearing away, stream bed and bank material by friction of solid particles moved by gravity, water, ice, or wind.

**Absolute time** - Geologic time measured in years. Compare to relative time.

**Acidic** - A material with a pH of less than 7.0 (opposite of alkaline). Soil nutrients are generally less soluble and less available to plants in moderately or strongly acid soils. Agricultural lime is commonly applied to acidic soils to increase the pH.

**Acclivity** - An ascending slope, opposite of declivity.

**Accretion** - The process of sediment accumulation due to flowing water.

**Acre** - An area of measurement equal to 43,560 square feet.

**Active Channel width** - The portion of the channel where sediment actively moves and/or permanent vegetation generally does not become established.

**Aeolian** - Sediment deposited by wind. Derived from Greek mythology; Aeolus was god of the winds.

**Aggradation** - The geologic process by which stream beds, flood plains, and the bottoms of other water bodies are raised in elevation by the deposition of material that was eroded and transported from other areas. Typically a stream that is undergoing aggradation over a long section of its length has an excess supply of sediment. Aggradation is the opposite of degradation.

**Aggregate** - Sand, gravel, crushed stone, or slag, usually having a known range of particle sizes. Used either with a cementing medium to form concrete, or alone as in a roadway bed or for railroad ballast.

**"A" horizon** - Soil zone immediately below the surface of the ground, from which soluble material and fine-grained particles have been moved downward by water seeping through the soil. Varying amounts of organic matter can give the "A" horizon varying colors, usually ranging from gray to black. Sometimes called topsoil.

**A-Jacks** - A proprietary product for scour protection, consisting of precast concrete units. Each unit has six legs, which interlock with other A-Jacks when the units are placed in the stream, providing greater stability. The units are available in various sizes from Armortec, Inc., Bowling Green, KY.

**Alkaline** - A material with a pH greater than 7.0 (opposite of acidic).

**Alluvial deposit** - Clay, silt, sand, gravel or other sediment deposited by the action of running, ponded, or receding water.

**Alluvial fan** - Depositional landforms whose surface forms a segment of a cone that radiates downslope from the point where the stream moves from a steep gradient to a flatter gradient and suddenly loses some sediment transport capacity. Typical of arid and semiarid climates, but not confined to these areas.

**Alluvial plain** - Flood plains produced by the filling of the valley bottom with alluvium. Alluvial plains are usually composed of fine mud, sand and gravel, but can include cobbles, boulders and organic material.

**Alluvial stream** - A stream whose channel boundaries are composed of appreciable quantities of the sediments transported by the stream flow. An alluvial stream is free to adjust its dimensions of size, shape, pattern, and slope in response to changes in flow and sediment.

**Alluvium** - A general term for all material deposited by a modern stream anywhere along its course. Alluvium would include sediments laid down in river beds, flood plains, lakes, fans, and estuaries.

**Alternate bars** - Depositional features on opposite sides of the channel formed when the low-water channel of a stream meanders within the banks of a straight section of the stream.

**Anaerobic** - An organism that can live without oxygen, or a process that takes place in the absence of oxygen. See anoxic.

**Angle of repose** - The maximum slope or angle (measured from the horizontal) at which granular noncohesive material (such as soil, gravel, or loose stone) comes to rest. Also called slope of natural repose (SONR).

**Anoxic** - The absence of oxygen, usually referring to zones of a lake that are devoid of oxygen.

**Apex of a bend** - The area near the center of a bend. Usually measured by dividing the total arc angle of the bend by two. E.g., in a 90 degree bend the apex would be the section of the arc near 45 degrees.

**Application rate** - The quantity (mass, volume, or thickness) of material applied per unit area or along a lineal distance (one ton per ft of stone as an example).

**Aquifer** - A permeable geological unit of sediment or rock within which groundwater is stored and transported.

**Arc** - A segment, or section of a curve.

**Arc Angle** - In degrees, the angle associated with a segment of a curve or circle. In river engineering usually associated with the degree of curvature of a bend.

**Armoring** - (1) Natural process whereby an erosion-resistant layer of relatively large particles is formed on a streambank or stream bed due to the removal of finer particles by streamflow. This layer inhibits the transportation of underlying finer material until such time that a flow of sufficient magnitude occurs and destroys the armor layer. (2) Placement of a covering on a streambank that prevents erosion.

**Arroyo** (also wadi or wash) - Flat-floored, vertically walled channel of an ephemeral stream typical of semiarid climates.

**Artesian** - A term referring to water existing under hydrostatic pressure in a confined aquifer. The water level in a borehole penetrating an artesian aquifer will usually rise well above the upper boundary of the water bearing rocks and may even flow out of the borehole at the surface, in which case it is known as a flowing artesian well.

**Articulating Concrete Mattress (ACM)** - Systems of individual concrete blocks (called elements) physically connected by cables or ultraviolet-stabilized rope that are placed on a streambank or streambed to prevent erosion. If required, filter fabric can be placed before mattress installation. The cavities between elements permit bank drainage and can allow growth of either volunteer or planted vegetation. This technique has been used extensively to protect pipelines since it can be easily removed, the pipeline can be repaired, and the ACM replaced.

**Articulated Concrete Mats** - A specialized form of articulated concrete mattress consisting of individual concrete blocks approximately four feet long by 1.5 feet wide, connected together with corrosion-resistant wire rope and fasteners. These mats are primarily placed for bank protection on the lower Mississippi River by the U.S. Army Corps of Engineers using the Mat Sinking Unit, the

only one of its type in the world.

**"As-built"** - The size, location, and condition of river training structures or bank protection works immediately after construction has been completed. Typically a survey of the structures is taken (referred to as "as-builts") and compared to the original construction plans to determine whether the project was built correctly. However, the most useful aspect of as-builts may be in future inspection and monitoring as an aid to determine how the protection is functioning and whether maintenance or reinforcement is required.

**Asphalt block** - Precast or broken pieces of asphalt that can be hand-placed or dumped on a streambank or filter for protection against erosion. The introduction of asphalt into a waterway may be environmentally unacceptable because of water quality concerns.

**Average depth (d)** - Calculated by dividing the cross-sectional area of the channel by the channel width.

**Avulsion** - An abrupt change in channel course that occurs when a stream suddenly changes its course, usually associated with a flood or even a more catastrophic event. The legal interpretations of whether an "avulsion" has occurred is often the subject of bitter and prolonged legal dispute. The decision usually rests upon judicial precedent in a particular jurisdiction. When used in a geological rather than an engineering or geomorphological context, "avulsion" may refer to the stream changing meander belts within a valley, or even breaking through into another valley.

**Backfill** - (1) *n.* The material used to refill a ditch, trench, or other excavated area. (2) *v.* The process of replacing excavated material back into the original excavated area.

**Backswamp** - A landform deposited over time in a slow moving or ponded backwater section of a waterway.

**Backwater effect** - An increase in water surface elevation upstream of an obstruction. The obstruction may be either permanent (such as a roadway embankment or dam), semi-permanent (such as a landslide, beaver dam, or debris accumulation), or temporary (such as a flood in a downstream channel or an ice jam.)

**Bank** - (1) The side slopes of a channel between which the streamflow is normally confined at flows up to and including bankfull discharge. (2) The side of the stream on the observer's right or left when facing downstream, either "right bank" or "left bank", sometimes called "right descending bank" or "left descending bank". Unfortunately, cross-sections of the channel are sometimes recorded, plotted, and entered into hydraulic computational programs without regard to this convention. Therefore, one must be certain of the convention being used in a particular case.

**Bank Barbs** - See Rock vanes.

**Bankfull discharge** - The discharge which overtops the streambank. On streams which are neither aggrading or degrading, this is often associated with a return interval of about 1.5 years, but this varies widely depending upon the region and the stream stability.

**Bankfull stage** - The water surface elevation attained by the stream when flowing at the bankfull discharge, when it is at the point of overtopping the banks at a given location. The local gage may be referenced to an arbitrary datum (see stage.)

**Bankfull width** - The width of the water surface when a stream is at bankfull stage.

**Bank zones** - See Zones, bank.

**Bar** - A sand, gravel, or cobble deposit found on the bed of a stream that is often exposed only during low-water periods.

**Base flow** - The discharge of the stream derived from natural storage. Typically the average stream discharge during low flow conditions.

**Base flow width** - The width of the water surface when the stream is at base flow discharge.

**Base level** - Level below which the bed of the stream cannot erode. Usually considered to be the elevation of the water surface of the stream or water body that the stream in question flows into for a given hydrologic condition. Ultimate base level for all streams is sea level. In the framework of engineering time, a non-erodible grade control structure or geologic formation may also serve as a base level.

**Basin** - See drainage basin.

**Bathymetry** - The measurement of ocean depths and the charting of the topography of the ocean floor. The equivalent term "hydrographic survey" is often used for rivers, streams, and lakes, and refers to surveying and mapping that part of the water body which is underwater at the time of the survey.

**Bayou** - A relatively small stream, esp. southern U.S.

**Bed** - (1) The bottom of a channel. (2) The floor or bottom on which any body of water rests. (3) In geology, a seam or deposit of mineral, also the smallest division of a stratified series.

**Bedload** - Sediment moving on or near the stream bed by saltation (jumping), rolling, or sliding.

**Bedload discharge** - The quantity of bedload passing a cross-section in a unit of time.

**Bedload driven** - A severely overwidened stream with an oversupply of sediment where the roughness of the bed material causes the stream to partially abandon its main course and distribute flow toward one or both banks, causing increased bank erosion and continued widening. Basically, an aggrading braided stream.

**Bedload sampler** - See Bed material sampler.

**Bed material** - The sediment mixture of which the bed is composed. In alluvial streams, bed material is transported in varying quantities depending upon the flow.

**Bed material discharge** - The quantity of bed material passing a cross-section in a unit of time, either in suspension or as bedload.

**Bed material load** - Synonymous with bed material discharge.

**Bed material sampler** - A device for obtaining samples of the bed material for analysis of its composition.

**Bedrock** - The solid rock underlying gravel, sand, and soils and overlying the mantle rock, ranging from surface exposure to depths of several hundred feet.

**Bed slope** - The longitudinal inclination of the channel bottom.

**Bench** - A strip of relatively level earth or rock breaking the continuity of a declivity (slope). See berm.

**Bend** - A change in the direction of a stream channel.

**Bendway Weir** - One of a system of low-elevation, level-crested, upstream angled underwater sills designed to break up secondary currents and redirect water flowing over the weirs away from the eroding outer bank of the bend and toward the center of the channel. Weirs can be constructed of stone, tree trunks, or geotextile tubes or bags filled with grout or streambed material.

**Benthos or benthic** - (1) The deepest part of sea, lake, or ocean. (2) The organisms living on river, sea or lake bottoms.

**Berm** - (1) A shelf that breaks the continuity of a slope. (2) A horizontal depositional feature located along the bank of a stream (3) A ridge of earth constructed to direct the flow of surface water. (4) The embankment of a pit or pond which may be wide and solid enough for vehicular traffic. (5) A surcharge of earth or other material added to a levee to increase geotechnical stability and to reduce seepage during floods.

**Best Management Practice (BMP)** - The preferred methods and/or products that will correct or control erosion or sedimentation on a specific site for particular site conditions.

**"B" horizon** - Soil zone below the "A" horizon. Usually contains some material moved down from the A horizon. Sometimes called subsoil.

**Bight of the bend** - See apex of a bend.

**Binder** - (also emulsion, tackifier) - Natural or synthetic additive that causes an otherwise noncohesive material to become bound into a cohesive matrix. Used to reduce soil erosion and retain seeds, which allows germination and growth.

**Bioengineering** - The science of using living materials (plants) to stabilize an eroding bank of a stream. See also soil bioengineering.

**Bituminous mattress** - An impermeable rock-, mesh-, or metal-reinforced layer of asphalt or other bituminous material placed on a streambank to prevent erosion.

**Blanket** - (1) Material covering all or a portion of a streambank to prevent erosion. (2) Also pertains to a large group of rolled materials consisting of coir (coconut fibre), jute, straw, wood fibre, or various synthetic materials used to prevent erosion, trap sediment, protect seed, and promote the growth of vegetation. These mats can either be permanent or biodegradable.

**Blockage** - Any material in the stream channel that causes a backwater effect.

**Bottomland** - See floodplain.

**Bottomset bed** - Layer of fine sediment deposited in a body of standing water beyond the advancing edge of a growing delta. As the delta grows, it covers the bottomset bed with additional sediment.

**Boulder** - A large, naturally occurring stone, which is transported by a stream only during high flows. Technically, any bed material particle with a diameter greater than 256 mm; the largest bed material size, larger than a cobble.

**Braided river** - A wide and shallow river whose flow passes through a number of interlaced branches that divide and rejoin and are separated by bars and shoals.

**Bridge scour** - Scour of the streambed at highway or railroad bridges caused by the localized hydraulic contraction of the bridge piers, abutments, or approach fills, and not by systemwide

erosional processes. Such scour may result in catastrophic failure of the bridge and is difficult to predict and protect against, although research continues.

**Broadcast** - The application of material scattered or sprayed on the soil surface. E.g., broadcast seeding is the uniform distribution of seeds over the entire planted area.

**Buffer zones** - Areas of trees, grass, or other vegetation located between top bank and adjacent pastures or cultivated fields (also called greenbelts or riparian buffer zones).

**Bulkhead** - A vertical or nearly vertical retaining wall or structure supporting a natural or artificial embankment.

**Candidate species** - Plant and animal taxa reviewed for possible inclusion on a Federal or State list of Endangered or Threatened species. A candidate species is not protected by law. See also Endangered species and Threatened species.

**Canopy** - The foliage of a tree, shrub, or herbaceous plant.

**Cap out** - The addition of rock to a river training structure, either to reinforce and bring permanence to a short-lived permeable structure, such as a timber pile dike, or to restore a structure to the original elevation in the event of settlement or scour.

**Caving** - The collapse of a bank following undercutting due to flow or wave erosion of the toe or an erodible soil layer above the toe.

**Cellular-block mattress** - See Articulated Concrete Block Mattress

**Cellular confinement system** - A synthetic grid matrix with open spaces filled with soil, sand, gravel, or concrete. The matrix mechanically stabilizes these materials and is used for erosion control and/or load support.

**Channel** - A natural or artificial waterway that continuously or periodically contains moving water.

**Channel blocks** - See valley plug and backwater effect.

**Channel Evolution Model (CEM)** - A conceptual classification system designed to determine the status of a stream as the effects of downstream base level lowering move upstream. When streambanks exceed a critical geotechnical threshold, bank failure results in rapid widening of the stream cross-section on both banks. As the bed degrades, and a stable bed slope is restored, a compound channel feature forms, with a low-flow channel flanked by one or two stable berms. The CEM can be useful in predicting the changes that can be expected to occur in a disturbed stream in the future,

by substituting space (distance along the stream channel) for time.

**Channel fills** - Accumulations of sediment in abandoned or aggrading channel segments, ranging from relatively coarse bedload to plugs of clay and organic mud.

**Channel-forming discharge** - See dominant discharge.

**Channelization** - The straightening of a stream, usually performed to increase hydraulic conveyance or to ease navigation.

**Check dam** - (1) A control structure placed in the channel downstream from a small headcut. (2) Small barriers constructed across a swale or drainage ditch to reduce flow velocities. See also grade control structure.

**Chemical stabilization** - Streambank 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 treated material.

**Chemical weathering** - Weathering of rock material by chemical processes that transform original material into new chemical combinations.

**Chevron** - A redirective structure spanning the streambed, keyed into both banks, with equal legs angled upstream at approximately 30 degrees, with a lower crest elevation near the center of the channel. Chevrons can act as both a grade control structure (bed armoring) and bank protection by redirecting currents away from the banks and toward the center of the channel.

**"C" horizon** - Soil zone that contains partially disintegrated and decomposed parent material. Lies directly under the "B" horizon and grades downward into unweathered (parent) material.

**Chute** - A secondary channel, usually on the inside of a bend in a meandering stream, or a minor channel in a braided stream.

**Chute cutoff** - The process of a chute becoming the main channel, either in terms of the amount of flow it carries or the depth or area of flow. The process can be gradual or relatively dramatic, and often results in hotly contested legal disputes.

**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). Clay is typically the finest (smallest) particles contained in a soil.

**Clay blanket** - Layer of compacted clay placed over noncohesive bank soils to protect them against erosive streamflow.

**Clay plug** - Cohesive sediment with much organic muck deposited in a cutoff river meander. (See channel fill).

**Clean water act** - Federal law that sets maximum permissible levels of pollution in waters of the United States. This law requires that a permit be issued before performance of any activities that could possibly impact the quality of any waters of the United States. This law is administered by the Environmental Protection Agency. The permitting process is administered by the U.S. Army Corps of Engineers.

**Climax plant community** - The final species diversity found in a matured vegetated area.

**Cobbles** - A rock fragment between 64 and 256 mm in diameter, thus larger than gravel and smaller than a boulder.

**Cofferdam** - A temporary watertight enclosure built in the water and pumped dry to expose the channel bottom so that construction (locks, dams, river training structures) can be undertaken.

**Cohesion** - The capability of sticking or adhering together.

**Cohesive sediments** - Sediments whose resistance to initial movement or erosion is affected mostly by the cohesive bonds between the particles.

**Coir fibre** - Organic fibrous tissue obtained from the fruit of the coconut palm (*Cocos Nucifera* L.). Coir fibre lies between the exocarp (tough outer covering) and the endocarp (hard shell that covers the kernel). Coir fibre can be used as a mulch, as a soil substrate mixture, and in the manufacture of erosion control blankets, woven geotextiles, coir tubes and logs, and other manufactured erosion control products.

**Colluvial** - Pertaining to material or processes associated with transportation and/or deposition by mass movement (gravity) and runoff on sideslopes and/or at the base of slopes.

**Colluvium** - A general term applied to loose and unsorted deposits, usually at the toe of a bank or slope, brought from the upper bank chiefly by gravity. Talus and cliff debris are forms of colluvium.

**Colonization** - The habitation by natural invasion of any site by generally highly adaptable and opportunistic species, e.g., smartweeds colonizing a newly exposed mudflat in a lake, river, or reservoir.

**Complex response** - A series of interrelated responses by a stream to an alteration or change.

**Concave** - Curved like the inner surface of a sphere.

**Concrete block** - Precast concrete material placed on a streambank or filter to prevent erosion.

**Confluence** - The junction of two or more streams, or rivers, or the junction of a tributary to a river or stream.

**Constriction (flow)** - A reduction in the channel cross-sectional area that results in greater average stream velocities within the constricted area.

**Continuous Bank Protection** - A bank protection technique that covers the entire longitudinal length of eroding bank in an unbroken manner. Opposite of Discontinuous Bank Protection.

**Contour** - (1) An imaginary line on the surface of the earth connecting points of the same elevation. (2) A line on a survey or map connecting points of the same elevation.

**Contraction dikes** - Dikes opposite each other, extending from both banks, designed to widen and/or deepen the navigable section of the channel. Usually constructed in crossings or relatively straight sections of the river.

**Controlled river or stream** - See regulated river or stream.

**Conveyance** - The ability of the stream to transport water. Often expressed numerically, with the most well-known relationships being Manning's formula or Chezy's formula, which both use an estimated value of channel "roughness" along with the cross-sectional area of flow and the hydraulic radius to obtain a numerical value for a given location.

**Convex** - Having a surface or boundary that curves or bulges outward, like the surface of a sphere.

**Creep** - (1) The slow gravity driven downslope mass movement of rock or soil that is usually not perceptible except to observations of long duration. (2) The slow change in length or thickness of a material under prolonged stress.

**Crest elevation** - (1) The maximum elevation of a water surface during a specific period of time. (2) The highest elevation of a structure.

**Crib** - A frame structure, filled with earth or stone ballast, designed to resist erosion of bank materials. Cribs can be vegetated to improve stability, reduce near-structure stream velocities, improve aesthetics and/or ecological values.

**Critical depth** - A theoretical hydraulics term which has little

application to alluvial channels. It is the depth in a culvert or channel at which, for a given discharge, flow changes from subcritical to supercritical or vice versa. Flow in an alluvial channel is always subcritical, except in rare circumstances such as a levee break. Supercritical flow is characterized by such high velocities that a moveable bed channel will scour to such an extent that subcritical flow is soon restored. (See hydraulic jump).

**Critical habitat** - Specific areas within a geographical area occupied by an endangered or threatened species that when adversely impacted could be detrimental to species survival or recovery.

**Critical shear stress** - The amount of shear stress required to initiate particle motion, as exerted by streamflow on the channel boundary.

**Crossing** - The relatively short and shallow reach of a stream where the thalweg crosses from one bank to the other, either between bends or between pools in a straight reach.

**Crossover or crossover point** - Same as crossing.

**Cross-section** - A diagram or drawing of a channel, made approximately perpendicular to the channel and/or flow direction, that defines the banks, bed, and water surface. Also may refer to the physical location of the cross-section on the ground.

**Cross vane** - A grade stabilization structure consisting of rock vanes on each bank connected with a low elevation sill oriented perpendicular to flow.

**Current** - The flow of water (velocity) through a waterway channel.

**Current set** - A term originated by river pilots to describe the direction of the current as it affects navigation at a specific location, especially approaching a bridge, navigation structure, sharp bend, or other critical point.

**Cut bank** - The eroding bank of a meandering stream, usually the outside (concave bank) of the bend. The cut bank is often steep and actively eroding and is located directly opposite the point bar.

**Cutoff** - A channel formed when a stream cuts, or is artificially realigned, through the neck of a bend or through a chute, thereby shortening its channel. See chute cutoff and neck cutoff.

**D-50** - The sieve opening size which allows 50% of a given sample to pass through.

**Datum plane** - The horizontal surface from which a set of

measurements are referenced.

**Deadman** - A log or block of concrete buried in the bank or bed of a stream that is used as an anchoring system for tree trunks or other bank stabilization structures.

**Dead Stout Stake** - A type of wooden stake used to anchor any of a number of different types of bioengineering materials. The dead stout stake is a 2 inch by 4 inch by 2 to 4 ft long wooden board with a long diagonal edge ending in a point.

**Debris** - See Large Woody Debris.

**Debris slide** - Small, rapid movement of largely unconsolidated material that slides or rolls downward to produce irregular topography.

**Declivity** - A descending slope, as opposed to acclivity.

**Decomposition** - See chemical weathering.

**Deflector** - Any object that redirects near-field currents away from a streambank. The patterns of deposition and scour in the immediate vicinity can be quite complex, varying with time and flow. A "shadow" of fine sediment usually settles on the streambed immediately downstream of the deflector, and bed scour will usually occur at the point of maximum flow constriction, that is, at the end of the deflector.

**Degradation** - The lowering of a relatively long reach of channel bed due to scour, usually caused by a lowering of the base level, a reduction in the size or quantity of sediment entering the reach, or, more rarely, a long-term increase in discharge. Degradation can occur along an entire stream length, a certain reach of a stream, (i.e. downstream of a dam, reservoir, or other sediment retention structure), or systemwide (every stream in the watershed is undergoing degradation). The opposite of aggradation.

**Degree of Curvature** - See arc angle.

**Delta** - A deposit of alluvium, usually flat and fan-shaped, formed where moving water is slowed by a body of standing water. Typical examples are found where a river flows into a bay, where a river flows into a lake or reservoir, or where a tributary flows into a larger stream or river.

**Dendritic drainage pattern** - A drainage pattern in which the streams branch randomly in all directions and at almost any angle, resembling in plan view the branching habit of certain trees. This pattern is produced where a consequent stream receives several tributaries which in turn are fed by smaller tributaries. It is indicative of streams flowing across horizontal and homogeneous strata offering uniform resistance to erosion.

**Density** - The mass of a substance per unit volume.

**Density current** - A highly turbid mixture of water and very fine grained sediment which flows into and along the bottom of a reservoir because its density is greater than that of the standing water in the reservoir.

**Deposit** - Earth material of any type that has accumulated by natural processes.

**Deposition** - The mechanical or chemical processes through which sediments settle and accumulate.

**Desiccation cracks** - The phenomenon which occurs in fine grained soils or dredged material (usually containing some clay) in which cracks form as the material dewateres and consolidates.

**Design discharge** - A quantity of flow that is expected at a certain location as a result of a design storm or flood frequency. The tractive force or velocities associated with the design discharge are commonly used to compute the size and thickness of stone riprap for protection works.

**Design frequency** - The reoccurrence interval for hydrologic events used for design purposes. E.g., a design frequency of 50 years (Q-50) means a storm of a magnitude that would be expected to occur on the average of once in every 50 years (2 percent chance of occurrence during a particular year).

**Design life** - The length of time for which it is economically sound to require a structure or project to successfully function without major repairs or replacement.

**Design storm** - A selected rainfall pattern of specified amount, duration, intensity, and frequency that is used to calculate the volume of water runoff and peak discharge rate.

**Detritus** - (1) Minute fragments of plant parts found on the soil surface. When fused together by algae or soil particles, this is an indicator that surface water was recently present. (2) Organic matter undergoing decomposition, with attendant protists, protozoans, and other organisms that serve as food for detritus feeders.

**Dewater** - The removal of surface or subsurface water. Can apply to the permanent removal of water behind a large dam, or to the temporary emptying of a dammed section of a river or stream for construction purposes, i.e. pumping water from an area enclosed by a coffer dam.

**Dike** - (1) A structure attached to and extending from the

streambank into the channel that is designed to (a) reduce the stream velocity as the current passes through the dike, thus encouraging sediment deposition along the bank (permeable dike) or (b) deflect erosive currents away from the streambank (impermeable dike) or (c) improve the depth and/or alignment of the navigation channel (contraction dike). Usually more than one structure is built at a given location; the aggregate is called a "dike field". A dike is sometimes referred to as a groin, jetty, spur, or wing dam. (2) A levee (esp. European).

**Dike notching** - Removal of a short section of the crest of a dike to concentrate flow and decrease sedimentation between dikes, ideally increasing habitat diversity in the area downstream of the dike or within a field of dikes.

**Discharge** - See stream discharge or sediment discharge.

**Discontinuous Bank Protection** - Redirective or indirect bank protection methods spaced at intervals along an eroding bank. The sections of the bank between structures are not treated or disturbed.

**Dissolved load** - The part of the stream load that is carried in solution, such as chemical ions yielded by weathering and erosion of the land mass.

**Dissolved oxygen (DO)** - Oxygen molecules dissolved into a body of water that are necessary for the respiration of most aquatic organisms. High concentrations of DO are usually present in free-flowing, tumbling water, but can be provided artificially by aerator pumps or constructed riffles or falls.

**Dissolved solids** - The mass of dissolved constituents in water determined by evaporating a sample to dryness, heating to 103-105 C for two hours, desiccating, and weighing.

**Distressed streambank** - A bank that has experienced, or is currently experiencing, erosion or failure.

**Distributary** - Any channel, waterway, or outlet that conveys water away from a stream. Opposite of tributary.

**Divided Flow** - The situation where streamflow is divided into two or more channels, separated by bars or islands. The channel which normally carries the most discharge is called the "main channel"; and the channel(s) which carry the remainder of the flow are "secondary channel(s)". The division of flow often varies with the total amount of streamflow, since the conveyance of each channel changes as the water level in the stream changes.

**Dominant discharge** - A term developed in an attempt to quantify a single flow which governs the longterm behavior of a stream. An

abstract quantity, since a single flow cannot create precisely the same channel as a continually varying range of flows over a long period of time. Often considered to approximate a bankfull discharge in a stream that is neither aggrading or degrading, but may also be viewed as the flow that over many hydrologic cycles transports the most total bed material sediment. Also called "channel-forming" discharge.

**Dormancy or dormant season** - The season of the year when plants no longer grow. For deciduous plants the time between leaf shedding and when the leaf buds appear. Roughly between late fall and early spring, dependent on weather and species.

**Drainage** - Interception and removal of ground or surface water by artificial means, such as excavating channels or placing pipes.

**Drainage basin or drainage area** - An area confined by drainage divides, often having only one outlet for discharge. Sometimes (esp. U.S.) called a watershed (not to be confused with U.K. usage of watershed, which is a drainage divide).

**Drainage pattern** - The configuration or arrangement in plan view of the natural stream courses in an area. Usually strongly related to the local geologic and geomorphologic features and history.

**Drawdown** - See rapid drawdown.

**Dredge spoil** - See dredged material.

**Dredging** - The process of excavating sediment from a watercourse, reservoir, or wetland.

**Dredging window** - That period of time when it is environmentally safe to dredge and deposit dredged material in an area occupied by a species of concern, such as the non-breeding season in areas with important waterbird colonies, or non-spawning season for locally important fish species.

**Drop inlet** - A structure in which water drops (1) through a vertical riser connected to a discharge conduit or (2) over the crest of a vertical wall to a lower elevation.

**Drop pipe** - A vertical pipe designed to convey water from an overbank area into the stream without detrimental effects.

**Drop structure** - A structure in a channel or conduit which permits water to drop to a lower level. In open channel hydraulics it is usually associated with efforts to control the grade (bed elevation) of the stream.

**Dunes** - Bed forms with triangular profile that advance downstream due to net deposition of particles on the steep

downstream slope. Dunes move downstream at velocities that are slow when compared to the stream flow velocity.

**Duration of flow** - See flow duration.

**Dynamic equilibrium** - A stream that has adjusted its width, depth, and slope such that the channel is neither aggrading or degrading. However, change may be occurring in the streambanks due to natural meandering, erosion may result, and bank stabilization may be necessary in critical areas.

**Ecological community** - See ecosystem.

**Ecological stage** - A specific period of growth or development of an ecological community; e.g., grassland could be an intermediate stage in the developmental process of a disturbed site that will ultimately become a forest.

**Ecological succession** - The progression of a site from early growth stages to climax; e.g., on a cleared site the stages of succession over time could be bare ground, sparse herbaceous cover, dense herbaceous cover, shrub/grasses, shrub/trees, and finally, forest. Succession in the riparian zone can be disturbed by channel migration, hydraulic events, or human disturbance.

**Ecoregion** - A geographic area defined by similarity of climate, landform, soil, potential natural vegetation, hydrology, or other ecologically relevant variables.

**Ecosystem** - All of the organisms (community) in a given area interacting with the physical environment; the interaction between living organisms and their non-living environment.

**Ecotone** - The transition zone between two ecological communities. The ecotone has some of the ecological features of both communities, but has its own distinct ecological structure, and can include species unique to the area.

**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.

**Effluent** - A material which flows out from the point of concern. e.g., sewage water or other waste liquids flowing out of a reservoir basin or treatment plant.

**Elevation** - The vertical distance from a datum to a specific point or object on the earth's surface or water surface.

**Embeddedness** - The degree to which an object is buried in surrounding stream sediment.

**Emulsion** - See binder.

**Endangered species** - A plant or animal species of such limited and declining population (in danger of extinction throughout all or a significant portion of its range) that the species has been legally placed on a Federal or State Endangered Species list. Federally listed species and their needs are published in the Federal Register. Species that decline to endangered status usually do so as a result of degradation or destruction of preferred habitat. By law the listed species and its habitat is protected from destruction. See also Candidate and Threatened species.

**Endangered Species Act of 1973** - A Federal law to designed to prevent the extinction of endangered or threatened species of plants or animals. Sections of the law describe how to identify and list threatened and endangered species; identifying, designating, and revising critical habitat; developing and revising recovery plans; and monitoring species removed from the list of threatened or endangered species.

**Energy dissipator** - Any object or structure installed at the outlet of a channel, drop structure, or conduit designed to reduce the effects, or absorb the force of high-velocity and high-energy flow. It may consist of a wide variety of materials and designs, such as riprap, boulders, linings, baffles, staggered blocks, or end sills.

**Energy grade slope** - 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 a distance of  $U^2/2g$  above the water surface ( $U$  = velocity and  $g$  = acceleration due to gravity).

**Engineering fabric** - See geotextile.

**Entrain** - To detach and transport an object due to the velocity of a moving fluid.

**Environmentally sustainable development** - See sustainable development.

**Eolian** - Same as aeolian.

**Ephemeral stream** - A stream that flows only in direct response to precipitation and receives little or no sustained supply from snowmelt, groundwater, or other sources. An ephemeral stream's channel is at all times above the water table.

**Erodible** - Capable of undergoing erosion.

**Erosion** - The wearing away of the land surface by detachment of soil and rock fragments through the action of moving water, wind, and other geological agents.

**Erosion control** - The prevention and/or reduction of soil particle movement. Erosion control reduces soil detachment, transport, and deposition.

**Erosion control blanket (ECB)** - A degradable material placed on a bank for the purpose of preventing erosion or providing temporary stabilization until vegetation is established. Sometimes called "Rolled erosion control product", or RECP. Composed of processed natural or polymer fibers bound together structurally, chemically, or mechanically to form a continuous blanket.

**Erosion control netting (ECN)** - A woven mesh of natural fiber or geosynthetic material used either as a component of "Rolled erosion control product" (RECP), or as a separate degradable cover for mulch.

**Erosion control revegetation mat (ECRM)** - A permanent blanket made of synthetic material used for long term protection against soil movement.

**Escarpment** - A steep slope or long cliff resulting from erosion or faulting and separating two relatively level areas.

**Essential habitat** - Habitat needed by a species to survive or recover, but not officially designated as "critical habitat".

**Estuary** - The seaward end or the widened funnel-shaped tidal mouth of a river valley where fresh water comes into contact with seawater and where tidal effects are evident.

**Evapotranspiration** - The diffusion of water vapor into the atmosphere from a vegetated surface.

**Exotic** - An organism or species that is not native to the region; a foreign species artificially introduced by man. Exotic species usually have few natural enemies or diseases, are extremely adaptable, and often become dominant at a site.

**Expansion** - A rapid or abrupt increase in the width of a stream. This expansion usually results in slower average velocities and deposition of sediment within the expansion area, but local bank scour may occur if the expansion is abrupt.

**Fabric** - See geotextile.

**Fabric-formed concrete systems** - Geotextile tubes, bags, or mattresses filled with grout or concrete. Used for "armor" bank protection.

**Failure** - Collapse or slippage of a large mass of bank material into a stream.

**Failure plane** - See slip plane.

**Fall velocity** - The falling or settling rate of a particle in a given medium.

**Fascine** - Cigar-shaped bundles of tree or shrub branch cuttings tied tightly together and anchored into trenches using either live stakes or dead stout stakes. Within the bundle all tips of the branches are at one end of the bundle and the butt ends are at the other end of the bundle. Fascines are installed on a slope with the butt ends of all branches at the lower elevation. The butt ends are usually covered with soil to promote root growth. Fascines are used for a wide variety of slope stabilization projects. Sometimes called a "live fascine". A variation is the "reinforced fascine" which uses either a small proprietary anchor or 5 ft sections of 1/2 inch diameter rebar driven through and tied to the fascine as anchors. See also Wattle.

**Fault** - (1) The relative displacement of formerly adjacent points on opposite sides of the fault, measured in the fault surface. (2) A smooth joint or crack where the strata have moved upon each other.

**Fence** - A streambank protection technique consisting of wire mesh or timber attached to a series of posts, sometimes in double rows; the space between the rows may be filled with rock, branches, brush, hay bales, or other materials. Fences may be placed either parallel to the bank or extended into the stream; in either case these structures decrease the flow velocity and encourage sediment deposition within the area protected by the fence.

**Feral animals** - Any domestic animal such as a dog or cat that has returned to the wild or was born to wild parents, survives by its own resources, and is no longer or has never been domesticated or a pet.

**Fetch** - The area in which waves are generated by wind having a rather constant direction and speed; sometimes used synonymously with fetch length.

**Fetch length** - The horizontal distance (in the direction of the wind) over which wind generates waves and wind setup. See fetch.

**Fill material** - Soil that is placed at a specified location to bring the ground surface up to a desired elevation.

**Filter** - A layer of fabric, sand, gravel, or graded rock placed, or developed naturally where suitable in-place materials exist, between the bank revetment or other river training structure and the underlying soil for one or more of three purposes: to prevent the soil from moving through the revetment by piping, extrusion, or erosion; to prevent the structure from sinking into the soil; and to permit natural seepage from the

streambank, thus preventing the buildup of excessive hydrostatic pressure.

**Filter cloth** - See geotextile.

**Filter strip** - A belt of vegetation engineered to provide infiltration, intercept sediment and other pollutants, and reduce stormwater flow and velocities. Designed to accept an even distribution of surface runoff; effectiveness is reduced if a channel forms, or if high velocity flows occur.

**Filtration** - The process of passing a liquid through a filter to remove suspended matter that usually cannot be removed by settling.

**Fine material** - Particles of a size finer than the particles present in appreciable quantities in the bed material; normally silt and clay particles (particles finer than 0.062mm).

**Fine material load** - That part of the total sediment load that is composed of particles smaller than the particles present in appreciable quantities in the stream bed. Normally composed of sediment particles smaller than 0.062mm (silts and clays).

**Fixed-bed physical model** - A hydraulic model in which the bed and bank materials are non-erodible. Current directions, velocities, or water surface elevations for a specific flow, bed bathymetry, or hydraulic structural configuration can be measured and scaled to the prototype. This information is then used to evaluate structural performance, navigability, or flood heights.

**Flanking** - Erosion resulting from streamflow between the bank and the landward end of a river-training or grade-control structure. Severe flanking can result in the structure becoming completely disconnected from the streambank, the function of the structure may be compromised, and accelerated local bank erosion may occur. Flanking may also occur at the ends of revetment.

**Flashy stream** - Stream with a relatively high flood peak of short duration.

**Flood** - Any relatively high streamflow which overtops the natural banks in any reach of a stream.

**Flood control measures or works** - See non-structural flood control measures and structural flood control measures.

**Flood duration** - The per cent of time over the period of study that a stream overflows its banks at a given location. See flow duration.

**Flood frequency** - Usually used interchangeably with the return interval of a specific magnitude flood. E.g., a flood event with a

2-year recurrence interval (frequency) is called the Q-2 event. See recurrence interval. There are hydrologic and probabilistic distinctions in the ways that the values of flood frequencies can be computed, but the distinctions are of little relevance to most applications. The most relevant fact is that a flood of a given frequency or recurrence interval can and often does occur more often than that, analogous to a coin flip turning up the same side several times in a row.

**Floodplain** - Low-lying areas of land adjacent to the stream that are inundated by water from the stream whenever the stream overflows its banks. Floodplains are sometimes delineated by the areas inundated during a flood with a specific reoccurrence interval, e.g. the 100-year floodplain.

**Flood stage** - The stage at which a stream overtops its natural banks. Synonymous with bankfull stage. It is not the stage at which flood control measures are overtopped; the term for that would vary from misfortune to catastrophe, depending upon the circumstances.

**Flow duration** - The per cent of time that a given discharge was equaled or exceeded during the period of record, often presented as a "flow duration curve", from which the converse can also be derived, the per cent of time that flow was equal to or less than a given discharge.

**Flow rate** - See stream discharge.

**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. Such failures may be sudden and dramatic, extending well behind top bank, and are often triggered by toe scour.

**Fluvial** - (1) Pertaining to streams or rivers. (2) Of, relating to, or living in a stream or river. (3) Caused by the action of flowing water.

**Fluvial geomorphology** - The scientific study of the form and structure of the geology of an area as affected by flowing water.

**Fluvial sediment** - Particles derived from rocks or biological materials which are transported by, suspended in, or deposited by flowing water.

**Foreshore** - (1) Lower shore zone, between ordinary low and ordinary high water levels. (2) (esp. southern U.S.) the land lying between top bank of the stream and a flood control levee; i.e. batture.

**Frost heave** - The raising of a surface or object due to the accumulation of ice in the underlying soil.

**Froude number** - A dimensionless number related to the ratio of inertia force to gravitational force. It is the velocity squared divided by length times the acceleration due to gravity. In open channels the numerical value of 1, termed critical flow, distinguishes between subcritical and supercritical flow.

**Gabion** - A wickerwork or wire mesh basket or cage filled with stone or other materials, placed against a streambank to prevent erosion or across the stream to act as a grade control structure.

**Gaging station** - A selected cross-section of a stream channel where one or more variables are measured continuously or periodically to index discharge, stage, sediment concentrations and yield, and/or other parameters.

**Geocomposite** - A manufactured material using geotextiles, geogrids, and/or geomembranes in laminated or composite form.

**Geogrid** - (1) A net-like polymeric material, used to reinforce, stabilize, and/or contain soil rock, earth, other material in a wide variety of applications including internally reinforced soil walls, segmental retaining walls, or steep slopes. (2) A synthetic erosion protection product which resembles large and durable egg carton separators, placed on streambanks, then filled with earth or other materials.

**Geologic column** - Chronological arrangement of rock units in columnar form, with oldest units on the bottom and youngest at top.

**Geologic control** - Natural geologic formation (erosion-resistant clay, stone, bedrock) that either temporarily or permanently controls the grade of a stream.

**Geologic time** - A length of time usually expressed in thousands or millions of years. In this time scale only major geologic activity (formation of mountain ranges, changes in sea level, climate change) would be significant.

**Geology** - The science which analyzes the earth, the rocks of which it is composed, and the changes which it has undergone, or is currently undergoing.

**Geomembrane** - A synthetic impermeable membrane used to contain liquids and/or sediment.

**Geomorphic threshold** - A progressive change in one variable that results in an abrupt change in the system.

**Geomorphology** - 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 the buildup of erosional debris.

**Geosynthetic** - Any synthetic material, including geotextiles and geomembranes, or any combination thereof, used with foundation, soil, rock, or any other geotechnical engineering related material, as an integral part of a structure or system.

**Geotechnical engineering** - The application of the laws and principles of science and mathematics to solve problems related to the materials of the earth's crust. It includes the fields of soil mechanics, rock mechanics, and many of the engineering aspects of geology, geophysics, hydrology, fluvial geomorphology, and related sciences.

**Geotextile** - A water permeable material, either natural or synthetic, used to filter liquids, prevent the movement of sediment, separate different materials, or reinforce or strengthen materials. Geotextiles may be constructed from straw, excelsior (wood shavings), coconut fibre (coir), or synthetics such as polypropylene or nylon. The synthetic forms are also called engineering fabric or filter cloth, and are available in either woven forms, which are thin and can be precisely designed for opening size, or non-woven form, which is more bulky. Each form has advantages for different applications.

**Glacial till** - Material deposited by glaciation, usually composed of a wide range of particle sizes, which has not been subjected to the sorting action of water.

**Gobi Block** - A proprietary precast cellular block mattress used as a substitute for riprap. One of the first such products.

**Gradation curve** - See particle-size distribution.

**Grade** - (1) The continuous descending curve of a stream channel just steep enough for current to flow and transport its load of sediment. (2) To level off to a smooth horizontal or sloping surface. (3) Measure of inclination expressed in percent. (4) The slope of a plane. (5) A reference elevation. (6) A position in a scale of size. (7) Particle size distribution of an aggregate. (8) A group of things all falling within the same limits.

**Grade control structure** - A structure placed across a stream channel from bank to bank (usually approximately perpendicular to flow) for the purpose of controlling the stream slope and preventing bed degradation upstream. Depending upon the design of the structure and the stream flow, it does this by discharging water from a higher to a lower elevation in a controlled fashion, and/or by armoring the bed at the site. In small channels, may be called a sill or check dam.

**Graded stream** - See dynamic equilibrium.

**Grade stabilization structure** - See grade control structure.

**Gradient** - Slope, particularly of a stream or a land surface.

**Grading** - Degree of mixing of size classes in sedimentary material. For sediments, well-graded implies a relatively continuous size distribution ranging from coarse to fine. For stone, well-graded implies a relatively continuous distribution of sizes from gravel to the maximum weight of stone specified. Poorly graded implies a uniformity in size or a lack of continuous distribution.

**Grassed waterways** - The practice of conserving soil on runoff ditches on slopes by gently sloping the ditch sides and perpetually maintaining them in mowed (turf) grass to trap sediment and reduce erosion.

**Gravel** - Rounded or semi-round particles of stone that can pass a 3-in. (76.2 mm) and be retained on a No. 4 (4.76 mm) U.S. Standard Sieve (Unified Soil Classification System). Gravel is smaller than cobbles and larger than coarse sand.

**Greenbelt** - See riparian corridor

**Grid (computational)** - Network of points covering the space, or time-space domain of a numerical model.

**Grizzly** - A large screen, usually constructed of iron bars, which is used to sort quarried stone into appropriate size classifications, e.g. an 18 to 24 inch stone size classification refers to the "b" axis length of the graded stones. The "b" axis is the middle axis (Not the longest, not the shortest) of the stone.

**Groin** - See dike.

**Ground cover** - Any vegetation producing a protective mat on or just above the soil surface. Usually refers to low-growing herbaceous plants

**Groundwater flow** - Water that moves through the subsurface soil and rocks. Groundwater lubricating an existing failure plane can lead to geotechnical failure.

**Groundwater table** - See water table.

**Grout** - A fluid mixture of cement and water, or sand, water and fly ash or other cementing agents that can be poured and pumped easily. Used to (1) fill voids between riprap, culverts, or other structures in channels or slopes to prevent or reduce erosion or inadvertent water flow, or (2) to fill geotubes or other fabric-formed structures.

**Habitat** - The environment in which an organism or biological population lives or grows.

**Habitat diversity** - The variability of parameters within a specific habitat. For aquatic habitats this would include variations of depth, flow, velocity, substrate, substrate size, and cover. Generally, the more diversity contained within a habitat, the greater the likelihood that the habitat requirements are met for a larger number of species, or that the requirements are met for the different life stages of a single species.

**Habitat management** - A planned sequence of activities that creates or augments various habitats needed to maintain or enhance the abundance of specified species.

**"Hard" bank protection methods** - Refers to the use of stone, block, jacks, or any of a myriad number of solid materials that are used as bank protection.

**Hard point** - A streambank protection technique whereby erodible materials are excavated from a streambank at intervals along the channel and replaced by stone or other inert non-erodible material.

Some hard points protrude a short distance into the channel to direct erosive currents away from the bank, in which case they may be referred to as dikes. Hard points also occur naturally along streambanks as passing currents remove erodible materials leaving non-erodible materials exposed. In some Corps of Engineers districts hard points and transverse dikes are interchangeable terms.

**Head** - Pressure measured as an equivalent height of water.

**Headcutting** - Channel bottom erosion moving upstream through a basin indicating that a readjustment of the basin slope and its stream discharge and sediment load characteristics is taking place.

Headcutting is evidenced by the presence of waterfalls or rapidly moving water through an otherwise placid stream, and often leaves streambanks in an unstable condition (oversteepened) as it progresses through a reach. See degradation.

**Helical flow** - Three-dimensional movement of water particles along a spiral path in the general direction of flow. This type of current is of most significance as flow passes through a bend, but also occurs in multiple cells in relatively wide straight reaches as well. The vector of flow nearest the bed is referred to as "secondary current", and its net effect is to move bank and bed material from the cut bank and deposit it on the point bar or middle bar.

**Herbaceous vegetation** - Plants without woody stems such as grasses, most legumes, forbs, and wildflowers. Can be annual or perennial.

**High-Density Polyethylene (HDPE)** - A synthetic polymer used for geomembranes and pond liners.

**Horizon** - See soil horizon.

**Humus** - See organic matter.

**Hydraulic constriction** - Flow around a small-radius bend that due to centrifical force results in higher velocities and a narrowed channel width (relative to upstream and downstream channel widths). See constriction.

**Hydraulic gradient** - A line which represents the relative force available due to the potential energy available. This is a combination of energy due to the height of the water and internal pressure. In an open channel, the hydraulic gradient is equal to the water surface.

**Hydraulic jump** - (1) In fluid flow, a change in flow conditions accompanied by a stationary, abrupt turbulent rise in water level in the direction of flow. (2) An abrupt transition from super-critical to sub-critical flow.

**Hydraulic mulch** - Processed materials such as wood and paper products, cotton or straw fibers that are applied by special equipment utilizing a water-based slurry which is sprayed on the soil surface to stabilize the surface and promote the growth of seeded plants.

**Hydraulic radius** - The cross-sectional area of a stream divided by its wetted perimeter. For practical purposes in natural streams, equivalent to average depth unless the stream is unusually deep and narrow.

**Hydric soil** - Soils that are in a wetted condition for a long enough duration to periodically produce anaerobic conditions, thereby influencing the growth of plants. Usually associated with wetland areas.

**Hydrograph** - A graph showing the stage or discharge of a waterway with respect to time.

**Hydrographic survey** - See bathymetry.

**Hydroseeding** - Spreading of seed hydraulically in a water medium. Mulch, lime, and fertilizer can also be incorporated into the sprayed mixture.

**Ice jam** - Fragments of broken river ice lodged in a narrow portion of the river channel. Can be associated with a difference in head resulting in backwater effects.

**Impermeable** - Not permitting the passage of a fluid. Can be a manufactured membrane, a natural material such as rock or clay., or an engineered structure. Often applied to stone dikes; even though

a stone dike may allow a limited amount of flow through it, the amount is insignificant relative to total streamflow..

**Impervious** - Not capable of being passed through; soil which is resistant to the entrance of water, air, or plant roots.

**Impinging flow** - Flow attacking a streambank at a angle oriented close to perpendicular to the bank of the stream.

**Incised stream** - A stream or channel that has become hydraulically disconnected from its original or previous floodplain due to bed degradation. A flow which previously overtopped the floodplain will now be contained well within top bank, e.g. the 5-yr flow event, or even the 100-year flow event, is confined within the main channel. Incision of the main channel usually results in the eventual base lowering of all tributaries, which can result in destabilization of the entire watershed. See degradation.

**Indirect bank protection** - A structure, or group of structures, that extend into the stream channel in order to redirect the flow so that hydraulic forces at the channel boundary (bank) are reduced to a non-erosive level, usually accompanied by deposition within the structure(s). Also known as redirective bank protection. See dike, rock vane, J-Hook vane, and bendway weir.

**Infiltration** - That portion of rainfall or surface runoff that moves downward into the subsurface rock and soil.

**Inorganic** - Composed of matter that is not of plant or animal origin.

**In-situ** - Material in its natural position or place. Said specifically of a rock, soil, or fossil when found in the situation in which it was originally formed or deposited.

**Instant Shade Theory** - A restoration technique designed to quickly provide vegetative shade and cover over the channel of a stream by planting long branches or trunks of plant materials, or container plants at angles from near horizontal to 45 degrees.

**Interdisciplinary team** - A group of people, each possessing expert knowledge in a different field (e.g. hydraulic engineering, soils and geology, biology, hydrology, fish and wildlife.) working together as a team to create hydraulically successful and environmentally compatible projects.

**Intermittent stream** - A stream that has the potential for continuous flow, but at times the entire flow is absorbed by the bed material. Sometimes used interchangeably with "ephemeral stream".

**Interstices** - A space, especially a small or narrow one, between things or parts, e.g. voids between rocks.

**Invert** - (1) The lowest point on a cross-section (usually called thalweg point in natural streams). (2) The lowest elevation of the inside of a culvert or pipe.

**Invertebrate** - An animal that does not have a backbone or spinal column.

**Jack** - (1) A type of river training structure consisting of wire or cable strung on three mutually perpendicular metal, wooden, or concrete struts. (jackstraw, tetrahedron jack, Kellner jack, Kellner jetty). Usually constructed in groups called "jack fields", with the individual jacks cabled together. Can be oriented either longitudinally (acting as a retard) or perpendicular to flow (a type of permeable dike). (2) Smaller units without wire or cable, usually used as scour protection (see A-jack).

**J-Hook or J-Hook Vane** - A small semi-circular flow concentrating sill attached to the stream end of a rock vane, designed to create a stable scour hole in the streambed for aquatic habitat purposes while the rock vane reduces near-bank velocities leading to bank stability.

**Joint** - A surface of actual or potential fracture or parting in a rock, without displacement.

**Karst** - Topography with sinkholes, caves, and underground drainage that is formed in limestone, gypsum, or other rocks by dissolution.

**Kellner jack** - See jack.

**Key** - The portion of a river training or bank stabilization structure placed on, or excavated into, the riverbank. Designed to prevent flanking. Sometimes called a "root" or bankhead when applied to a dike.

**Kicker** - A dike, usually located at the downstream end of a bend, intended to improve and stabilize the navigation crossing to the opposite bank. Used extensively on the Missouri River, the Red River, and other regulated streams to control crossings between bends.

**Knickpoint** - A location on the thalweg where there is an abrupt change of elevation and slope, usually referring to a vertical overfall.

**Knickzone** - A steep reach of channel where a headward migrating zone of degradation is occurring.

**Laminar flow** - Motion of fluids where the fluid moves in distinct and separate lines. Seldom occurs in natural channels.

**Large woody debris (LWD)** - Trees or large branches of trees that have fallen or been eroded into a stream.

**Launching** - Self-adjusting ability of undercut material (stone riprap, rubble, slag, etc.) to roll downslope. If sufficient material self-adjusts or accumulates on the streambank face and scoured sections of the toe, the slope can remain effectively armored and scour will be arrested.

**Leaching** - The removal in solution of soluble materials by percolating water. Generally refers to the movement of soil nutrients to a deeper soil horizon, making them unavailable for plant growth.

**Left bank or left descending bank** - When looking in a downstream direction, the streambank on the left. See bank.

**Lens** - A non-continuous layer of material that is different in composition than adjacent material.

**Lentic** - Of, relating to, or living in still water. Opposite of lotic.

**Levee** - An embankment or structure built to contain periodic floodwater in river systems within specific areas of the floodplain, thus preventing overflow into adjacent lowlands.

**Lift** - An applied and/or compacted layer of soil, waste, gravel, or stone. Also referred to as a course. Most dikes on the Mississippi River, and many reinforced soil projects, are constructed in "lifts".

**Liner** - A layer of emplaced materials which serves to restrict the escape of liquids or solids placed within an impoundment. Liners can include reworked or compacted soil or clay, asphaltic and concrete materials, spray-on membranes, polymeric membranes, or any substance that serves the above stated purpose.

**Listed species** - Any species of fish, wildlife, or plant which has been determined to be endangered or threatened under the Endangered Species Act of 1973.

**Load** - See sediment load.

**Loam** - A soil textural classification in which the proportions of sand, silt, and clay are well balanced. Loams have the best properties for cultivation of plants.

**Loess** - Material transported and deposited by wind and consisting of predominantly silt-sized particles. Loess can stand at nearly vertical slopes, but is easily erodible when situated on lesser slopes.

**Longard tubing** - Sand-filled synthetic tubes placed on a streambank, lake bank, or beach for erosion protection.

**Longitudinal** - The direction parallel with stream flow or a section of streambank, or parallel with the general downvalley direction of the stream.

**Longitudinal Fill Stone Toe Protection (LFSTP)** - A resistive streambank protection method consisting of a continuous trapezoidal windrow of stone placed at, or slightly streamward of, the toe of a streambank. The LFSTP is keyed into the bank at its upstream and downstream limits, often with intermittent keys or tiebacks extending back into the bank along its length. Sometimes used in conjunction with bank grading and vegetative treatments, or a constructed vegetated bench or floodplain. LFSTP is usually constructed of a self-launching stone (see launching) to control localized scour on the stream side of the LPSTP. When designed and constructed correctly, LFSTP provides enough self-launching stone to maintain its original height of protection even in areas experiencing considerable localized scour. The LFSTP can also be designed to act as a roadway during construction in areas of limited access.

**Longitudinal Peaked Stone Toe Protection (LPSTP)** - A triangular section of stone placed parallel to, or slightly streamward of, the toe of an eroding streambank (at the natural angle of repose of the stone) to prevent erosion of the toe and induce sediment deposition landward of the LPSTP. The LPSTP is keyed into the bank at the upstream and downstream limits, with intermittent keys or tiebacks extending back into the bank along its length. Typically used where the streambank either is already vegetated (existing vegetation not disturbed during construction) or the protected bank can be expected to vegetate once the toe is stabilized. Is usually constructed with a minimal disturbance to the existing bank, and does not require precise design and control. The controlling specification is usually expressed in tons of stone per linear foot of bank, rather than by structural dimensions (e.g., 2 tons/ft), although a crest elevation can also be specified. LPSTP is usually constructed of a self-launching stone (see launching) to control localized scour on the stream side of the LPSTP.

**Longitudinal profile** - A graph of the bed (thalweg) elevation (y-axis) of a stream versus the length of the stream (x-axis).

**Lotic** - Of, relating to, or living in moving water. Opposite of lentic.

**Lower bank** - That portion of a streambank which is usually underwater. See also upper bank, middle bank, and zones.

**LUNKERS (or LUNKER structure, an acronym for Little Underwater Neighborhood Keeper Encompassing Rheotactic Salmonids)** - An

engineered structure employing a roof and having an open front and ends, designed to replicate an undercut bank thus functioning to improve aquatic habitat for rheotactic fishes (species that prefer to face into the current) while providing streambank protection. Can be constructed of concrete, wood, or "synthetic wood".

**Main channel** - see divided flow.

**Management** - The process of setting goals, defining objectives, identifying problems, implementing actions to address problems, and evaluating actions to determine if objectives and functions have been achieved.

**Mass movement** - Unit movement of a portion of the land surface under direct gravitational stress, as in creep, landslide, rock slides and falls, earthflows, debris flows, and avalanches.

**Mass wasting** - (1) The slow down-slope movement of rock debris. (2) A general term for a variety of processes by which large masses of earth material are moved by gravity either slowly or quickly from one place to another.

**Mathematical model** - A model that uses mathematical relationships to represent the prototype. Sometimes used interchangeably with "numerical model", but can more accurately be considered the basis for a numerical model, in which the basic equations can realistically only be solved approximately. See numerical model.

**Mattress** - A covering of concrete, wood, stone, or other material used to protect a streambank against erosion.

**Mean** - The average value of a group of numbers.

**Meander** - (1) *n.* One of a series of sinuous curves, bends, or loops, developed in a flood plain by flowing water. (2) *v.* To change course in a sinuous, and somewhat systemic, pattern.

**Meander belt** - (1) The part of a flood plain encompassed between two lines tangent to the outer bends of all the meanders. (2) The zone within which channel migration has historically occurred. Within the meander belt, channel migration is indicated by abandoned channels, accretion topography (scrolling), and oxbow lakes.

**Meandering stream** - A stream which has a basically sinuous pattern characterized by alternating changes in direction (bends).

**Meander scroll** - One of a series of long, parallel, close fitting, crescent-shaped ridges and troughs formed along the inner bank of a stream meander as the channel migrated laterally and/or downvalley.

**Mean high water** - The highest level of inundation which occurs under "normal" hydrologic conditions. The term is too imprecise to be useful for engineering or scientific purposes, but is often the subject of intense regulatory and legal debate.

**Mean low water** - The lowest elevation of the water surface under "normal" hydrologic conditions. As with mean high water, it must be accompanied by a more scientific definition to be useful in practice.

**Midden** - A mound or stratum of refuse (broken pots, ashes, food remains) normally found on the site of an ancient settlement.

**Middle bank** - The ill-defined zone of transition between the lower bank and upper bank. See also lower bank, upper bank, and zones.

**Middle bar** - An area of deposition lying within the channel of the stream but not connected to the banks.

**Migration rate** - Distance a stream moves laterally over a specific unit of time. Usually determined by comparison of aerial photographs or surveys taken at different times, and reported as an average distance per year over that period of time.

**Mitigation** - The process of reducing the negative environmental impacts of a project. Sometimes takes the form of replacement or substitution of a habitat in repayment for habitat that has been degraded or destroyed.

**Modern time** - A period of time spanning anywhere from tens of years to several hundreds of years, depending upon the context.

**Monitoring** - The process of collecting physical, chemical, and environmental data to determine the impacts of an action undertaken on a waterway, ideally before, during, and after the action.

**Morphology** - A scientific study of changes in form and structure.

**Movable-bed physical model** - A model in which the bed or bank materials, or both, are erodible and are transported in a manner similar to the prototype. Usually designed to determine the effects of various river training structures on the bathymetry or planform of a reach of river.

**MSL** - Mean Sea Level, referring to the datum established in 1929. Another, more current, version is referred to as National Geodetic Vertical Datum (NGVD). The two terms can be considered to be interchangeable for most purposes.

**Mulch** - A natural or artificial layer of material covering the land surface which reduces the rainfall impact and tractive forces

of water on the soil surface (thereby reducing erosion), conserves moisture, improves soil structure, and aids in the establishment of plant cover. Straw, hay, wood chips, leaf litter, compost, paper, etc. can all be used as a mulch.

**Mycorrhiza** - A family of fungi that colonize some species of plant roots, effectively extending the root system into the surrounding soil, assisting the plant in the uptake of nutrients and increasing disease resistance, resulting in superior growth and survival of the plant.

**National Pollution Discharge Elimination System (NPDES)** - Federal legislation that requires cities with populations over 100,000 to establish a permit process to control sediment pollution. A permit is also required for developments 5 acres or larger. Permits are authorized and enforced by the Environmental Protection Agency or a designated state agency as directed by the Clean Water Act.

**Native vegetation** - Vegetation that is indigenous to a certain area and is adapted to that area's environmental conditions (climate, rainfall, soils, etc.)

**Natural levee** - A low, alluvial ridge adjoining the channel of a stream, formed by sediment deposited by floodwaters that have overflowed the channel banks. Deposits in a natural levee usually graduate from coarse to fine in the direction away from the stream.

**Natural Resources Conservation Service (NRCS)** - A federal agency, formerly called the Soil Conservation Service (SCS), that provides technical assistance on natural resource management issues.

**Navigable stream** - (1) A waterway of sufficient depth and width to handle specified navigation traffic. (2) A waterway which has been officially designated as "navigable" for legal and regulatory purposes.

**Neck cutoff** - Breakthrough of a river across a narrow neck separating two meanders, where downstream migration has been slowed and the next meander upstream has overtaken it. Compare with chute cutoff.

**Newbury Rocked Riffle** - A type of engineered grade control structure, usually constructed in series, that utilizes large partially buried stones to form an artificial rapids or rock riffle. The upstream face of the Newbury Rocked Riffle is usually sloped on a 4 horizontal to 1 vertical grade and the downstream face can vary from 5H to 1V, to 20H to 1V, depending on application and the types of fish that must traverse the riffle. Typically, 1 to 1.5 ft of stream grade can be taken out with each Newbury Rocked Riffle.

**NGVD** - See mean sea level.

**Noncohesive sediments** - Sediments consisting of discrete particles. For given erosive forces, the movement of such particles depends only on the properties of shape, size, and density, and on the position of the particle with respect to surrounding particles. Examples include: sand, gravel, and cobble.

**Non-point Source Pollution (NPS)** - Pollution that enters a water body from diffuse and indistinct sources. NPS pollution occurs when water runs over land or through the ground, picks up pollutants, and deposits them in surface waters or introduces them onto groundwater. The most common NPS pollutants are sediment and nutrients that wash into water bodies from agricultural land, construction sites, urban areas, or disturbed areas. Compare to point source pollution.

**Non-structural flood control measures** - Measures taken to reduce flood damage without altering the stream or its overflow characteristics. Non-structural measures may include, but are not limited to: land use regulation, land acquisition, providing for the maintenance of aquatic areas, floodplain zoning, flood-proofing of existing buildings, flood forecasting, flood warning, providing flood hazard information, flood insurance, tax adjustments, emergency assistance, and relocation of properties and people.

**Non-uniform flow** - The depth and velocity of flow changes along the length of the channel. Typical of natural channels.

**Normal** - Perpendicular. Usually applied to the angle of a dike relative to the direction of flow, e.g., a dike oriented normal to flow.

**Noxious plant** - (sometimes termed "noxious weed". (1) A plant that is undesirable at a given site because it conflicts with management objectives. (2) A plant that has been legally declared "noxious".

**Numerical model** - A mathematical model in which the governing equations are not solved analytically; using discrete numerical values to represent the variables involved and using arithmetic operations. The governing equations are solved approximately.

**Obstruction** - Any material in the stream that causes flow to be retarded or diverted.

**Open channel** - A waterway or drainage course which has no restrictive top.

**Open Weave Textile (OWT)** - A degradable rolled erosion control product (RECP) composed of processed natural or polymer yarns woven into a matrix and used to provide erosion control and facilitate establishment of vegetation.

**Optical opacity** - An expression for the amount of light absorbed and scattered by a suspension. Reported as: (1) extinction coefficient, (2) percent of incident light scattered at 90 degrees, and/or (3) percent of incident light transmitted at 180 degrees over a standard distance.

**Order** - See stream order.

**Organic matter (humus)** - That portion of soil, usually dark in color, resulting from the decomposition of plant and animal materials.

**Organic mixtures and mulches** - Any of a number of agents (e.g. petrochemicals or vegetative matter) used to stabilize a streambank 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 broadcasters.

**Outcrop** - (a) The part of a geologic formation or structure that appears on the surface of the earth. (b) An exposure of bedrock at or above the ground surface.

**Overbank** - See floodplain.

**Overbank deposits** - Sediment deposited on the floodplain when a river or stream overflows its banks.

**Overbank drainage** - Water from the floodplain that flows over the top bank, down the bank slope, and into the waterway.

**Overbank flow** - Water movement above top bank elevation either due to a high stream stage or to inland surface-water runoff.

**Overburden** - (1) The material (soil, sand, silt, gravel, clay) that overlies bedrock. (2) All material overlying an underground excavation. (3) Material placed over a buried pipeline or cable to protect it from stream forces (sometimes called backfill).

**Overfall** - A sudden drop in grade, as in a gully or the upper edge of a steep bank.

**Oxbow** - (1) An abandoned meander caused by a neck cutoff (see oxbow lake). (2) An extremely curved active channel meander with only a narrow neck between adjacent reaches. (3) The land within an oxbow reach.

**Oxbow lake** - A lake, usually curved, crescent, or horseshoe-shaped in planform, occupying a cut-off channel reach that has been abandoned by the main watercourse.

**Palisades** - A proprietary technique, developed by Erkon, Inc. (formerly Hold That River, Inc.), consisting of steel pipe pilings

connected by webs of nylon netting to form a permeable dike (usually deployed in system fashion), typically oriented normal to flow. Palisades are designed to protect a streambank by reducing near-bank velocities, thereby encouraging deposition of sediment within the Palisade field.

**Parallel flow** - Flow in a direction roughly parallel to the bank of a stream.

**Particle size** - A linear dimension, usually designated as "diameter", used to characterize the size of a particle. The dimension may be determined by any of several different techniques, including sedimentation sieving, micrometric measurement, or direct measurement.

**Particle size classification** - See sediment grade scale

**Particle size distribution** - The frequency distribution of the relative amounts of particles in a sample that are within specified size ranges, or a cumulative frequency distribution of the relative amounts of particles coarser or finer than specified sizes. Relative amounts are usually expressed as percentages by weight.

**Particle size intermediate axis** - The size of a rock or sediment particle determined by the direct measurement of the axis normal to a plane representing the longest and shortest axes. This dimension is typically the quoted size of stone when graded at the quarry, i.e. a 12 inch maximum diameter stone would have a maximum B-axis length of 12 inches. Basically, the width of a stone. Also called the B-axis.

**Pavement** - Streambank surface covering, usually impermeable, designed to serve as protection against erosion. Common pavements used on streambanks are concrete, compacted asphalt, and soil-cement, although asphalt may not meet current environmental standards.

**Peak discharge** - The maximum instantaneous flow from a given storm condition at a specific location.

**Percent open area** - The net area of a fabric that is not occupied by fabric filaments, normally determinable only for geotextiles having distinct visible and measurable openings that continue directly through the fabric (i.e., woven fabric). See geotextile.

**Percolation** - The downward movement of water through the soil horizons. The percolation rate of a soil is usually expressed as inches per hour.

**Perennial stream** - A channel that has continuous flow at all times.

**Permeability** - The ease with which water can move or pass through a structure ((e.g., a dike) or material (e.g., soils, filters).

**Permit** - Written authorization from a regulated agency authorizing work in waters of the United States. Some activities requiring a permit (not an all-inclusive list) include: diversion of water, construction of a bank protection project, a dock, bridge, dam, culvert, or irrigation project; mining; dredging; replacement or maintenance of existing structures; debris removal; channel widening, relocation, filling, excavation, or reshaping. More than one permit might have to be obtained for a single activity. The public and several agencies might review or comment on a single permit. There are over 50 nationwide permits. For example, a nationwide "Section 13" permit can usually be issued for construction of bank stabilization works if the project is less than 500 ft long, and there is less than 1 cu. yd. of fill material introduced into the stream per lineal ft of stream length. An individual permit is issued for projects not meeting nationwide guidelines.

**Permittivity** - The flow rate of water through a geotextile.

**Pervious** - Allowing passage through openings or interstices, e.g. fluid through a membrane.

**pH** - A measure of the acidity or alkalinity of a substance. A pH value of 7.0 is neutral, less than 7.0 is acidic, greater than 7.0 is alkaline.

**Photo degradable** - The ability of a material to break down due to exposure to ultraviolet light.

**Phreatic line** - The upper boundary of the seepage water surface landward of a streambank.

**Physical model** - A scale model that uses the physical properties and behavior of modeling materials to represent the prototype. See movable-bed physical model and fixed-bed physical model.

**Piedmont** - Lying or formed at the base of a mountain or mountain range. In the United States the Piedmont (noun) is a low plateau extending from New Jersey to Alabama and lying east of the Appalachian Mountains.

**Pile** - An elongated member, installed vertically, usually made of timber, concrete, or steel, that serves as a structural component of a river-training structure.

**Pile dike** - A permeable dike usually constructed of timber, steel, or pre-cast concrete pilings designed to trap sediment

within the dike field in order to protect the bank or improve the navigation channel. See dike.

**Pioneer vegetation** - The first several species of plants to become established in a disturbed area that has been stabilized. Sometimes called volunteer vegetation.

**Piping** - The movement of soil particles by subsurface flow of seepage water through a soil, leading to the development of voids, tunnels, or pipe-like cavities within the soil bank.

**Planform** - The pattern formed by a waterway as viewed from above. The primary types of planform are meandering, braided, and straight.

**Planning** - The selection and prearrangement of events for the attainment of an objective.

**Plan view** - Viewing an object or stream from above, i.e. a birds eye view.

**Plasticity** - The property of a material that enables it to undergo permanent deformation (putty like) without appreciable volume change or elastic rebound, and without rupture.

**Polymer** - A macromolecular material formed by the chemical combination of monomers. Plastics, rubbers, and textile fibers are all high molecular weight polymers. Only synthetic polymers are used to make synthetics.

**Polyvinylchloride (PVC)** - A synthetic thermoplastic polymer prepared from vinyl chloride. In erosion control applications PVC can be compounded into rigid forms used in pipe manufacture and coatings for the wire in gabion baskets, or into flexible forms used in the manufacture of geotextiles.

**Point bar** - Sediments laid down on the inside (convex side) of a meander bend. Compare to alternate bar and middle bar.

**Point source pollution** - Pollution discharged into a water body at a single distinct location, such as an industrial discharge or a sewer pipe.

**Pollution** - A condition caused by the presence of substances of such character and in such quantities that the quality of the environment is impaired. Water pollution is generally divided into point source and non-point source. See point source pollution and non-point source pollution.

**Ponding** - See backwater effects.

**Pool** - A relatively deep section of a stream or river marked by slower velocities and finer bed materials.

**Poorly graded** - See grading.

**Poorly sorted** - See sorting.

**Porosity** - The percentage by volume of voids of a given material with respect to the total volume of the material.

**Porous pavement** - A permeable surface material which provides support for traffic without deformation and allows for stormwater and surface runoff to gradually infiltrate into the subbase or subsoil.

**Potable water** - Water suitable for human consumption.

**Precipitation** - The process by which water in a liquid or solid state (rain, sleet, snow) is discharged out of the atmosphere onto a land or water surface.

**Present time** - Encompassing a period of current time spanning from one to ten years.

**Profile view** - An object as viewed from its side.

**Project life** - The period of time a project is designed to function as originally planned.

**Proposed species** - Any species of fish, wildlife, or plant that is proposed in the Federal Register to be listed as endangered or threatened under the guidelines of the Endangered Species Act of 1973.

**Prototype** - The full-sized structure, system process, or phenomenon. Usually used in connection with modeling; the actual situation as opposed to the model.

**Pulsed monitoring** - When an existing project or reach of stream is monitored on a long-term schedule with varying levels of effort. As an example a project could be photographed and analyzed at six month intervals but comprehensively surveyed only once every several years.

**Quarry-run stone** - Natural material used for streambank protection as received from a quarry without regard to gradation requirements with only an upper size limit specified. Also termed "shot rock".

**Radial drainage** - Arrangement of stream courses in which streams radiate outward in all directions from a central zone.

**Radius (of a circle)** - The distance from the center to any point on the circumference of a circle.

**Radius of curvature** - The radius of a circle defining the curvature of an individual bend measured between adjacent inflection points.

**Rapid drawdown** - Lowering the elevation of water against a streambank more quickly than the bank can drain, which can leave the bank in a saturated condition with positive pore pressure that may cause the bank to fail.

**Ravine** - A small stream channel, narrow, steep-sided, and commonly V-shaped in cross-section, larger than a gully. Also called a gulch.

**Reach** - (1) A selected portion of a channel's length between any defined limits. (2) A relatively long, straight section of river (river pilot term).

**Reclamation** - (1) The process of restoring and revegetating a disturbed site to, or near to, its previous habitat quality. (2) (rarely now) The conversion of wetland, desert, or other "non-productive" land to a form suitable for agriculture or human settlement.

**Recurrence interval** - The average time interval between occurrences of a hydrological event of a given or greater magnitude. It is important to realize that the computation is based on an average over a period of record, so events of a given recurrence interval may, and often do, occur more often than that over the short term. It is not a forecast.

**Redirective Bank Protection Methods** - Any of a number of bank protection techniques designed to vector energy away from the eroding bank and toward an area where the energy will not cause adverse effects. Some examples include bendway weirs, rock vanes, J-Hooks, and upstream and downstream kickers or deflectors. See indirect bank protection.

**Refusal** - (1) Erosion resistant material placed in a trench (excavated landward) at the stream end of a revetment to prevent flanking. Sometimes used interchangeably with "key". (2) The point at which a piling, sheet pile, or other object cannot be driven any deeper into the ground.

**Regime theory** - The application of the idea that the width, depth, slope, and planform of a river are adjusted to a channel-forming discharge. See dominant discharge.

**Regulated river or stream** - A section of stream or river where the stage and duration of flow are at least partially changed or affected by upstream dams, reservoirs, or grade control structures. The upstream structures must have at least some retention capacity and/or the ability to control flow releases. This typically results in lower peak flows and higher minimal flows, both of

longer duration than what occurred naturally prior to regulation.

**Rehabilitation** - Partial restoration of a structure or a river or stream to as near its original condition and function as functional. See restoration.

**Reinforced-earth bulkhead** - A retaining structure consisting of vertical panels and attached to reinforcing elements embedded in compacted backfill for supporting a natural or artificial streambank (a specific type of retaining wall).

**Reinforcement** - (1) To strengthen by the addition of materials or support; e.g., the strengthening of a soil geosynthetic system by the contributions of the geosynthetic inclusion. (2) The addition of structural components to a stabilization structure in order to strengthen it. (3) The introduction of living plants whereby the plant roots will assist in holding structural components or soils in place.

**Relative time** - Dating of events by place in chronological order of occurrence rather than in years.

**Relief** - The difference in elevation between the highest and lowest points in an area.

**Reservoir** - An impounded body of water or controlled lake where water is collected and stored.

**Restoration** - Return of a stream, river, waterway corridor, or ecosystem to as close an approximation of its original condition and functions prior to disturbance. In many instances true restoration is not possible due to extreme changes in basin hydrology and topography.

**Retaining wall** - A vertical 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** - Structure placed parallel to a streambank to prevent erosive currents from attacking the bank. See indirect bank protection.

**Return period** - See recurrence interval.

**Revegetation** - The process of reestablishing vegetation cover on any disturbed or newly formed site.

**Revetment** - Cover of erosion-resistant material placed to protect the bank of a stream, river, or channel.

**Revised Universal Soil Loss Equation (RUSLE)** - An updated, computerized method of estimating soil movement due to water erosion. RUSLE incorporates the updated climate, soil erodibility,

and vegetative cover factors of the Universal Soil Loss Equation.

**Riffle** - A shallow section of a stream where the stream flows at relatively greater velocities over coarse bed material or bedrock, resulting in a rapids of comparatively little fall.

**Rill erosion** - Land erosion forming small, well-defined incisions in the land surface that are less than 1 ft (30 centimeters) in depth.

**Right bank or right descending bank** - When looking in a downstream direction, the streambank to the right. See bank.

**Right-of-way** - Legal permission from a landowner that allows a person or agency personnel ingress and egress to a project site to perform site reconnaissance, construction, monitoring, and maintenance activities.

**Riparian** - Pertaining to anything connected with, adjacent to, or influenced by a stream, river, lake, reservoir, or other water body.

**Riparian area** - The land surrounding a stream, river, or other body of water that is, at least periodically, influenced by flooding. This undisturbed corridor of trees and shrubs growing parallel to a stream provides several benefits, including: preventing overuse of the top bank area by man, animals, and machinery; naturally filtering pesticides, nutrients and other chemicals; retarding rainfall runoff; providing habitat, food, shelter, and vegetative cover for wildlife; and providing a root system which binds soil particles together helping to prevent streambank and overbank erosion. Sometimes called "riparian buffer zone" or "greenbelt".

**Riparian corridor** - A continuous, unbroken riparian zone conducive to the movement of fauna between two or more riparian areas

**Ripple** - Small, roughly triangular, bed forms that are similar to dunes but have much smaller heights and lengths of 0.3 m or less. Ripples develop when the Froude number is less than approximately 0.3. See dunes.

**Riprap** - See stone riprap.

**Riser pipe** - A vertical outlet pipe used to control the discharge rate from a pond or basin.

**Riverine** - The area along or near the banks of a river or stream which was produced by the waterway and is still influenced by it.

**River training structure** - Any configuration constructed in a

stream, or placed on, adjacent to, or in the vicinity of a streambank that is intended to deflect currents, induce sediment deposition, induce scour, or in some other way alter the flow and sediment regimes of the river or stream.

**Riverward** - In a direction towards a river.

**Rock** - (1) Strictly, any naturally formed aggregate or mass of mineral material, whether or not coherent, constituting an essential and appreciable part of the earth's crust. (2) Sometimes used interchangeably with "stone".

**Rock-and-wire mattress** - A flat or cylindrical wire cage or basket filled with stone or other suitable material placed on a streambank as protection against erosion.

**Rock check structures** - See check dam.

**Rock vanes** - A type of sloping dike, usually constructed in series, consisting of a triangular shaped cross-section of stone, designed to protect an eroding bank by diverting flow around the structure and away from the bank.

**Rolled Erosion Control Product (RECP)** - A general term applied to manufactured materials, which may be synthetic or organic, fabricated into a mat or blanket, designed to be placed over a prepared surface and fastened to the soil in order to stabilize the soil until vegetation is established. Usually furnished in rolls, thus sometimes called "rolled goods". There are four categories of RECP: erosion control netting (ECN), open weave textile (OWT), erosion control blanket (ECB), and turf reinforcement Mat (TRM). See separate listings for each.

**Rolling drainage dip** - An inverted water bar.

**Root** - When used in context with "dike", that portion of the dike that is excavated into the streambank. See key. When used in context with plant, the underground part of the plant that serves as support, draws water and nutrients from the surrounding soil, and stores food.

**Rotational slip or rotational failure** - A deep seated soil failure along a well-defined curved shear surface that results in back-tilting of the failed mass toward the bank.

**Rubble** - Rough, irregular fragments of random size placed on a streambank to retard erosion. The fragments may consist of broken concrete slabs, masonry, or other suitable refuse.

**Runoff** - Flow that is discharged from an area to a stream channel. Runoff is sometimes subdivided into surface runoff, ground-water runoff, and seepage.

**Sack revetment** - Streambank protection consisting of sacks (e.g. burlap, paper, or nylon) filled with mortar, concrete, sand, stone, or other available material placed on a bank to serve as protection against erosion.

**Saltation** - Mechanism by which a particle moves by jumping from one point to another along a streambed due to flow.

**Sand** - (1) Mineral particles that can pass the No. 4 (4.76 mm) U. S. Standard Sieve and be retained on the No. 200 (0.075 mm) sieve. (2) A loose, granular material that results from the weathering and disintegration of rocks, consisting of particles smaller than gravel and larger than silt. (3) A soil containing 85 percent or more of sand and 10 percent or less of clay.

**Sandbar** - A depositional area composed primarily of sand, within the channel of a river, either attached to the bank or in midstream. See also bar.

**Sapping** - The disintegration and entrainment of a section of bank due to piping and seepage flow.

**Saturation** - The point at which all the voids (interstices) between soil particles are filled with water.

**Scale of particle sizes** - See sediment grade scale.

**Scarify** - (1) To loosen or till the ground surface in preparation for seeding or other operations. (2) To abrade the coating of a seed to improve germination.

**Scarp** - An escarpment, cliff, or steep slope of some extent along the margin of a plateau, mesa, terrace, bench, or overbank of a stream.

**Scour** - Erosion due to flowing water; usually considered as being localized as opposed to general bed degradation. See also bridge scour.

**Secondary channel** - See divided flow.

**Secondary currents** - Currents flowing in a helical pattern on a path parallel to the main downstream flow direction. See helical flow.

**Section depth** - When used in context with a structure, the vertical measurement of stone or other material used in a dike, weir, or key.

**Sediment** - (1) Particles derived from rocks or biological materials that have been transported by a fluid. (2) Solid material suspended in or settled from water.

**Sedimentation** - A broad term that embodies the process of erosion, entrainment, transportation, deposition, and the compaction of sediment.

**Sediment budget** - The quantification of the incoming and outgoing sediment within the area under study. Usually used in connection with mathematical or numerical modeling

**Sediment deposition** - See deposition.

**Sediment discharge** - The mass or volume of sediment passing a particular point on a stream during a unit of time. Technically, "sediment discharge rate".

**Sediment grade scale** - The grouping of sediment particles into size classes based on particle diameters using the American Geophysical Union size classification scale of 1947.

**Sediment load** - The mass or volume of sediment being moved by a stream past a given point in a given unit of time. The total of bed load plus suspended load. For practical purposes, interchangeable with sediment discharge.

**Sediment sample** - A quantity of water sediment mixture or deposited sediment that is collected to characterize some property or properties of the sediment.

**Sediment transport (rate)** - See sediment discharge.

**Sediment yield** - The total sediment outflow from a drainage basin during a specific period of time. Usually used in context with studies of an entire watershed; sometimes used interchangeably with "sediment discharge" or "sediment load".

**Seepage** - The slow movement of water through soil, rock, embankments, or structures.

**Self-adjusting stone** - See Launching.

**Self-launching stone** - See Launching.

**Separation** - The function of a geotextile or other product used as a partition between two adjacent dissimilar materials to prevent mixing of the two materials.

**Shear** - A force parallel to a surface as opposed to directly on the surface.

**Sheet erosion** - The more or less uniform removal of soil from an area by raindrop splash and/or overland flow without the development of water channels. Included with sheet erosion, however, are the numerous conspicuous small rills that are caused by minor concentrations of runoff.

**Sheet flow** - Unchanneled flow of water over a sloped surface. Sometimes called sheet wash.

**Shotcrete** - Mortar or concrete conveyed through a hose and pneumatically projected at high velocity onto a surface. Used to stabilize the surface. Can be applied by either a "wet" or "dry" mix method.

**Shot Rock** - See quarry run stone.

**Shrink-swell** - The volume change of soil based on moisture capacity. Soils that shrink when dry and swell when wet can damage plant roots, roads, dams, and building foundations.

**Sieve** - A wire mesh utensil used to size materials ranging in size from clay to gravel.

**Sieve analysis** - The action of sieving and analyzing soils and rock and classifying said materials by size, usually conforming to the American Geophysical Union size classification scale of 1947.

**Sieve diameter** - The smallest standard sieve opening size through which a given particle of sediment will pass.

**Sill** - A structure built across the bed of a stream to prevent scour or head-cutting; see also grade-control structure.

**Silt** - Material passing 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). Silt is smaller than fine sand and larger than clay.

**Silvicultural Activities** - All forest management activities, including logging, log transport, and forest roads.

**Sidecast** - The act of moving and depositing excavated material to either side of a excavated area.

**Sinuuous** - Refers to a meandering stream planform pattern

**Sinuosity** - The ratio of the distance measured along the thalweg of the stream divided by the downvalley length of the drainage basin where the stream flows. In other words, the distance a fish swims divided by the distance a crow flies. The sinuosity of a perfectly straight stream would equal one. A stream with a sinuosity of less than 1.2 is generally considered straight. Typically this is an unnatural (altered) condition where the stream has been straightened by man. Sinuosity greater than 1.3 is considered meandering.

**Slag** - (1) Cinders resulting from steel-making. (2) Rough, cindery lava from a volcano.

**Slide** - A landslide. The landform produced by mass movement under the influence of gravity.

**Slip** - See fault.

**Slip plane** - Closely spaced surfaces along which differential movement takes place in rock or soil.

**Slope** - Degree of deviation from horizontal; expressed either as a percentage, as a numerical ratio, in degrees, or as rise or fall per unit distance of stream length. As a percentage, the number of feet of rise or fall in 100 ft of horizontal distance. As a ratio, it is the number of feet of horizontal(H) to the number of feet vertical(V). E.g., a 25 percent slope is equal to a 4H:1V slope, is equal to a slope of approximately 14 degrees, and is equal to 0.25 ft per ft. Slope is sometimes described by the phrase "the rise over the run".

**Slope of natural repose (SONR)** - See angle of repose.

**Sloughing** - See Slumping.

**Slumping** - Shallow movement of a soil mass down a streambank as the result of an instability condition at or near the surface. Conditions leading to slumping 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. Sometimes called "slope failure" or "sloughing".

**Slurry** - A thick, but watery, mixture of suspended matter.

**Small Woody Debris (SWD)** - Small trunks or branches of trees (and leaves) that have fallen in the floodplain, or fallen or have been eroded into a stream or river. Often overlooked in "restoration projects" in addition to many important environmental values, SWD can provide many hydraulic values as well (dissipation of energy, scour and deposition of sediment). In some observed low-energy systems (along with leaf litter and leaf packs), SWD provides most of the channel diversity and complexity.

**Snagging** - The removal of material that is obstructing the flow of the stream or interfering with navigation.

**Socioeconomic considerations** - Social and economic conditions and opinions which must be evaluated for any project to determine project cost: benefit ratios, as well as the project good to the community.

**"Soft" bank protection methods** - Usually refers to the use of living plant (bioengineering), or combinations of bioengineering and coir fibre rolls or mats for bank protection.

**Soil** - Unconsolidated mineral and organic surface material that has been sufficiently modified and acted upon by physical, chemical, and biological agents so that it will support plant growth.

**Soil bioengineering** - The science of using living materials (plants) and some compatible solid (hard) materials to stabilize an eroding bank of a stream. See also bioengineering.

**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 streambank erosion.

**Soil Conservation Service** - See Natural Resource Conservation Service.

**Soil horizon** - A layer of soil that is distinguishable from adjacent layers by characteristic physical and chemical composition. Soil horizons are commonly referred to as topsoil, subsoil, and parent material, or as the "A" horizon, "B" horizon, and "C" horizon, respectively. See "A" horizon, "B" horizon, and "C" horizon.

**Soil liquefaction** - Loss of strength of a saturated soil resulting from the combined effects of vibration and hydraulic forces, thereby causing the material to flow.

**Soil mechanics** - The application of the laws and principles of mechanics and hydraulics to engineering problems dealing with soil as an engineering material.

**Soil profile** - Vertical section of the soil from the surface through all horizons.

**Soil sealants** - See binder.

**Soil stabilization** - Chemical or mechanical treatment designed to increase or maintain the stability of a mass of soil or otherwise to improve its engineering properties.

**Soil test** - The process to determine the soil pH and the nutrient-supplying capability of a specific soil for a specific crop or plant species. Used to determine recommended fertilization and liming rates.

**Sorting** - (1) In a descriptive sense, the degree of similarity, in respect to some particular characteristic, of the component parts in a mass of material. (2) In reference to size distribution, poorly sorted implies a wide distribution of material sizes. Well-sorted is the opposite of poorly sorted and would describe material of similar size and shape. Compare to grading.

**Spall** - (1) The breaking off of chips, fragments, or thin

layers of rock due to physical and chemical forces, such as freeze-thaw cycles, weathering, or quarrying and handling operations. (2) A fragment of rock resulting from such forces, sometimes used in the context of riprap gradation specifications.

**Species** - A taxonomic designation assigned to a distinct group of plants or animals which can only breed with another like organism, and which is usually characterized by individual differences from any other species.

**Species recovery** - Improvement in the status of an endangered or threatened species to the point at which listing is no longer appropriate under the criteria set forth by the Endangered Species Act of 1973.

**Specifications** - A detailed description of particulars, such as size, gradation and amounts of stone, quality of materials, contractor performance, terms, quality control, etc.

**Specific gage record** - A series of stage readings from a single gage, taken over a relatively long period of time, for a specific discharge, that are plotted to determine the long term trends in stage changes for the specific discharge. This information is then used to determine if the long-term tendency of the stream is to aggrade, degrade or remain stable.

**Specific gravity** - Ratio of the mass of any volume of a substance to the mass of an equal volume of water at 4 degrees centigrade. A substance with a specific gravity of less than 1.0 will float, specific gravity greater than 1.0 will sink.

**Spillway** - (1) Principal spillway - An open or closed channel or conduit used to convey excess water from a pond, reservoir, or basin. (2) Emergency spillway - A designed depression at one side of the embankment of a pond or basin that will pass peak discharges greater than the maximum design storm controlled by the principal spillway and detention storage.

**Splash pad** - A non-porous material placed at the outfall of a conduit, channel, or grade stabilization structure, designed to decrease the energy of water flow to a non-erosive velocity.

**Spoil** - Excess rock or soil material not needed after a project is constructed. Sometimes used in reference to material which has been dredged from a navigation or flood control channel.

**Spur dike** - See dike.

**Stable channel or stable stream** - A condition that exists when a stream has developed the correct bed slope and cross section for its channel to transport the water and sediment delivered from the upstream watershed through the system without significant aggradation or degradation.

**Stage** - Water surface elevation of a stream, lake, reservoir, or other water body referenced to a datum plane, which may be MSL, NGVD, or an arbitrary datum plane, such as the average low water elevation at a given location, or an even more arbitrary value, such as a surveyor's estimate of the elevation of the river bed at some point in time. A given value for stage is meaningless for scientific or engineering purposes without a definition of the datum plane to which it is referenced (usually referred to as "zero" of the gage).

**Stone** - (1) Concreted earthy or mineral matter. (2) A small piece of rock. (3) Rock, or rocklike material, for building. Large, natural masses of stone are generally called rocks; small or quarried masses are called stones.

**Stone-filled dike** - A dike constructed entirely of stone. Seldom used now, because of possible confusion with "stone-filled pile dike" or other similar terms. The term "stone dike" is much preferred.

**Stone-filled pile dike** - An existing pile dike that has been filled in with stone to increase or maintain its effectiveness.

**Stone riprap** - Quarried rock placed on a sloped streambank as protection against erosion. Occasionally, natural cobbles or boulders may be used, if suitable for the erosive forces at the site.

**Stratification** - (1) The formation, accumulation, or deposition of materials in layers. (2) Two or more horizontal layers of water of differing characteristics, especially the arrangement of the waters of a lake in layers of different densities.

**Stream** - Any body of running water that moves under gravity to progressively lower levels, in a relatively narrow but clearly defined channel on the ground surface, in a subterranean cavern, or beneath or in a glacier. It is a mixture of water and dissolved, suspended, or entrained matter.

**Streambank** - The side slopes of a channel between which the streamflow is confined except during floods.

**Stream barbs** - See Rock vane.

**Streambank 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 streambank erosion.

**Streambank failure** - Collapse of a relatively large section of streambank that fails and slides into the channel.

**Streambank protection or streambank protection works** - Any technique used to prevent erosion or failure of a streambank.

**Stream discharge (Q)** - The quantity of flow passing a channel cross-section in a unit of time, usually measured in cubic feet per second (cfs) or cubic meters per second (cms). The stream discharge can consist of water, dissolved solids, organic sediment, and inorganic sediment. The defining equation is  $Q=AV$  where the discharge  $Q$  (the flow rate) is equal to the cross-sectional area ( $A$ ) multiplied by the average velocity ( $V$ ).

**Streamflow** - The movement of water and sediment through a channel.

**Stream hydraulics** - The science and technology of water behavior in streams.

**Stream order** - A classification system designed to provide information on the relative size of a stream. A headwater stream with no tributaries is designated a first order stream, a stream with first order tributaries flowing into it is a second order stream, and so on. Lower (first and second) order streams are usually small and can be intermittent or ephemeral, even in temperate climates.

**Stream restoration** - See restoration.

**Stream slope** - See slope.

**Stream stability** - See stable stream.

**Stream terrace** - See terrace.

**Structural flood control measures** - Artificial measures designed to reduce flood damages by altering the stream and/or its overflow characteristics. Examples include: channelization, reservoirs, floodways, dikes and other river training structures, levees, clearing of riparian areas to improve flood conveyance, floodwalls, pumping plants, and flow diversions.

**Subaqueous** - Found or taking place under water.

**Subcritical flow** - Flow with a Froude number less than one. The usual state of alluvial streams. See Froude number, hydraulic jump.

**Subsoil** - (1) Soil below a subgrade or fill. (2) That part of the soil profile occurring below the "A" horizon.

**Substrate** - The foundation upon which all things exist. E.g., soil is a substrate that supports plants, animals, buildings, roads, and other structures. The bed material that the stream

rests on is also a substrate. This includes the layers of material underlying the bed surface layer.

**Supercritical flow** - Flow with a Froude number greater than one. Rare in alluvial streams. See Froude number, hydraulic jump.

**Surface runoff** - That portion of rainfall that moves over the ground toward a lower elevation and does not infiltrate the soil. See runoff.

**Survey** - A map of the bed, banks, and/or the adjacent floodplain of a stream. Typically, elevations are taken along a series of cross-sections that are roughly perpendicular to the direction of stream flow, although recent innovations in surveying and mapping technology are less restrictive, and may allow more detailed coverage with less field work. Surveys made for special purposes may involve more or less detail or area of coverage, depending upon the specific need. See bathymetry.

**Suspended load** - That part of a stream's total sediment load which is transported within the body of fluid and has very little, or no, contact with the bed.

**Suspended sediment** - Sediment that is carried in suspension by the turbulent components of the fluid, both bed material and fine material.

**Suspended sediment discharge** - The quantity of suspended sediment passing a cross-section of the stream in a unit of time, both bed material and fine material.

**Suspended solids** - Soil particles and organic matter which remain suspended in the water column after agitation from dredging, or during movement downstream in river systems.

**Suspension** - The state of a substance when its particles are kept from falling or sinking.

**Sustainable development** - A project that works in harmony with the natural system to meet the needs of the present without compromising the ability to meet the needs of future generations.

**Swale** - A natural or artificial low-lying, often wet, area of land. Typically results from irregular deposition patterns as a stream channel migrates, but artificial swales can be engineered to slow, store, route, or filter runoff.

**Synthetic mattress, matting, or tubing** - A manufactured, semi-flexible casing placed on a streambank and filled with grout or sand to prevent erosion

**Tackifier** - See binder.

**Talus** - Fallen disintegrated material which has formed a slope at the foot of a steeper declivity. See colluvium.

**Target species** - A desired species or group of species toward which habitat development and management are directed.

**Tensile strength** - The maximum force a material can bear without tearing apart. Units are reported as maximum stress (e.g. pounds per square inch) or force per unit thickness (e.g. pounds per inch width).

**Tenting** - Separation of installed manufactured blankets from contact with the ground surface. Often is a symptom of underlying problems which may lead to partial failure of the protection.

**Terrace** - A flood plain that seldom, if ever, floods due to streambed degradation.

**Tetrahedron jack** - A type of river-training structural component made of six steel or concrete struts fabricated in the shape of a pyramid, as opposed to being assembled as a jack.

**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 degrees with the other three.

**Texture** - The percent of sand, silt, and clay in a soil.

**Thalweg** - The line connecting the lowest or deepest points along a stream bed in the longitudinal direction.

**Threatened species** - A species of plant or animal that is not listed on the endangered species list, but if species population continues to decline in all or a significant portion of its habitat range, it will be listed as endangered. See also Endangered and Candidate species.

**Tieback** - Structure placed between longitudinal protection or longitudinal training works and the bank to prevent flanking.

**Timber mattress** - A revetment made of brush, poles, logs, or lumber interwoven or otherwise lashed together. The completed mattress is then placed on the bank of a stream and weighted with ballast, usually stone.

**Toe** - The break in the slope at the foot of a bank where the bank meets the bed. May not be well-defined; often the bank slope flattens as it nears the toe, and the horizontal location and elevation of the toe at a given location often changes with stream discharge.

**Top bank** - The usually well-defined break at the top of the bank slope, where the flood plain begins.

**Topographic map** - A map of contour lines showing differences in elevation.

**Topography** - Shape and physical features of land.

**Topsoil** - See "A" horizon.

**Tractive force** - The force on a stream bed or bank caused by flowing water, which tends to pull soil particles along with the streamflow, or remove structural components of bank protection, such as riprap.

**Transpiration** - Process by which water vapor escapes from a living plant and enters the atmosphere.

**Transportation (sediment)** - The complex process of moving sediment particles from place to place. The principle transporting agents are flowing water and wind.

**Transport capacity** - The ability of a stream to carry sediment.

**Transverse** - Oriented perpendicular to the longitudinal direction of the river or stream.

**Transverse dike** - A dike that extends into the channel approximately perpendicular to the channel.

**Trap efficiency** - The proportion of the incoming sediment load that is deposited in a defined area, such as a sediment retention reservoir, reported in per cent.

**Trash rack** - A structural device used to prevent debris from entering a pipe, spillway, or other waterway.

**Trellis pattern** - Roughly rectilinear arrangement of stream courses in a pattern reminiscent of a garden trellis, developed in a region where rocks of differing resistance to erosion have been folded, beveled, and uplifted.

**Trenchfill revetment** - Stone, concrete, or masonry material placed in a trench dug on a relatively smooth alignment landward of an eroding streambank. When the erosive action of the stream reaches the trench, the material placed in the trench launches (self-adjusts) down the bank slope into the stream channel, thus armoring the bank and toe and retarding further erosion.

**Tributary** - Any channel, waterway, or outlet that conveys water into a stream.

**Turbidity** - The degree of cloudiness in water caused by suspended particles. Turbidity can be precisely measured and is often used as an indicator of pollution.

**Turbulence** - Motion of fluids in which local velocities and pressures fluctuate irregularly in a random manner. Opposite of laminar flow. In general terms, the irregular motion of a flowing fluid. Open channel flow is almost always turbulent to some degree.

**Turf Reinforcement Mat (TRM)** - A relatively permanent rolled erosion control product (RECP) composed of ultraviolet stabilized synthetic fibers, netting, and/or filaments processed into a three-dimensional reinforcement matrix designed for critical hydraulic applications where design discharges exert velocities and shear stresses that exceed the limits of mature natural vegetation. Designed to provide sufficient thickness, strength, and void space to permit soil filling and/or retention and allow development of vegetation within the matrix of the mat.

**Unconsolidated** - Friable or loose material lacking internal cohesion.

**Uniform flow** - Flow in which the depth, velocity, cross-sectional area, and discharge are all constant as flow moves downstream. Rare in natural channels.

**Unsteady flow** - A flow in which the depth at a given location changes with respect to both space and time.

**Upland** - The region of higher elevation above a floodplain, usually characterized by vegetation not tolerant of inundation, but can range from bare ground to mature forest.

**Uplift** - The hydrostatic force of water exerted on or underneath a structure, causing a displacement of the structure.

**Upper bank** - The portion of a streambank which is normally above water. See also lower bank, middle bank, and zones.

**Universal Soil Loss Equation (USLE)** - An estimate of the amount of soil that moves due to water erosion based upon five factors: climate, soil erodibility, length and steepness of slope, vegetative cover, and structural and/or management practices. See Revised USLE.

**Vadose or Vadose zone** - The capillary area above the groundwater table where sufficient moisture exists but roots are not oxygen deprived.

**Valley plug** - Blockage of a stream channel by sediment or debris to the extent that flow is forced into overbank areas.

**Vane dikes** - Structures not attached to the bank, working as a system, designed to direct streamflow away from an eroding bankline, but permitting limited amounts of both water and sediment

to pass landward of the structures.

**Vector** - A quantity completely specified by a magnitude and a direction.

**Vegetation** - Plant life or total plant cover of an area. Can be rooted, attached, or floating, deciduous or evergreen, woody or herbaceous, commercial or noncommercial.

**Vegetative succession** - See ecological succession.

**Velocity** - The speed that water travels in a given direction; expressed as a distance traveled during an interval of time, usually in feet per second (fps) or meters per second (m/s). Theoretically, velocity is a vector, and the value of speed would be accompanied by a precise direction, but for practical purposes it is usually assumed to be in the general direction of flow at the time and under the conditions under study.

**Vertebrate** - A living organism that has a backbone or spinal column.

**Void** - (1) Space within a soil or rock mass not occupied by solid mineral matter. (2) The open spaces in a geosynthetic material through which flow can occur.

**Wadi** - See Arroyo.

**Wash** - See Arroyo.

**Wash load** - See fine-material load.

**Washout** - The failure of a culvert, bridge, embankment, or other structure resulting from the action of flowing water.

**Water bar** - A diversion ditch and/or hump in a trail or road built for the purpose of carrying runoff water into a ditch, a dispersion area or vegetated area so the water does not gain sufficient volume and velocity to cause soil movement and erosion.

**Water discharge** - See stream discharge.

**Watershed** - (1) See drainage basin. (2) (esp. U.K.) The dividing line of highest elevations, or "divide", between drainage basins.

**Waters of the United States** - Includes all dry land and water-covered areas below the ordinary high water marks on navigable or non-navigable streams.

**Water table** - The upper surface of the zone of permanent saturation in permeable rock or soil. This is typically an irregular surface with shape or slope determined by the quantity of

groundwater and permeability of earth materials. In general, it is highest beneath hills and lowest beneath valleys.

**Wattle** - Cigar-shaped bundles of tree or shrub branch cuttings tied tightly together and anchored in trenches using live stakes or dead stout stakes. Wattles are installed on contour (level), with cuttings oriented in both directions within the bundle. The butt ends and about one-half of the wattle should be covered with soil to promote root growth. Wattles are used for a wide variety of slope stabilization projects. Sometimes called a "live wattle". A variation is the "reinforced wattle" which uses either a small proprietary anchor or 5-ft sections of 1/2 inch diameter rebar driven through and tied to the wattle as anchors. See fascine.

**Wave attack** - Impact of waves on a shoreline or riverbank.

**Weathering** - Physical disintegration or chemical decomposition of rock due to wind, rain, heat, freezing, or thawing.

**Weephole** - Opening placed in a revetment or bulkhead to allow groundwater drainage.

**Well-graded** - See grading.

**Well-sorted** - See sorting.

**Wetland** - A land area that is wet or flooded by surface or ground water often enough and long enough to develop characteristic hydric soil properties and to support vegetation that will grow in saturated soil conditions. Wetland types range from coastal intertidal marshes to freshwater swamps and bottomland hardwoods. Wetlands usually have quite distinctive vegetation communities.

**Wetted perimeter (P)** - The length of the wetted cross-section (i.e. bed and banks) measured normal to the direction of flow. The practical equivalent of channel width, except for channels that are relatively narrow and deep.

**Width-depth ratio (w/d)** - The channel width divided by the average depth (d) of the channel.

**Willow curtain method** - A bioengineering streambank protection method whereby medium to large willow tree trunks are placed and anchored in shallow trenches oriented longitudinally to the direction of stream flow at elevations slightly above the base flow water surface elevation of the stream.

**Willow pole method** - A bioengineering streambank protection method whereby medium to large willow tree trunks are placed and anchored in shallow trenches oriented roughly perpendicular to the slope of the eroding bank.

**Willow post method** - A bioengineering protection technique

whereby large willow tree trunks are systematically installed in augured and backfilled holes on a streambank. As with all such methods, most successful when installed during the plant's dormant season.

**Windrow revetment** - A row of stone (the windrow) placed on a relatively smooth alignment on the top bank landward of an eroding streambank. As erosion continues, the windrow is eventually undercut, launching the stone downslope, thus armoring the bank face and toe. Compare to trenchfill revetment, which is excavated into the bank. Windrow revetment has the advantage of being easier to construct, but the disadvantages of requiring more stone to accommodate a given scour depth and the presence of a mass of stone on the streambank for an indeterminate length of time.

**Wing dam** - see dike.

**Wiggle-wobble** - The analytical (but sometimes roundabout and convoluted) process whereby hydraulic engineers arrive at, and develop, a streambank stabilization plan.

**Wonderment of nature** - A natural phenomenon that cannot be readily explained. A very useful concept for stream analysis, or any other human endeavor involving uncertainty; can be used interchangeably with "further study is needed".

**W-Weir** - Four modified and connected rock vanes aligned in a "W" orientation designed to split a single channel into two channels for the purpose of protecting or reducing scour near a mid-channel resource (e.g. bridge piling).

**Yazoo-type river** - Tributary unable to enter main stream due to natural levees along main stream. Usually flows along a back-swamp zone parallel to the main stream. Derived from the Native American , and present-day, name for a stream in Mississippi which has such a relationship with the Mississippi River.

**Zone of aeration** - Zone immediately below the ground surface in which voids are partially filled with air and partially filled with water trapped by molecular attraction.

**Zone (of a streambank)** - A specific area of a streambank at a given location or reach of stream, distinguished by elevation, used to determine what vegetative species or structural techniques would be most successful for bioengineering protection applications. The specific terms may vary, but one useful approach is a division into four categories: terrace zone, bank zone, splash zone, and toe zone. Those designations graduate, respectively, from the flood plain down to or beyond the toe of the bank. For bioengineering, these terms are more useful than upper bank, middle bank, and lower bank. Usually, existing vegetation in the area is a better guide to zone distinction than an arbitrary hydrologic distinction.

**Zone of saturation** - Underground region within which all openings are filled with water. The top of the zone of saturation is called the water table. Water contained within the zone of saturation is groundwater.